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COOPER'S    DICTIONARY  
OF  
PRACTICAL SURGERY

VOL. II.



LONDON: PRINTED BY  
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AND PARLIAMENT STREET



# COOPER'S DICTIONARY

OF

# PRACTICAL SURGERY

AND

## ENCYCLOPÆDIA OF SURGICAL SCIENCE

### NEW EDITION

BROUGHT DOWN TO THE PRESENT TIME

BY SAMUEL A. LANE

Consulting Surgeon to St. Mary's and to the Lock Hospitals; formerly Lecturer on Surgery at  
St. Mary's Hospital; Member of the Court of Examiners of the  
Royal College of Surgeons

ASSISTED BY VARIOUS EMINENT SURGEONS

IN TWO VOLUMES

VOL. II.

LONDON

LONGMANS, GREEN, & Co.; SIMPKIN, MARSHALL, & Co.; WHITTAKER & Co.;  
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1872





# PREFACE

TO

## THE SECOND VOLUME.

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ON COMPLETING the Second Volume of the first posthumous edition of COOPER'S SURGICAL DICTIONARY, it has appeared to the Editor, that an authentic biographical sketch of its learned author would more appropriately occupy its first pages than any lengthened preface. In the Preface to the First Volume the scope and object of the work, as well as the plan adopted in carrying it through the press, have been sufficiently explained. It will be there seen, that as much as possible of Cooper's original matter, whether historical or strictly professional, has been retained, and that the erasures have consisted only of material which, by lapse of time and the improved state of our knowledge, had become obsolete. A promise is also there given that the more modern views necessarily resulting from the rapid advance in the several collateral sciences, chemistry, histology, and natural philosophy, bearing more or less directly on surgical pathology and therapeutics, should be sedulously introduced throughout the entire work. How far this has been effected, it must be left to the Profession to judge. The subjoined list of the able contributors of several of the principal articles affords an encouraging guarantee that to a considerable extent this has been accomplished. The Editor gladly acknowledges that from the comprehensive character of the work, and the labour which it demanded, the task of editing this Dictionary, and infusing into each article the most recent information, would have been entirely beyond his individual powers, and that without their efficient aid the task could hardly have been achieved.

The seventh and last Edition by the Author himself contained 1,500 closely set pages, in one volume. But such has been the press of new matter, that it has been found necessary to divide the present edition into two volumes, each of which contains upwards of 1,000 pages of the same size and type.

It would at first sight appear that only 500 pages have been added to the original work ; but this would not fairly represent the full extent of the additional matter contained in the present edition, inasmuch as the



erasures must have amounted to at least another 200 pages. These 700 pages of new matter distributed throughout the work have been apportioned as follows:—249 have been allotted to entirely new articles, that is, to articles not found at all in former editions of Cooper; 280 more have been consumed by articles which, although contained in previous editions, required to be written *de novo*; the remaining 171 pages have been expended on the new matter necessarily introduced by the reviser in almost every article.

In the preface to the First Volume it is stated that, "To the Second Volume, which will appear as speedily as possible, will be added an Appendix, in which will be embodied the latest discoveries and improvements." During the progress of the Second Volume, however, it has been found that the great facilities of introducing, either by the insertion of original articles, or under various headings, "the latest discoveries and improvements," have altogether superseded the necessity of adding an Appendix for the present, indeed for a few years the material will be hardly sufficient for the purpose.

It would have been a pleasing duty to the Editor to have expressed his high appreciation of the way in which each contributor had performed his appointed task; but the number of his highly esteemed coadjutors, and the confined space of a preface, compel him to restrict himself to expressing to them collectively his admiration of their talents, and to acknowledging his obligation to them for their invaluable services in the arduous undertaking now drawn to its close. The list of the contributors given in the Preface to the First Volume was necessarily prospective and imperfect; but the names and the subjects for which each became responsible can now be recorded with precision, and are here transcribed:—

ACTON, WILLIAM	. . . . .	<i>Impotence.</i>
ADAMS, JOHN	. . . . .	<i>Head, injuries of.</i>
ADAMS, WILLIAM	. . . . .	<i>Orthopædic Surgery; Talipes; Spine, curvatures of.</i>
ANCELL, HENRY	. . . . .	<i>Pathology of Blood; Hæmorrhagic Diathesis; Anæmia; Hyperæmia; Hydræmia; Hyperinosis; Plethora.</i>
BADER, DR. C.	. . . . .	<i>Ophthalmic Surgery; Ophthalmoscope; Vision.</i>
BARNES, DR. ROBERT	. . . . .	<i>Phlegmasia Dolens; Pregnancy; Transfusion; Uterine Diseases; Uterine Sound and Speculum.</i>
BIRKETT, JOHN	. . . . .	<i>Tumors.</i>
BLENKINS, G.	. . . . .	<i>Gunshot Wounds.</i>
COOKE, WEEDEN	. . . . .	<i>Zinc.</i>
COOPER, G. LEWIS	. . . . .	<i>Tongue, diseases of; Psoas Abscess; Biography of Samuel Cooper.</i>
COOPER, WHITE	. . . . .	<i>Cataract.</i>
COULSON, WILLIAM	. . . . .	<i>Lithotomy; Lithotrity.</i>
DRUITT, DR. ROBERT	. . . . .	<i>Abscess; Erysipelas; Fevers; Granulations; Hospital Gangrene; Inflammation; Suppuration; Mortification.</i>
ERICHSEN, JOHN	. . . . .	<i>Aneurism.</i>

GASCOYEN, G. G.	. . .	<i>Mollities Ossium; Necrosis; Rickets; Osteosarcoma; Periostitis; Spina Ventosa; Spina Bifida; Testicle, diseases of; Varicocele.</i>
GIBB, SIR DUNCAN	. . .	<i>Laryngoscope.</i>
HART, ERNEST	. . .	<i>Hydrophobia; Surgery.</i>
HUNTER, CHARLES	. . .	<i>Neuralgia; Neuroma; Opium; Subcutaneous Injection.</i>
JONES, DR. HANDFIELD	. . .	<i>Cancer.</i>
LANE, J. R.	. . .	<i>Amputation; Anus; Bladder, diseases of; Hydatids; Dislocations; Fractures; Perineal rupture; Rectocele; Rectum, diseases of; Vesico- and Recto-Vaginal Fistula.</i>
LEACH, HARRY	. . .	<i>Scurvy.</i>
LEE, HENRY	. . .	<i>Pyæmia; Veins, diseases of.</i>
MACLEOD, DR. G. H. B.	. . .	<i>Pharynx; Trachea; Œsophagus; Tonsils, surgical affections of; Ulceration; Ulcers; Varix; Wounds.</i>
MAUNDER, C. F.	. . .	<i>Intestinal Obstructions.</i>
PILCHER, GEORGE	. . .	<i>Ear, diseases of.</i>
POLAND, ALFRED	. . .	<i>Tetanus.</i>
SERCOMBE, EDWIN	. . .	<i>Palate, fissure of.</i>
SMITH, SPENCER	. . .	<i>Ankylosis; Caries.</i>
SNOW, DR. JOHN	. . .	<i>Anæsthesia.</i>
THOMPSON, SIR H.	. . .	<i>Fistula in Perinæo; Prostatic Diseases; Urinary Abscess; Urine, extravasation of; Urine, incontinence of; Urine, retention of.</i>
WAKLEY, THOMAS	. . .	<i>Joints, diseases of; Joints, excision of; Ecraseur; Hydrocele.</i>
WELLS, T. SPENCER	. . .	<i>Ovariectomy; Burns; Chilblains; Cicatrix; Hare Lip.</i>
WILSON, ERASMUS	. . .	<i>Skin, diseases of.</i>
URÉ, ALEXANDER	. . .	<i>Caustics; Lupus; Mamma, diseases of; Mercury.</i>

2 BERKELEY STREET, PICCADILLY:  
August, 1872.





## BIOGRAPHY OF SAMUEL COOPER, F.R.S.

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THE NEED of a biographical memoir of SAMUEL COOPER, the author of the "Surgical Dictionary," has long been felt by the readers of that great work. But in drawing up the short sketch of his life which I now present to their notice, I am fully aware of the difficulties of the task which, prompted by a feeling of gratitude to my distinguished kinsman, and by the solicitations of many professional friends, I have undertaken. It is impossible in the compass of a few pages to paint in sufficiently brilliant colours the career of one whose name is almost hallowed in the science of surgery; who, by his constant energy and unwearied zeal, circulated throughout the world the fruit of his great labours, and condensed for us into one library the writings of so many illustrious men, hitherto diffused and scattered over a vast surface. The achievement of his great work the "Surgical Dictionary" raised him to the highest pinnacle of professional fame, and as during his life he ever laboured in the cause of science, so he has left behind him, in the fruit of his industry and talent, an imperishable monument to his memory.

Samuel Cooper was the descendant of an old family for many years resident in the neighbourhood of Salisbury. His father, who had acquired a considerable fortune in the West Indies, died when Samuel was a boy, leaving to the care of his mother three sons—George, Samuel, and Leonard afterwards a lieutenant-colonel in the service of the Honourable East India Company. The eldest son, George, was in due time called to the Bar, and subsequently, on the recommendation of Lord Eldon, was knighted, and appointed Recorder of Penang, and finally one of the Puisne Judges in the Supreme Court of Judicature at Madras. He died at that Presidency, much beloved and admired for his just and talented administration of the law. He published "Reports in Chancery," "On Equity Pleadings," and other works, which live and do honour to his name. Samuel was born in September 1780, and was placed, at an early age, under the care of Dr. Burney, of Greenwich, whose reputation was high in those days for his success in the instruction of youth. During the period of his education he displayed much zeal in the classics, and always showed a preference for companions of quiet and studious habits. At the age of sixteen he evinced a taste for medicine and surgery; and was accordingly entered as a pupil at St. Bartholomew's Hospital, under the guidance of Mr. Ramsden, who was at that time assistant-surgeon to the hospital. He was soon noticed by his seniors for the habits of diligent and strenuous application which at that early age gave promise of his future success. His regular attendance at the lectures, and the copiousness of the notes which he contrived to take down, were remarkable. In due time he became a member of the Medical Society of the Hospital, and was fond of joining in the debates on Pathology and on the treatment of cases witnessed in the wards. Sir James Blick and Mr. Abernethy regarded him with much interest, and foretold his future celebrity, at all times showing, by their friendly and encouraging converse with him, their high estimation of his studious and persevering habits, holding out to him the certainty of success and distinction in the profession he had chosen. In 1803 he completed his studies at the Hospital, and became a member of the Royal College of Surgeons in that year,



his diploma bearing date in October 1803. He now settled in Golden Square, in the hope of reaping some of the substantial benefits of his profession, and devoting his leisure hours to the study of medical literature. At this early period he made his first appearance as an author by the publication of an octavo work of considerable merit on Cataract, which by its success afforded him great encouragement. In the year 1806 he gained the Jacksonian prize at the Royal College of Surgeons for the best essay on Diseases of Joints, and in the following year (1807) the first edition of the "First Lines of Surgery" made its appearance, and was well received by the profession at large. This work, of considerable practical utility, eventually passed through seven editions, proving a valuable class-book for the student, and a work of reference for the practitioner; but his great work, the "Surgical Dictionary," was already in hand. Days and nights were consumed in the accomplishment of this gigantic book until its completion in the year 1809, when the first edition appeared, and at once placed him among the most eminent authors in his profession. His two works were now before the world, and rapidly gaining an extensive circulation, for we find that in 1813 a second edition of the Dictionary was demanded and completed, as also a third edition of the "First Lines." Towards the end of this year he was appointed Assistant Surgeon to the Forces, and joined the army at Malta. In May 1814 he was promoted to the rank of full surgeon, and served until the proclamation of peace, when he returned to this country to resume his favourite writings in accordance with his taste, showing a decided preference for the employment of his pen to a military life. These two works continued to occupy his principal attention, and passed through seven editions during his lifetime. In 1817 he was elected a Fellow of the Royal Medical and Chirurgical Society, and contributed to its "Transactions" many excellent papers, but he never reached the President's chair: a circumstance attributable, perhaps, to the lateness of his entrance into that society. In 1821 he was a candidate for the appointment of Assistant-Surgeon to St. Bartholomew's Hospital, and received the strongest support from the medical and surgical staff, but was defeated by local interest, a circumstance which sadly disappointed and grieved him; still his rewards were approaching, and within a few years afterwards abundant honours were heaped upon him. In 1826 he was appointed Surgeon to the Queen's Bench and Fleet Prisons, and in the following year he was elected a member of the Council of the Royal College of Surgeons. In 1828 he became a candidate for the office of Surgeon to the Bloomsbury Dispensary, which was strongly contested, and terminated in his favour by a large majority. In 1831, on the resignation by Sir C. Bell of the Chair of Surgery, he received an offer of the Professorship of Surgery at University College, and of the Senior Surgeoncy to the Hospital, which appointments he held with distinguished honour until the year 1847. During this period he lectured to large classes of students, and gained, by his kindness and urbanity of manner, their love and admiration. The interest which he felt and manifested in their welfare was remarkable; at all times he was ready to advise them in their studies, to communicate knowledge, or to assist them in their intended career, regarding them in the light of pupils under his immediate care. The Medical School of this College possessed in those days teachers of great eminence; among them I may especially refer to Elliotson, Turner, Jones Quain, Richard Quain, Carswell, David Davis, and Grant, with Samuel Cooper in the Chair of Surgery, and Liston as his colleague at the Hospital; but its greatness was to be only temporary. Towards the end of 1832 Samuel Cooper edited the third edition of Dr. Mason Good's "Study of Medicine" in four vols., and subsequently published a fourth edition in 1834. This work is too well known to need any notice here; it is full of practical and scientific research by its original and learned author. In this year he delivered the Hunterian Oration at the College of Surgeons, and paid, in graceful language, a just and able tribute to the memory of its great founder, the immortal John Hunter. In 1837 he reaped further honours by his election

into the Court of Examiners, where he sustained the dignity of this high position to within a year of his death, combining kindness and encouragement to the candidates with a due sense of his responsibility as a guardian of the public interests. In 1845 he reached the distinguished station of President of the College of Surgeons, and in the following year was unanimously elected a Fellow of the Royal Society. Soon after this period his health declined, and he was induced to seek quietude at his country residence. His frame, which had hitherto been strong, although he had suffered from frequent attacks of gout, now became much enfeebled, until his illness assumed an alarming character. In December 1848 he died at Shepperton, in the presence of his bereaved family. Thus ended the life of one who laboured in his profession with an assiduous and constant zeal, and who has left behind him a spotless and unsullied name. His remains were conveyed to their last home in the cemetery at Kensal Green, his funeral being followed by his family, his friends, and former pupils, all in silent grief at the loss of one so admired and beloved.

To this short notice of his professional career, which, in truth, might be designated as the brilliant result of talent and industry, of genius and perseverance, I must add a few words on his domestic character, in illustration of the various traits which could be observed only by one who had passed with him the greater part of his life. As his nephew I was brought up by him from my earliest childhood, and was eventually his articled pupil, and assistant in his professional labours. In his days of boyhood he differed much from the ordinary class of youths, evincing but little taste for their amusements and sports, and selecting as his companions those of a similar temperament. During his holidays he was in the habit of devoting certain hours in the day to the study of the classics, and always showed a decided predilection for the study of languages, which in after life was of the highest value to him. He was fully conversant with French and German, and ready to select from, or refer to, authors in those languages. In 1800 he chose his profession, and entered the path of life so eminently suited for him, his constant and devoted friend, Mr. Lawrence, being his chief companion at the Hospital. For him throughout his life he cherished the warmest regard, not as an ordinary friend, but as a brother and fellow-labourer in the field of science. In 1810 he married the daughter of William Cranstoun, Esq., a gentleman residing in Hampshire. His wife died in the following year, leaving an only daughter, Mary Anne, who afterwards married Thomas Morton, Esq. After his wife's death he entered the army, partly perhaps as a means of diverting his mind from painful scenes and recollections, and partly for the vast opportunities which it presented of witnessing and practising the operative department of surgery. He often spoke of his presence at Brussels during the battle of Waterloo, and loved to describe the fatigues he endured and the many operations he performed upon the wounded throughout the day. On the restoration of peace he returned to England, and was placed on half-pay, having no taste for the mere routine of a military life. His great object now was to resume his pen, and to devote as much time as possible to literary pursuits. His principal works, viz., the "Surgical Dictionary," and the "First Lines of Surgery," engrossed his whole attention, and proved, by the numerous editions through which they passed, that his labours received at the hands of our profession the reward which they merited. His writings were also much appreciated throughout the continent of Europe. The Dictionary was translated into the French, German, and Italian languages; and reached its third edition in America. As a surgeon Samuel Cooper was a man of much talent, original genius, and persevering industry, kind and encouraging to his patients, at the same time by his manner inspiring them with confidence; but although his writings were so extensive and voluminous, he never reached the summit of practice which his friends Sir Astley Cooper or Sir Benjamin Brodie attained. As an operator he was slow and careful, but not so brilliant as Liston. In consultation his opinion was invaluable, being cautiously delivered, but at



times rather too much influenced by foreign views. In the lecture theatre he was eminently clear, yet in manner diffident and nervous, imparting to his pupils a sound and practical knowledge of his subject in a persuasive and impressive tone. His mode of illustration by the recitation of cases often amused as well as interested his class; he excited their attention, and received in return their long and loud plaudits. In domestic life he was amiable, kind, and benevolent, preserving a highly moral and upright character, and imbued with the deepest sense of honour and integrity, with a perfect horror of extravagance, and of the habits which are sometimes set down as the follies of youth. His manner was cold and rather reserved, yet courteous and kind, his friendship most sincere, and he had a genuine admiration for intellect and talent. In his later days, he was almost a martyr to gout, which rendered his walk and gait in appearance those of a man much senior to him in years. His love of study was great, and he had a remarkable power of gathering from an author the cream and pith of his work, storing it in his mind for a future edition of his Dictionary. His tenacity of memory was strong, and at all times, whenever disengaged from the practice of his profession, the subject of his writings was foremost in his mind. His powers of abstraction were as great as his appreciation of music was small, for I have often heard his daughter perform on the pianoforte in the same room with him, and even sing operatic songs during his hours of occupation without causing the slightest interruption to him, or in any way distracting him from his close and earnest investigation. I must not omit to mention that amongst his friends he numbered many highly distinguished men, especially Sir Astley Cooper, Sir Benjamin Brodie, Mr. (afterwards Sir William) Lawrence, and Dr. Mason Good, names much regarded and respected by him. His house was ever open to authors of talent and renown from foreign countries, and how frequently have I there enjoyed the society of many who have won a world-wide reputation in the field of medical and surgical literature! Finally, he was a great and good man, with a mind ever open for the acquirement of science, with a heart which beat for and sympathised with the trials of others; one whose lofty and expansive intellect searched after and collected the materials of the great works which have won for him a lasting and splendid fame.

GEORGE LEWIS COOPER, F.R.C.S.

7 WOBURN PLACE, RUSSELL SQUARE:  
*August, 1872.*

# DICTIONARY

## OF

# PRACTICAL SURGERY.

## IMP

**IMPERFORATE HYMEN.** (See VAGINA.)  
**IMPERFORATE VAGINA.** (See VAGINA.)

**[IMPOTENCE.]** Impotence is the term given to all those morbid conditions in man or woman which are opposed to the *physiological* union of the two sexes, that is to say coition. Impotence has been likewise defined inability to consummate marriage from whatever cause arising, and the word **STERILITY** is reserved for all those morbid states which either in the one or other sex prevent the reproduction of the species. When, however, the term sterility is mentioned, it more especially applies to the female; and is synonymous with barrenness.

Impotency or Impotence is the term usually applied to the man, and may be perhaps best described under the two divisions: 1. Absence of desire for connection—Temporary or false impotence. 2. Absence of power, or inability to perform the act of consummation of marriage—True Impotence.

1. *Temporary or false impotence* may arise from a variety of causes. We find, for instance, that some men reach adult age without having experienced any sexual desire at all. The complete sexual quiescence which is the proper condition of childhood continues, in these cases, during the period of youth, and even into adult age.

So unusual a phenomenon as the entire non-developement of the sexual desire must always be rather an alarming and suspicious circumstance; unfortunately, in most cases the medical man is not consulted, as neither the patient nor his friends are aware that there is anything unusual in his condition until it is accidentally discovered. When the surgeon is consulted, however, he will usually find that the individual is fat, without hair on his face, or even on the pubes; the testes and penis are small, almost rudimentary like those of a young child; no sexual desire ever troubles him, and his voice is often weak and almost falsetto in quality; in fact, the condition is much the same as that of the castrated individual or eunuch.

Dr. Davy has given the following post-mortem appearances in a patient who showed (according to the account given by his comrades) an aversion to the sex. There was little hair on pubes or

## IMP

chin, the *partes naturales* were all small—the larynx was small, the skin delicate. A very minute portion of fluid only could be procured from the vasa deferentia, which under the microscope exhibited numerous small particles, and a few larger globules, but no spermatic animalcules. The fluid of the *vesiculæ* was also small in quantity and destitute of animalcules; it was of a light brownish hue, slightly opaque, containing some globules, and did not change the colour of turmeric or of litmus paper. The fluid from their fundus was mostly gelatinous, and appeared to consist chiefly of mucus. The *vesiculæ seminales*, in this instance, and their contents, resembled those of such castrated animals as I have hitherto examined. (*Edinburgh Medical and Surgical Journal*, vol. 1. p. 7.)

Pope Clement XIV. in the eighteenth century, abolished castration of youths, which was then practised in Italy for the purpose of retaining the soprano voice: it is well known that the castrated preserve the shrill voice (*voix aigue*) of infancy, at the same time that the chest becomes fully developed, thus giving volume to the voice. Women, in those days, were not admitted to the theatres; hence this horrid mutilation, as it qualified the victims to sing soprano parts.

In the cases of temporary or false impotence, which we are now considering, it is clear that the non-developement of the testes has produced this state of eunuchism, as well as most of the peculiar changes which, both in animals and in human beings, attend the condition of castration.

It does not at all necessarily follow that the existing impotence in any given case is anything but temporary. There may be a late developement of the organs. Instead of the young man being precocious, circumstances may simply have delayed the structural and functional maturing of the testes, which, under proper treatment, may still be perfected. If, however, on examination it should appear that the testes, instead of being merely small, are deficient; if they are apparently mere nodules; if this degeneration has followed early attacks of mumps, or inflammatory affections of the testes, or accidents which have injured them early in life, the case must be considered as a hopeless one, and we must consider the patient as permanently impotent. Terrible as this doom may



seem, it is singular to notice how indifferent such persons appear to their loss, or rather deficiency. They do not know the value of what they have never possessed and never will possess, and pass through life contented men, evincing no aversion to, or liking for, the opposite sex. The undeveloped state of the reproductive system, whether permanent or temporary, usually indicates itself by, among other signs, a marked indifference to manly sports and exercises, and a visible deficiency in virile attributes generally.

Other causes, however, besides an undeveloped state of the sexual organs, produce indifference to the opposite sex, and deficiency in manly vigour. The most common of such causes is the wretched habit of masturbation. A youth who masturbates himself, and continues the practice as he grows up to manhood, generally evinces, even after he has arrived at the marriageable age, no disposition towards the other sex, only his own solitary pleasure can give him any gratification; and as far as women are concerned he is virtually impotent. Lallemand gives the following graphic account of such a person's state of feeling towards women:—"Their solitary vice has a tendency to separate those practising it from women. At first of course it is on the sex that their thoughts dwell, and they embellish an ideal being with all the charms of imaginary perfection: the habit, however, which enslaves them little by little, changes and depraves the nature of their ideas, and at last leaves nothing but indifference for the very reality of which the image has been so constantly evoked to aid their criminal indulgence. At a later period, when erection becomes temporary and too incomplete for them to think of sexual intercourse, they abandon themselves with fury to their fatal habit, notwithstanding the almost complete flaccidity in which the erectile tissues are left. At this period, the handsomest woman only inspires these patients with repugnance and disgust; and they ultimately acquire an instinctive aversion, a real hatred for the sex. They dare not always let their feelings on this subject escape them, from fear of their shameful vice being suspected, or the humiliating condition to which they are reduced being discovered; but they lose no opportunity of, as it were, revenging themselves for the repugnance which they believe they produce in women; and which, in truth, they do inspire, in consequence of the instinctive reciprocity of such feelings; that is inevitable." (Vol. iii. p. 114.)

This perversion of the natural excitement causing temporary impotence is among one of the saddest pictures which suffering humanity can show. A striking instance of the kind has lately come under the care of the writer of this article.

A tall gentlemanly young man, who had been cauterized repeatedly, assured me that he masturbated himself in sleep, in spite of all his efforts, and this particularly occurred after taking wine. He did not find the desire irresistible during his waking moments, except after he had failed in attempting intercourse with women, when, in a kind of despair, he generally yielded to the old temptation.

To avoid the practice during sleep, he had sometimes been compelled to tie his wrists together by a cord that passed round his neck, so as to be unable to touch the penis. I have known several

such cases, where patients, who wished to cure themselves of the habit of masturbation, have, against their feelings, sought the society of women, have attempted connection in vain, and then have come to me ashamed of their failure, disgusted with themselves for the vice, and apparently almost ready to commit suicide from despair and misery. Others have confessed to me that though sexual intercourse has been attended with difficulty, still the act was accomplished, but that it was attended with no pleasure, and as their own self-pollution could still afford them gratification, they acknowledged that they fell back to their old vice, of which they were all the time thoroughly ashamed. The same result occurs in women who have abused their sexual instincts. The explanation of this probably is, that the nervous system, and particularly the sympathetic nerve, has been so often and repeatedly excited, that it will only respond to this particular kind of stimulus, which it has become accustomed to, and is proof against all others.

There is another and very different cause which often produces a kind of temporary impotence that creates much more anxiety than it is worth. The student, during any strenuous and long-continued mental exertion, while he is absorbed with his studies, finds all sexual feelings annihilated. Men who are or have recently been reading hard at the Universities, frequently complain of impotency of this kind; but they may be assured it is only temporary, and that it is easily accounted for. It is undoubtedly true that such persons are temporarily impotent. Nature has wisely ordained that the testes should not always secrete; whenever the brain is overtaxed, or any great muscular exertion is taken, temporarily all sexual desire ceases, but it is quite certain that if the reproductive organs are healthy and have not been abused, sexual feelings and powers will return as soon as the overtaxed brain or muscles are allowed to return to the normal condition.

*Indisposition for connection among married men* as a temporary affection is another cause of anxiety, which in some produces the greatest alarm. Men, however, who gain their bread by the sweat of their brows or the exhausting labour of their brains, should know full well that they cannot hope to be always in a fit state to perform the sexual act. During certain periods, when occupied with other matters, the thoughts can dwell but little on sexual subjects, and no disposition exists to indulge anything but the favourite or absorbing pursuit, mental or physical as the case may be. After a lapse of time, different in various individuals, sexual thoughts arise again, and the man who yesterday was so indifferent to sexual feelings, as practically to be temporarily impotent, now becomes ardent and sexually disposed.

This quiescent condition is much more persistent in some married men than in others, occasionally so much so as to cause no little alarm. There are many men (married as well as single) who only at very infrequent intervals feel any disposition for sexual intercourse, just as there are others who never feel any such desire at all. Again there are lethargic men that, unless roused, will hardly do anything. It requires an apparent effort in some men to eat. There is in some of these cases undoubtedly great sexual debility. Again, the habitual drinker cares little for sexual enjoyments;

and I am quite certain that excessive smokers, if very young, never acquire, and if older, rapidly lose any keen desire for connection. The pleasures of the table so monopolise others again, that they are indifferent to all other indulgences. It is, indeed, often difficult in these cases to say whether the sexual organisation was originally weak, whether the other tastes have overpowered, or whether the individual has not early in life abused, his generative functions.

Again, among the married we find men taking a dislike or even a disgust to their wives, and as a consequence there is an entire want of desire. A first failure will sometimes so annihilate men's sexual feelings, that they are never able or anxious to attempt connection a second time. In many cases this arises from mere *amour-propre*, as they succeed with other women. Again, early excesses in married life will, in a certain number of cases, produce occasionally a temporary impotency late in life. Want of sympathy, or want of feeling, again, is not an infrequent cause of apathy, coldness, indifference, or *frigidity* on the part of the husband. Lastly, there are cases of amiable men who carry their consideration for the women they love to such an extent that they render themselves practically impotent for very dread of inflicting pain. A singularly agreeable and gentlemanly, but very mild looking man, thus described his case to the writer of this article. He said that he had been lately married, and had not succeeded in performing his marital duties. Ordinary treatment was adopted, and he got better, but still the act was not satisfactorily completed; and he said enough to induce the belief that the failure was not to be attributed to him alone. The lady was found to be one of those pretty, pleasing, but excessively nervous and excitable young women, to be met with from time to time, and in whom the least approach of anything towards the generative organs creates excessive alarm in consequence of their inordinate sensibility. At first the mere application of cold water could not be borne, but after some time, and a good deal of careful management, an astringent lotion could be used, and when the morbid excitability was somewhat reduced, the hymen was found not only entire, but very tough, presenting the appearance of the finger of a kid glove on the stretchers. Division of the hymen and dilatation of the vagina at length accustomed the parts to bear contact, and a permanent cure was effected. There is reason to believe that such cases as this are much more common than is supposed; and cohabitation is not likely to be followed by impregnation when the husband has previously been continent, and his natural disposition renders him particularly unwilling to distress or hurt his wife while she is in a state of unnatural and morbid sensitiveness. It is not improbable that divorces have taken place before now from some such causes as these, when interfering friends have exaggerated and envenomed the painful difference between the young couple, easily perceiving its existence, but utterly ignorant of its cause.

II. *Absence of or deficiency of power. True impotence.*—We now have to speak of those melancholy cases in which the absence of sexual power is not temporary or casual but permanent. "True impotence," says Lallemand, "consists in want of power in connection, not once, but habitually; not

only with courtezans, but with those whom we most love—not under unfavourable circumstances, but during long periods of time, say five, fifteen, or twenty years, when married to women whose devotion to their husbands has never been questioned. (Vol. ii. p. 242.)

That this lamentable state of things truly exists there can be no doubt, and in London those who devote their attention to diseases of the reproductive organs, occasionally meet with cases in which there appears to be complete annihilation of all the sexual feelings and actions, and in which the man is reduced to what Roubaud describes as *generative syncope*; such instances, however, are rare. Usually it happens, at least in England, that the functional diseases requiring treatment consist in the absence of only one or more of the conditions necessary for coition. But in the East, I am told, the Levantines are often perfectly impotent before they arrive at the age of thirty. If report speaks correctly, Hien Fung, the late Emperor of China, was in this condition. The forms that impotence assumes are various, though the result is the same in all cases, viz. inability to perform the sexual act. Thus, a man may be entirely impotent whether he has or has not erection attendant on desire. Again, there may be only a partial erection, lasting an insufficient length of time for penetration—or the erection may be so weak, or the emission so quick, as practically to render the man impotent; or a man may be impotent from having no emission at all, or an emission that does not take place until after the time of attempted connection.

CAUSES.—I fear we must come to the conclusion that when there is desire, and merely a want of power, this state of things arises from abuse of the generative organs, aggravated in most instances by alarm, fear of not succeeding, habits of intemperance, too free a use of tobacco, timidity, or too frequent excitement without gratification.

The exact way in which these causes produce impotence is not certainly known, but it is most probably by occasioning lesions of the nervous system, and most especially that portion of it which is under the influence of the sympathetic nerve or excito-motory system.

*Non-descent of the testes* is in some men a cause of partial impotence, and it appears almost invariably attended by sterility. It is not pretended that every man who has an undescended testicle must necessarily be altogether impotent; for cases are recorded of men whose testes had never descended into the scrotum having had families; but the writer has met with several instances, one of which will be presently described, where it was believed that entire impotence arose from this cause. It is true that, in the elephant, and some other animals, in the cetaceæ, in birds and reptiles, the testes are constantly found in the abdomen, side by side with the kidneys, lungs, &c. In the greater number of instances, however, the testes, even if free within the abdomen, will not secrete spermatozoa or living animalcules. This subject has been repeatedly examined in France, and among others M. Goubax, professor of the veterinary school at Alfort, says, "When the testicles remain within the abdomen of the animal they augment very little in size. The substance of the gland although healthy remains soft, as it is in the fœtus. The semen, which is contained in



the vesicula seminalis of the side corresponding to that on which the testis is in the abdomen, is found on microscopic examination to contain no spermatic animalcules, and observation and experience prove that the animals in whom double *Cryptorchis* is found, are unfruitful or barren. This only shows that if the adult's testes are truly in the abdomen, they may secrete semen as readily as when in the scrotum; but when in the inguinal canal, or in the groin, such pressure may have been, and probably has been, exercised on the gland as to impair its secreting powers.

Breeders look with great distrust on animals with undescended testes. M. Godard has written a very interesting account of this condition, which he has called *cryptorchidie*, from *κρύπτειν* to conceal, and *ὄρχις* testicle. This author says, in the case of a dog wolf he examined, in which both the testes were undescended, their structure was neither fibrous nor had they undergone fatty degeneration: the parenchyma was grey and drier than usual, although of a natural consistence; in size the gland was a third smaller than usual. The semen contained no traces of seminal animalcules, but simply epithelial cells. M. Godard further observes that, in the case of a man with undescended testicles whom he examined after death, the section of the testes presented no peculiarity. The glandular parenchyma was of the ordinary colour; the canals were healthy and pervious; the liquid which was pressed from them contained epithelial cells, blood, and fatty globules; the vasa deferentia contained a liquid composed of fatty globules of variable diameters; no animalcules but epithelial cells were present. Although he personally examined the seminal secretion of many living men who had both testes in the abdomen, his conclusion was that in the cryptorchis no seminal animalcules are ever found in the secretion, and he concludes that "men whose two testicles are arrested in their evolution are sterile but not impotent; that those who have for their generative apparatus only vasa deferentia are sterile, and nearly incapable of sexual intercourse." (*Comptes Rendus des Séances de la Société de Biologie*, tom. iii. série 2, p. 315, 1856.) The writer's experience certainly is, that men with undescended testes have no family. I was consulted by a gentleman in 1861 in consequence of his wife having no children. He said he had been married some years, and his wife presented all the external attributes of a person likely to have a large family; she had consulted a celebrated physician, at whose suggestion the husband had come to me. There was no suspicion at the time that the testes were absent, or even imperfectly developed. However, on examination, it was impossible to detect any testicles in the scrotum, and pressure in the groin did not give him any peculiar pain. There was nevertheless abundant evidence that the testes existed, although undescended. In no other respect did the patient differ from other men, and he assured me that the sexual feeling was natural, and that he had connection once or twice a week, the emission being as abundant as he supposed it ought to be in other men. As far as my personal observations go, I look with great suspicion on the procreative powers of any person with undescended testes.

Among other causes of impotence, or rather sterility, may be mentioned the influence of her-

nia and trusses. In practice, we find that both one and the other considerably interfere with the circulation. Whatever does this must impair the secretion of the seminal fluid; and, in fact, we find that many persons who wear trusses complain of impaired sexual power.

In the same way, sexual power is sometimes absent in the more severe cases of *varicocele*, but in the slighter instances it is only impaired. Fortunately, this kind of affection is generally only temporary; but, by taking a few precautions, permanent impotence can be avoided, and the procreative functions be sufficiently performed. In our discussion of the causes of impotence they could hardly be, however, passed by.

Before leaving this branch of the subject, the reader should be reminded that all the practical results of impotence can be, and constantly are, produced by the mechanical effect of a *stricture* of the urethra, in preventing the emission of semen. Impregnation is of course rendered almost impossible by a serious stricture, as the semen, instead of being at once ejaculated, can only dribble away afterwards when all erection has disappeared. The act of connection, moreover, is often painful, the pain being generally felt during the ejaculatory act. This form of impotence is far from incurable, as proper treatment by dilatation and other means generally succeeds in removing the stricture.

Impotence arising from a similar cause, viz., *obstruction*, is observed in sheep. The high fed and high-bred rams, from which the best breeds are obtained, become subject to a kind of stricture, arising from the deposit of calcareous matter in the urethra. The peculiar conformation of the organ in sheep conduces to this result. The glans penis of the ram consists of an oval and wrinkled swelling, divided horizontally at the end, looking like the head of a snake. From this glans projects a long thin appendix of a consistent character. This appendix, which shepherds call "The Worm," tapers to a point, and the canal passing through it is very small.

A ram is sometimes observed to be very uneasy and apparently to be less and less able to micturate. On examination, the vermiform appendage is found to be distended and hardened by an accumulation within the urethral canal of calcareous matter in a sabulous form. This, in many instances, can be removed by slightly pressing and rolling the appendage between the fingers, which will at once relieve the strangury and save the animal; but frequently either the ram has to be killed or part of the "worm" to be removed. If sufficient is left the ram may still be able to breed; and even if complete connection is impossible, breeders still use these mutilated animals, called "teazers," to excite the ewes and so spare the valuable tups some fatigue. The subject is so curious that it deserves the careful attention which Mr. Simmons, professor at the Royal Veterinary College in London, has bestowed on it.

*Obesity*.—Carpenter, in his *Comparative Physiology*, particularises obesity as a cause of impotence. He says, "it must be observed that there is a certain degree of antagonism between the nutritive and the generative functions, the one set being exercised at the expense of the other. The generative apparatus derives the materials of its operations through the nutritive system,

and is entirely dependent upon it for the continuance of its activity. If, therefore, the generative activity be excessive, it will necessarily draw off some portion of the aliment destined for the maintenance of the fabric at large. It may be universally observed that where the nutritive functions are particularly active in supporting the individual, the reproductive system is in a corresponding degree undeveloped, and *vice versâ*." Instances of this as a cause leading to generative debility or impotence come daily under our notice in the human being. It is likewise becoming very well known amongst breeders of the finest stock. At the Veterinary College, various opportunities occur of seeing this exemplified. It is noticed that impotence in bulls occurs rarely in the commoner sorts. Those sent to the College, in consequence of not getting stock, are found to be the highly-bred animals; and this is not to be wondered at, as competitors for prizes care little about prolific bearers. They wish animals that produce fat readily. If we had the statistics of these high-bred cattle, we should find that the high prices obtained for them are fully warranted, as the sire and dams are anything but prolific. The practical deduction from these observations tends to prove that the best remedy for all such cases of impotence is Abernethy's prescription to live on a shilling a day and earn it. There is reason to suppose that in many of the class first alluded to, the testis has itself undergone fatty degeneration; but from facts that have lately come under the writer's observation, impotence arising from corpulency is by no means a hopeless case, provided exercise and attention to diet can be, and are, observed.

That impotence in males frequently depends upon fat may be considered an established fact. There is every reason to believe that the same cause occasionally induces sterility in females. A large farmer in Suffolk lately informed the author that he is often disappointed when he wishes to breed from cart mares. This year, out of his own working stock of twenty-eight horses, eleven mares did not *stand*, greatly to his disappointment and loss, as a yearling cart colt is worth 20*l.*, and the mare ceases work only one month before and one month after parturition. This sterility he attributes to the high condition his cattle are kept in by the carters, who, proud of their teams, do not care to see them in foal. To obviate it, fresh stallions have been purchased, and with as little success, sterility still prevailing. Among these eleven mares, there were young as well as old ones, but none of them proved in foal.

*Impotence dependent upon the structure of the parts.*—Where, however, manifest impotence exists which cannot be accounted for by the accidental causes, so to speak, of early excess, or the predominance of the nutrition over the other functions of the frame, it is necessary to look and sometimes rather minutely, into the structure of the parts. It will generally be found that this kind of impotence depends on some lesion or imperfect development of the erectile tissue. The penis may be, for instance, of an unusual length, but thin, particularly at its base. It is terminated by a large fungiform glans which extends beyond the corpora cavernosa, and is almost always uncovered, or at least imperfectly covered by the prepuce. These massive penes, which seem to thin as they

approach the point of their insertion, are almost invariably deficient in energy. In fact, the erections are rarely complete, particularly towards the base. Where, therefore, this peculiarity of formation is very marked, permanent and hopeless impotence may, and probably will, be found to exist. On this subject Lallemand remarks:—"The *consistence* of the erectile tissue differs greatly in individuals of the same age, independently of their volume and form. When I have noticed the penis completely hanging on the scrotum, the corpora cavernosa empty, flabby, without any resistance or elasticity under the finger, I have always remarked that the function was, to say the least, not energetic, and a cure, if possible, difficult." (Vol. ii. p. 187.)

A very small and shrivelled condition of the organs may equally produce permanent impotence. This is described by Lallemand thus:—"There is unnatural development of the prepuce, depending probably on the unusually small size of the penis. The rudimentary state of the erectile tissue as well as of the testicles, necessarily allows of but little energy in the functions of these fundamental parts of the generative apparatus." (Vol. ii. p. 185.)

Again, we find on the other hand that in some cases the penis is hard and inelastic, the coverings are firm and indurated, and not contractile. The cause of this state usually is that in consequence of abuse, or too frequent use, or by accident, blood has been effused into the trabecular tissue; and inflammation has occasioned the deposition of lymph, which has not been reabsorbed, but remains in the shape of small indurated masses. The deposition of this lymph in the coverings of the penis causes them to lose their elasticity, and the organ becomes non-erectile, and the man remains impotent. When we remember the variety of complex and consensaneous actions which perfect sexual congress requires, it seems really astonishing that impotence should not be more common than it is. Thus there must be to make coition complete—1, Excitement of the glans penis; 2, Suffusion of blood through the organ; 3, Contraction of the bulbo-cavernosi and ischio-cavernosi muscles; 4, Welling back of the blood of the bulb in the corpus spongiosum urethræ; 5, Compression of the dorsal vein of the penis by the anterior portion of the bulbo-cavernosi muscles. Now if any one of these phenomena is checked or prevented, practical impotence is the necessary result. Thus if the venous plexuses which make up the spongy portion of the urethra present varicose tumours, or if the muscle is paralysed, the blood not arriving in sufficient quantity at the glans, the primitive excitement will not exist, and the erethism will not occur; and as the sensibility of the glans ceases, the erection will subside.

*PROGNOSIS.*—Considering then the nature of the causes of impotence, it is not wonderful that in the face of such serious nervous organic lesions the prognosis should often be unfavourable, especially in the more severe cases or in those instances in which the affection has been of long standing. Experience tells us that even where the only cause is early abuse, and too great demands upon the nervous system at a time when it was unequal to its duties, the condition can only be remedied, if at all, by strengthening the constitution generally, and allowing it to rally and repose, in fact, by pursuing the exactly opposite course to that which



has brought about the complaint. It is certainly not by a few doses of physic, or the administration of any stimulant or quack remedy, that we expect restitution of power, even where there is no physical lesion or condition which renders the case hopeless. There is great difficulty, however, in applying even the proper treatment to these melancholy cases. The hardest part of the medical man's task often is to rouse the patient from the depression which impotence induces, and to overcome the dreadful self-accusation which unnerves most of these sufferers.

**DIAGNOSIS.**—Before marriage it is often very difficult for a medical man to decide whether an individual is truly impotent or not. Lallemand points out the most obvious diagnostic sign, when he says the power of easily maintaining perfect continence and entire quiescence of the sexual organs and desires, "are fair grounds for presuming that there is little if any energy in the generative system, for if the semen was retained in the vesiculæ seminales, it would produce from time to time energetic or at least perceptible effects." (Vol. ii. p. 245.)

So vague a test as this should be of course applied with the greatest caution: for instance, a healthy man has his organs well developed, suffers only occasionally from emissions, has never abused his sexual powers, and is subject occasionally in the early morning to erections; then however continent he may be, and however easy he finds it to remain so, we may usually pronounce him potent. There are, however, other cases which do not admit of such ready solution, as the following instance shows:—A middle-aged man, with deep marks under each eye, wished to know if he might marry. He was engaged to a person of about his own age, and they were mutually attached. He had abused himself early in life, but had never committed fornication. Emissions took place once a week, not very abundant, and there were occasional erections in the morning; but the testes were small and flaccid, although he had worn a varicocele ring: the penis was also small, being, as my patient stated, not large even when erection took place. He was informed that there were serious doubts as to the propriety of his marrying, but that no positive opinion could be given on the subject. Unsatisfactory as such a dictum must be, anything is better than the vile test which some recommend such patients to try, viz., to commit fornication in order to ascertain if they are competent to marry. Now, such a test is not only fallacious, but is often more dangerous. What, for instance, is more probable than that a nervous man, who, for the first time, meets a loose woman, goes to a strange house, and is frightened by the disgrace which may attend any exposure of his folly, should find himself unable to consummate the act. The only greater misfortune that can befall him, is to be dragged subsequently and consequently into the hands of the quacks.

If, however, the fact of impotence is discovered, we must push our diagnosis farther, and enquire whether the impotence extends to the whole act of copulation or only to some part of it, that is, whether the complaint does not depend upon something amiss in the acts of erection, or emission, or in the condition of the ejaculated semen. It is most important that the surgeon, in investi-

gating the local symptoms, should discover which of these functions is imperfectly performed.

**TREATMENT.**—The proper treatment is then no longer a problem of such extreme difficulty. Where impotence is curable at all, the general rules as to the requisite treatment can be comprised in a very few words. To give the system rest; to improve the general health, so that the nervous centres shall have time, opportunity, and encouragement to rally, if it be possible; to invigorate the muscular powers, so that both voluntary and involuntary muscles may regain their tone—are among the most important maxims to be borne in mind; at the same time it is necessary to avoid as much as possible any local or other stimuli which merely excite without strengthening. In any curable case it is probable that the nervous system has been over-excited beyond the natural limits which a phlegmatic constitution imposes. The one object is to restore the nervous power, or rather to allow it to restore itself—not to excite or exhaust it still farther. The diet should, I need hardly add, be of the most wholesome and nutritious kind; but we should not forget the true old proverb—*sine Cerere et Baccho friget Venus*.

By means such as these the sexual organs will probably, in all simple cases, become in common with other functions equal to their desires.

Some, however, not content with these simple measures, have devised remedies for the purpose of stimulating the flagging powers. No doubt can exist that, in certain persons, when the affection arises from some temporary cause—more especially in the timid hypochondriacal, and those suffering from mental disquietude, the employment of stimulants may be very proper. But though this treatment is sometimes justifiable and advantageous, it is most unscientific and dangerous in other cases—particularly in those of general prostration. Here it can only aggravate the mischief; whereas, had the general health been first improved, the local disorder next relieved, and, subsequently, a stimulant given, we could understand the formula. Such should be the true method of effecting a cure; and had these principles of treatment been more generally known, many of the invalids we meet with would have been rescued from much physical and mental suffering.

*Cantharides* have been employed against impotence. They form the basis of the pastilles de serail, as well as of the numerous pills, pastes, and opiates which constitute in the East the principal commerce of all those who sell drugs. The Spanish fly enters largely into the diabolini and other aphrodisiac preparations still too much employed in Italy.

Lallemand protests strongly against the use of this drug. "The effect," he says, "produced by cantharides on a healthy man has induced persons to believe that they could restore virility lost from excesses. Thus, charlatans, and even many legitimate practitioners, have at all times prescribed cantharides as a traditional resource. For my own part, I have seldom met with an impotent person who has not had cause to regret the use of this drug. The greater proportion have not even experienced the momentary benefit which they expected; and in many cases the erectile tissue has become smaller than in the habitual state of repose. Some few have experienced erection

more or less energetic, which have lasted a longer or shorter period; but the loss of semen has exasperated symptoms instantaneously, or very shortly afterwards." (Vol. iii. p. 233.) No doubt can exist that the habitual employment of cantharides is prejudicial; but in the present day, when this substance is no longer given as indiscriminately as it was formerly, the surgeon may often advantageously prescribe it. Thus, where erection is feeble, when the fears of the patient greatly influence his mind, a few doses are very advisable. But after success, the remedy must be left off, for we do not want to excite the organs frequently, as the repeated shocks on the nervous system will often only farther depress the vital powers.

*Phosphorus* is another of the pharmaceutical preparations which the modern surgeon frequently employs in the treatment of impotence. The object is to supply that peculiar pabulum which the exertion of nervous influence appears to exhaust. We may theoretically infer that in these complaints there is a great expenditure of phosphorus in its various combinations, and that there may be a deficiency of this substance in the system, just as in other diseases, particularly chlorosis, there is a deficiency of iron. In either case we should supply the system freely with the element it seems to need, in such a way as it may be easily taken up and retained in the circulation. Practice as well as theory seems to sanction this treatment, and phosphoric acid, in combination with syrup of orange peel and syrup of ginger is a favourite formula, particularly in those cases where there is reason to suppose the semen is not secreted in sufficient abundance, or where too rapid ejaculation attends the sexual act, or when connection is attended with serious nervous depression.

*Strychnine* has been frequently recommended in the treatment of impotence, and it is a very valuable tonic in cases attended with great nervous depression, whether resulting from sexual excesses or any other cause. It is equally beneficial in those forms of impotence depending on weak or imperfect erection. It is capable of increasing the general muscular energy, and in such cases may be prescribed either alone or in combination with quinine.

*Electricity* must be classed among the modern remedies for impotence. This agent has answered best in those lethargic constitutions that require rousing, and simply demand a local stimulant, capable of determining blood and nervous power towards the generative system. When, on the contrary, there is debility dependent on previous over excitement, this, as well as every other local stimulant, acts injuriously on the system. The patient can, by means of the batteries which may now be obtained anywhere, at no great cost, apply the remedy himself.

*Marriage* has been classed among the remedies for the slighter affections of the sexual organs. Lallemand thinks that, in the slighter cases of functional disease, no doubt can exist that marriage may completely cure the patient, before continued excess or evil habit has produced those ill consequences which have been described; for "the regular exercise of organs will alone give all the energy of which they are susceptible, and those of generation are far from forming an exception to this general law. To complete the

cure it is necessary that sexual relations should be established."

In the confirmed cases, however, where irritation or inflammation is set up in the vesiculæ seminales, or when diurnal or nocturnal emissions take place involuntarily, the man who is injudiciously persuaded "to commit" matrimony will only aggravate the complaint. He will probably find all his previous symptoms exaggerated, and erection, even under excitement, will probably not take place. And even if it does, ejaculation may precede the intromission of the virile organ, or in many cases not occur at all.

Lallemand judiciously observes, in reference to such cases, that "it is precisely because marriage is the most sacred bond for individuals, as well as the most important for society, and because an iron law renders it indissoluble, that it is rational as well as moral not to contract it without the certainty that it will be perfect and complete." (Vol. iii. p. 470.)

In practice, however, we find that the plans of parents and the advice of the surgeon are alike frustrated by other considerations. In many cases the patient is too young to marry; in other instances of spermatorrhœa, the dislike to marriage is such that every woman is distasteful to the sufferer, as if nature really intended to spare the victim those mental sufferings we have noted as attendant on these ill-starred matches.

Indeed the writer's experience is, that, as a general rule, there is little need to dissuade those from marrying who ought not to do so. Our task is rather in the other direction—to encourage those nervous hypochondriacal people, who labour under the delusion that they are unfit to undertake the rational duties of husbands and fathers.]

W. Acton.

**INCARCERATION.** This term is usually applied to those cases of hernia in which the viscera are pressed upon, either by the opening through which they protrude, or by the parts themselves within the hernial sac, to such a degree, that the course of the intestinal matter towards the anus is obstructed, and nausea, sickness, pain, and tension of the hernial swelling and of the abdomen, &c., are occasioned. The rupture is then said to be in a state of incarceration.

Professor Scarpa makes the following distinction between an *incarcerated* and a *strangulated* hernia. In the first case, says he, the course of the intestinal matter is interrupted, without any considerable impairment of the texture, or vitality of the bowel. On the contrary, in the *strangulated* hernia, besides the obstruction to the course of the fecal matter, there is organic injury of the coats of the intestine, with possible loss of its vitality. The bowel that is merely incarcerated, resumes its functions immediately it is replaced in the abdomen, while that which is truly strangulated does not so readily return to its natural state. (*Traité des Hernies*, p. 251.)

**INCONTINENCE OF URINE.** (See URINE, INCONTINENCE OF.)

**INFLAMMATION.** [Section I.—On the difficulties of definition; and on the question whether processes of repair are to be considered inflammatory. —In order to start with something tangible in the way of definition, we will state that we define inflammation shortly as a "diseased process,



a perversion of growth and nutrition, with hyperæmia and exudation."

But it must be confessed that there is no definition which can be framed which is perfectly satisfactory. It is most difficult to draw the line between inflammation and some processes which are normal and healthy. The term, simple as it seems, may be made to include a host of phenomena, most discordant in reality, produced by the most opposite causes and relieved by the most opposite measures. The student, too, will be perplexed by finding that, whilst some authors of repute in the English school almost deify inflammation, and treat it not only as if it were the universal disease, but as if it were the means of reparation after all diseases, other writers ignore its pretensions and almost deny its existence.

On the one side let us hear Mr. Travers :—

"Inflammation is either primarily or secondarily associated with so large a proportion of diseases incident to the animal body, that it is to be regarded in a generic sense as comprehending almost all the varieties of organic change in its subdivisions. To dispute about the universality of its agency is as idle as it would be to question its existence, although by some the term may have been from ignorance erroneously employed; or from an affected scepticism, a love of paradox, or an ambition of novelty, by others have been discarded." (*On Inflammation*, 1844, p. 23.)

On the contrary, Andral said that the term inflammation was employed to express a variety of phenomena, which have little or no connection with each other; that it had become vague, arbitrary, and of no fixed value; and that, like an old piece of money which had lost all trace of inscription or effigy, it ought forthwith to be put out of circulation. (*Anatomie Pathologique*, tom. 1. p. 9, Paris, 1829.)

"Our notions of inflammation," says Virchow, "have undergone an essential change. Whilst until quite recently it was the custom to look upon inflammation as a real entity, as a process everywhere identical in its essence, after I made my observations no alternative remained but to divest the notion of inflammation of all that was ontological in it, and no longer to look upon the process as one differing in its essence from other pathological processes, but only to regard it as one differing in its form and course." (*Cellular Pathology*, by Frank Chance, M.B.: London 1860, p. 384.)

The first difficulty in the definition and diagnosis of inflammation consists in the fact that hyperæmia, or local determination of blood, which is an essential symptom and instrument of inflammation, is not only not peculiar to inflammation, but is the commonest possible condition in many diseases, which are not inflammatory, and in most natural processes which are attended by energy or rapidity of action. Thus any one would be led into error if he were to take the old fourfold combination of heat, pain, swelling, and redness, as proof of inflammation; or if he were to adopt John Hunter's definition :—"I shall call by the name of inflammation whatever produces the following local effects—viz. pain, swelling, and redness, in a given time, and these dependent on, or the effects of, one immediate cause." (*On the Blood*, &c. chap. ii. § 6.) For every one of these, which are the signs of hyperæmia, may exist under conditions which it would be absurd to call inflammatory; for instance,

in the brain and eye of the over-worked student; in the spinal cord in tetanus; and in the female breast and ovaries when in the active discharge of their natural functions; and in any vascular organ whatever, if excited by an extraordinary stimulant.

If we seek to amend this definition of inflammation by saying that pain, redness, and swelling, must, to constitute inflammation, be accompanied by other physical conditions, or at least by a tendency to them—for example, by exudation or by structural change—then we open up a second difficulty, which has much vexed pathological writers. If, for example, an exudation rapidly degenerating into pus, and attended with heat, pain, redness, and swelling, be considered inflammatory, is a similar exudation to be considered inflammatory if *minus* the heat, pain, redness, and swelling? This is a question with which readers of John Hunter are familiar; and they will remember that he asserts that no suppuration can take place which is not preceded by inflammation; and that "collections of matter which occur without inflammation are not suppurations."

We may pass from these *logomachies*, or wordy battles of the last generation, and come to a question which has been disputed in our own day, and on which the minds of surgeons are by no means made up. This is the question, whether repair after injury is to be considered an inflammatory process or not;—whether, for example, the beneficial process by which wounds are united should be included in the same category with that diseased process of adhesion by which the iris may be glued to the cornea, or the lungs to the inside of the ribs.

If we consult John Hunter, we shall find him most emphatically affirming the doctrine of repair without inflammation, and devoting an entire chapter of his great work on the Blood to the subject. He speaks of the alteration of structure by violence as "requiring only the most simple change in the natural action of the part to restore it." He describes injuries, such as strains, bruises, and fractures of bone or tendon, in which the skin is not divided, as seldom inflaming; whereas, injuries attended with skin wound, "commonly both inflame and suppurate." Yet he says that an injury of the former kind may, under some circumstances, inflame and suppurate; and, conversely, that if an injury of the second kind be "properly treated and united by the first intention," both inflammation and suppuration will be prevented. He describes "union by the first intention"—or "immediate union," as it was afterwards called by Macartney—as "taking place so soon after the injury that it may be said to be almost immediate." He says that the union is effected by the interposition of the thinnest possible layer of coagulated blood; and that where the quantity of blood is small, and "where all the divided surfaces can be brought into almost absolute contact, their union will be firm in four-and-twenty hours, as happens in a hare-lip, or wounds of the scalp." In cases of accidental injury he goes on to say, "Whether they be in themselves slight or considerable, in whatever situation or part they may have happened, if the salutary processes above described go on readily, no other effect of injury, or irritation, or pain, in consequence of Nature's operations is felt. No universal fever or sym-

pathy takes place, except what arises from the mere injury done, but all is quiet as if nothing had happened." Moreover, Hunter speaks of the adhesive inflammation as a thing set up, if the union by the first intention fail from any cause. "Inflammation," he says, "is an action produced for the restoration of the most simple injury in sound parts, which goes beyond the power of union by the first intention." "In a wound that is kept exposed, the inflammatory act of restoration becomes, or is rendered, necessary, and it takes place; but bring those parts together, or let the blood coagulate and dry upon it, and it becomes unnecessary." "I have shown," he adds, "that in parts which have been divided and exposed, the inflammation is in a great measure prevented by bringing them together; or if it (viz. inflammation) has taken place previous to the union, that the same operation of union is sufficient to produce resolution; and I have likewise shown that, where parts were not brought together, Nature attempted to prevent inflammation by covering the wound with blood and forming an eschar, which, in many cases, will either prevent or remove inflammation."

We might multiply such quotations largely; but our end is attained if we show that Hunter maintained the doctrine of repair by the first intention without inflammation; that he specified subcutaneous injuries, wounds quickly and accurately closed, and wounds covered with a crust of blood, as examples in which inflammation does not occur; and that he maintained the theory that inflammation, in its mildest and most beneficent form—the adhesive—was a substitute for union by the first intention when the latter was by any cause frustrated.

Curiously enough, surgeons of the succeeding generation, whilst revering Hunter as their oracle, and appealing to him as the fountain-head of scientific surgery, took upon themselves to set aside this, which is one of his fundamental principles, and to include all processes of repair whatever, under the term adhesive inflammation. It is true that Hunter, in his description of union by the first intention, ascribes too much to the agglutinating power of the blood; yet even in this small detail his error, if any, is not material, and gives no reason why the whole doctrine should be set aside.

Yet, set aside it was; and we find that the great teachers of the reign of George IV. emphatically affirmed that inflammation was the universal agent in repair. "Inflammation," said Sir Astley Cooper, "is a restorative process; no wound can be repaired without it; even the little puncture made by the lancet in bleeding would inevitably destroy life if this salutary process did not prevent it." (*Lectures, Lancet, 1823-24, ed. 3, p. 37.*)

Some few there were, it is true, who held the Hunterian doctrine, amongst whom the writer well remembers Herbert Mayo, the first professor of physiology in King's College, London, a man of singular genius, attainments, and misfortune. He always steadily taught the distinction between repair and inflammation.

In 1838, too, Dr. James Macartney, of Dublin, published his "Treatise on Inflammation," in which he insists on the entire separation of that process from the phenomena of repair, whether primary or secondary. In combating Sir Astley

Cooper's dictum respecting the wound in venesection, he says: "Those who contend for the necessity of inflammation in all cases for the reparation of injury cannot refuse to admit that, in the instances I have just mentioned" (for example, the speedy union of wounds) "none of the phenomena ascribed to inflammation exist; and that whenever the surgeon intends to accomplish union by the first intention, his success will depend on his being able to keep the parts in so easy and tranquil a state that none of the phenomena of inflammation make their appearance. If there be any degree of inflammation in which there are no heat, redness, tumor, pain, or disturbed vascular action, it ought to be clearly distinguished from that kind which is attended with these phenomena; and then we should have two sorts of inflammation; the one with phenomena, the other without, which, if we chose to disregard the logical contradiction involved in such an admission, would amount to the same practical result as if on one occasion inflammation did exist, and on others did not." (*Macartney, op. cit. p. 50.*)

Thus Macartney denies the name inflammatory to processes unattended with the palpable outward evidence of that state. On the contrary, Mr. Travers, who may be accepted as the representative of the Astley Cooper epoch, says:—

"Inflammation is not the less inflammation because the development of one, or even all its signs, is so feebly and obscurely manifested as to render its presence questionable to inexperienced observers.

"From the slighness of many injuries and the concurrence of a good habit of body, the exaltation of sensibility and of heat, the increase of fullness and of colour are imperceptible; and it is to continue this happy state of imperception, and to prevent their becoming palpable, that rest, position, soothing and cooling applications, and medicines, are enjoined; in other words, it is to preserve the subdued state of inflammation, which favours healing, and not to supersede it, which would more effectually retard or preclude healing, than the aggravation caused by an improper treatment." \* \* \* "A graduated scale of inflammatory action, commencing from this scarcely appreciable 'zero' would, if the instrument were as true as delicate, conduct us through all its successive stages, from simple phlogosis to self-destructive gangrene.

"Degree, though not the parent, is the great indicator and instrument of change." (*Travers, op. cit. p. 27.*)

In deciding this matter for ourselves and our readers, whether it will be better to adopt the Hunterian doctrine and keep repair distinct from inflammation, or the Borough doctrine which unites them, we may be guided either by what seems intrinsically the most rational and logical plan, or by that which is the most convenient in practice; and we believe that on both grounds it will be better to adopt the Hunterian doctrine.

On grounds of intrinsic reasonableness we may argue that a certain power of repair after injuries is almost as essential to the maintenance of life as is the regular course of nutrition. That ordinary exertion, and the wear and tear of everyday life, are in some degree injuries, which have to be repaired by ordinary daily nutrition; and that the repair of a mechanical injury may be considered



as the exertion of the power of nutrition under extraordinary circumstances and in an unusual degree; that repair, when proceeding favourably, is unattended with unpleasant sensation, or *disease*; and that after any injury whatever, the occurrence of heat, pain, swelling, and redness—or, in other words, of every appreciable degree of inflammation, is justly looked upon as a most untoward event, which is sure to delay, if not to frustrate the work of repair. Repair goes on easily, painlessly, tranquilly, with no increased heat, no sign of “action”—nothing which can be called inflammatory save on hypothesis. Inflammation is a process of disturbance, disease, disquiet, and disorder.

Besides, if the processes of healthy repair are to be called inflammatory, by hypothesis, there is no reason why every other active process in the animal economy should not receive the same name. If we say that it is inflammation which causes the healing of a wound, or repair of a broken bone, we may consistently say that the periodic excitement of the ovaries, and the secretion of milk, are also inflammatory acts.

But to come to the ground of practical convenience. It is of course easy so to define a given term, that it may be made to include anything that we choose. And if any one chooses, he may so define inflammation as to include under it, not only repair, but every action of health and of disease. But to such a course there is this practical objection. Inflammation may be a loose, inclusive term. But the opposite term, *antiphlogistic*, is, unfortunately, in most minds but too terribly rigid and precise. With the idea of inflammation there is but too apt to go also the idea of excess of action, and excess of power, and the idea that the proper mode of treating it is by “lowering the system,” as it is but too commonly understood; that is, by bleeding and starvation. Hence, if any process is considered inflammatory, the surgical instinct is led to the use of debilitating measures, which would probably be useless or injurious if inflammation did exist, and are doubly so if it does not. If the processes are kept distinct in idea there will be less risk of the antiphlogistic regimen, as it is called, being indiscriminately and injuriously adopted when there is no inflammation to be combated.

We propose, then, to treat of inflammation as a disease, and as a deviation from healthy processes of nutrition, whether ordinary or extraordinary.

Before dismissing this point of our subject, we ought to be prepared with an answer to the question,—If inflammation be a disease, what becomes of the doctrine that it is a salutary process, and one endowed with a multiplicity of uses, as is often taught? such as the property of limiting effusions, which is often ascribed to the adhesive inflammation; the use of suppuration in getting rid of extraneous substances, and so forth. To this we reply, first, that many of these alleged uses of inflammation are so many figures of speech, or metaphorical manners of stating plain facts; and secondly, that, although inflammation be a disease, and therefore, abstractedly considered, an evil, yet that, under some circumstances, it may be the lesser of two evils.

We hear of *healthy* inflammation. But this expression, which is a barbarism and a paradox, really implies comparison; between inflammation proceed-

ing favourably in a tolerably healthy and vigorous person, and that which affects one who is much out of health and exhausted.

When we endeavour to define accurately what inflammation is, and what it is not, we find it impossible to act upon the Hippocratic axiom, *curationes morbum ostendunt*, and to establish an experimental test of inflammation; to say that any given state is inflammatory if it be subdued by “lowering,” or antiphlogistic measures, and that any condition which is relieved by stimulants is not *genuine* inflammation. Under the term inflammation are included many states, to which the terms “low,” or “languid,” may be applied, and which may require good diet and wine, but which are truly inflammatory notwithstanding. A true inflammation may exist, and yet there may be no necessity of depletion, or anything that reduces strength.

It is easy to isolate a certain set of phenomena and consider them as the type of inflammation; but like every other set of objects and conditions in nature, inflammation is bounded by no abrupt lines, but slides off imperceptibly into processes which are normal, and natural, or certainly not diseases;—or else into processes which, if diseased, are not commonly considered inflammatory.

In other words, the limits of the term are purely conventional. When a process, then, is called inflammatory, nothing is proved thereby, nor can be inferred as to causes, nor yet as to treatment. Each case or set of cases requires to be analysed independently, and treated according to its own conditions.

If mere hyperæmia, pain, and exudation, constituted inflammation, then the menstrual period in most women, and certainly in those subject to dysmenorrhœa, must be called inflammatory. Pain, afflux of blood, shedding of mucous membrane, mixed with exudation, and hemorrhage from distended capillaries, or capillaries *shed* with the separated membrane, exist in dysmenorrhœa, as they do in dysentery, or in cystitis.

“The process by which the ovum is discharged from the ovary,” says D. A. Farre, “has been compared by Blumenbach to the spontaneous bursting of an abscess. So many points, indeed, of similarity may be traced between these two processes, that the term ‘inflammation’ is employed by some authors in describing the preparatory changes in the Graafian follicle.” (*A. Farre*, art. *UTERUS*, *Todd's Cyclopædia*, 1858.)

“In proportion,” says Virchow, “as pregnancy advances, as the lymphatic vessels in the uterus dilate, and the interchange of material in the organ increases with the development of the fœtus, the lymphatic glands in the inguinal and lumbar regions become considerably enlarged, and that sometimes to such an extent that if we were to find them in a similar state at any other time, we should regard them as inflamed.” (*Op. cit.* p. 191.)

In the same manner, the constitutional symptoms which go before and with inflammation, have their exact analogies in the condition which precedes menstruation; there are heaviness, headache, languor, and other signs of blood change; which signs invariably, as we believe, go before local inflammations of spontaneous or idiopathic origin. Still more clear is this in the case of lactation. Here the blood is evidently loaded, like the sky before a thunder-storm; the whole

system is oppressed; the head aches, the heart and lungs are oppressed; and all these symptoms of *milk fever* go, when hyperæmia and secretion from the breasts is established, just as all symptoms of inflammatory fever go on the appearance of an eruption, or formation of a critical abscess.

As with natural processes, so with diseases. All hyperæmia is not inflammatory; yet who can say where one ceases and the other begins? All exudations are not inflammatory; but it must be remarked that the distinction between such as are and are not, is often purely arbitrary or conjectural. In the case of slow, silent deposit of cancer, or what is called "tubercle," who shall say that "inflammation" in a languid state was, or was not, present? But the same exudation, or new formation which may at one time grow without inflammation, may at another have a distinctly inflammatory character. The first observer of fungus hæmatodes called it *spongy inflammation*. Hypertrophy is not necessarily inflammatory, yet in some instances, as of the hypertrophy of cuticle in psoriasis, and of cartilage and bone and tendon, in common and syphilitic gout and rheumatism, is attended with truly inflammatory symptoms. "A number," says Virchow, "of inflammatory processes on their first appearance really exhibit nothing more than an increased assumption of material into the interior of the cells, entirely resembling what we find in simple hypertrophy." \* \* \* It is extremely difficult in many cases to distinguish simple hypertrophy from those forms of inflammatory processes, which are essentially accompanied by increased absorption of nutritive material." (*Op. cit.* p. 297.) So with regard to pain. Inflammation and neuralgia are usually considered opposites, and if certain specimens of each be compared, are so. But they meet and amalgamate, so that no definite line can be drawn between them; and there are many true neuralgias, curable by stimulants and tonics, from which it is impossible to exclude the term inflammation, if rigorously applied.

From what has gone before, it will be seen that there are no elements or processes in inflammation which are in themselves *unnatural* or foreign to the animal economy; it is their excess or perversion, or occurrence under circumstances unfavourable to life or its enjoyment, which constitute inflammation a *disease*.

Section 2.—*Analysis and description of the symptoms of inflammation; and first of the local symptoms.*—Having discussed these preliminary matters, now let us come to a description and analysis of the symptoms of inflammation in its most typical form.

Let us suppose that a man, who habitually indulges in more food and spirituous liquors than his system requires, and who is somewhat irregular in his habits, meets with a severe bruise, and that he neglects the injury, lives as usual, and gives no rest to the injured part. Then probably will follow the following phenomena:—

Intense pain of a throbbing character; sensation of heat; swelling elevated in the middle, and tight; soft and œdematous at its circumference; redness vivid in the centre, paler around, and gradually lost in the natural colour of the skin; and the natural use of the injured part either rendered impossible, or attended with extreme pain and difficulty. With these local symptoms others will be conjoined, showing the participation of the

entire body in the disease. There will be shivering, or at least a creeping sensation of coldness down the spine; yet the skin, perhaps, is hot and dry; there will be flushed face and headache; general languor; sleeplessness or delirium at night; a white tongue; loss of appetite; thirst; and defective action of the bowels; the urine scanty.

These symptoms may be divided, for the sake of analysis, into local and constitutional. The local consisting of pain, heat, swelling, and redness, with impaired function; the constitutional, of fever. Let us investigate these one by one:—

First, as to the *pain*; respecting which we may observe that, although pathologists formerly expended much ink in endeavouring to show why inflammation was painful, we may rest content with the fact that Providence has wisely ordered all the actions of the healthy body so that they shall be executed, not only without pain, but with a certain obscure consciousness of pleasure, which is one of the highest privileges of health and strength; and that, on the contrary, many of the sensations and actions of the diseased body shall be painful. This we may treat as an ultimate fact. Yet without enquiring into the essential nature of pain, we may analyse its varieties, as the knowledge of these is often highly important in practice.

In the first place, the pain of inflammation may depend on the original cause of the inflammation, and will vary according to the nature of that. Of the external causes of inflammation—the various kinds and degrees of violence, or of irritation—each probably produces a pain peculiar to itself. This is evident by the fact that people speak of cutting, stabbing, and tearing pain; of burning, and scalding, and the like. This is also true with regard to the internal causes of inflammation. Every variety of exudation that may be poured into a part probably causes its own kind of pain. The pain of boil or carbuncle differs from that of phlegmasia; rheumatic pain is not the same as gout; eczema, herpes, and psoriasis, each causes a sensation differing from that of erythema, and from that of each other.

Secondly, the pain of inflammation will vary with the part inflamed. Every part has a certain limited number of sensations, which alone are possible to it; and which alone can be excited in health or in disease;—subjectively, or objectively. This is most true and most evident in the case of the organs of special sense.

When the eye is diseased there may be flashes of light; when the ear, there may be sounds of various kinds; when the skin, various itchings and smartings. And in respect of parts which are not specially endowed as organs of sense, each has its own variety of feeling, which is provoked by inflammation. The aching of bones and ligaments, the stabbing produced by stretching an inflamed pleura, the sickening pain of inflamed testicles, may be examples.

Moreover, not only the sensibility of any organ, but its connection with visceral nerves, will give a character to the suffering it occasions when inflamed, and an apparent degree of gravity or danger. Thus inflammation of a kidney or testicle may produce considerable faintness or nausea.

Together with perverted sensibility there will be perverted receptivity of impressions, and these will be transmitted to the spinal cord, and produce



reflex actions. Thus in inflammation of any surface there will probably be spasm, or irregular action of the surrounding muscles;—of the sphincter in dysentery; of the orbicularis in conjunctivitis; of the constrictors of the larynx in croup, and so forth. These muscular actions form an important part of the pain of many inflammations, and aggravate the difficulties of treatment.

In the third place the pain of inflammation may be connected with the intensity of the hyperæmia; witness the painful throbbing which attends most acute inflammations, especially of parts unyielding, as the skin of the hand and the testicle.

In the fourth place, pain may depend on the mechanical distention caused by a rapid exudation underneath ligamentous textures, or fasciæ; although the same parts will bear a slow non-inflammatory distention to almost any extent without pain. Conversely, inflammation of loose areolar tissue, or of the substance of the lung where there is no distention, is less painful than inflammation of parts that are themselves unyielding, or bounded by others which are so.

Further, it must be noticed that, in some cases, the pain of an inflamed organ is not felt at the part, but at a distance; of which the instances commonly quoted are, pain in the shoulder from diseased liver; pain of the knee from diseased hip, and of the testicle from diseased kidney or urethra. These are illustrations of the fact that irritation of any one part of any nerve may be felt at any other part of its course.

Closely allied to pain is the condition called *tenderness*, which is almost universal in inflammation, and betokens an exalted sensibility, so that any touch or pressure gives pain.

Lastly, it must be noticed that pain may be absent—as in many slight inflammations of the skin, or pleura, and in inflammations of a slow, lingering character. In such cases it may be said that no pain is created. In others, though created, it is not felt. This is the case in inflammation of parts whose connection with the central organs of the nervous system is severed; and in cases in which the nervous centres themselves are rendered less sensitive by opium, or other narcotic poisons, by the abuse of spirits, or by the poisoned blood of fever. Strictly speaking, pain is a condition of the brain and spinal cord; not of the part affected.

Secondly. In treating of the *heat of inflammation*, we must distinguish, first, the patient's sensations of heat, which are often quite disproportionate to the reality. Secondly, we may state it as a fact, that an inflamed part is generally hotter to the touch and to the thermometer than parts in its vicinity. Dr. Spurgin, who has paid great attention to this subject, and has constructed a small thermometer for the purpose of making accurate observations, informs the writer that he has seen the instrument mark  $98^{\circ}$  over the chest or scalp in inflammation. In one case of painful delusion, the temperature of the head was reduced from  $95^{\circ}$  to  $82^{\circ}$  in eight-and-forty hours by leeches, cooling applications, and free purgation. But is there any evidence that an inflamed part is really hotter than the rest of the body? During this generation the authority of Hunter has been accepted; and what he believed of the heat of inflammation may be summed up in these two propositions: In acute inflammation with fever, the *heat of the entire*

*mass of blood may be raised two or three degrees; and the heat of an inflamed part may rise nearly or quite to the heat of the general mass of the blood, but not beyond.* The usual heat of the blood may be stated in round numbers as  $100^{\circ}$ . In fever, especially scarlet fever, it has been stated to rise so high as  $106^{\circ}$ ,  $108^{\circ}$ , or even  $112^{\circ}$ . (*Bateman, On Cutaneous Disease*, 1819, p. 74.) The writer has never found it higher than  $103^{\circ}$  or  $104^{\circ}$ . This increased heat is due, on the prevalent chemico-vital theory, to an increased oxydation of the tissues, and to a diminution of the perspiration, which naturally cools the body by its evaporation. The experiments of Hunter, by which he thought he proved that inflamed parts have not a temperature higher than that of the blood, as they have somewhat of a classical character, deserve to be quoted at some length:—

“Experiment I. A man had the operation for the radical cure of the hydrocele performed at St. George’s Hospital. When I opened the tunica vaginalis I immediately introduced the ball of the thermometer into it, and close by the side of the testicles the mercury rose exactly to  $92^{\circ}$ . The cavity was filled with lint, dipped in salve, that it might be taken out at will: the next day, when inflammation was come on, the dressings were taken out, and the ball of the thermometer introduced as before, when it arose to  $98\frac{3}{4}^{\circ}$  exactly.

“Here was an increase of heat of  $6\frac{3}{4}^{\circ}$ , but even this (heat) was not equal to that of the blood, probably. \* \* \*

“Experiment II. I made an incision into the thorax of a dog; the wound was made about the centre of the right side, and the thermometer pushed down so as to come into contact, or nearly so, with the diaphragm. The degree of heat was  $101^{\circ}$ ; a large dossil of lint was put into the wound to prevent its healing by the first intention, and covered over by a sticking-plaster. The dog was affected by a shivering. The day following the lint was extracted, and the thermometer again introduced; the degree of heat appeared exactly the same, viz.  $101^{\circ}$ . The dog recovered.” \* \* \*

Hunter goes on to argue that the heat of an inflamed part may be the maximum heat of the body, and that the latter may be increased in disease.—“For in Lord Hertford’s servant, who was tapped eight times, and seven of them in thirteen weeks, the seventh time I held the ball of a thermometer in the stream as it flowed from the canula of the trocar, and it raised the mercury to  $101^{\circ}$  exactly through the whole time. Twelve days after I tapped him the eighth time; the water was partly clear; when I held the thermometer in the stream it rose to  $104^{\circ}$ . Now, as the heat of the abdomen was  $104^{\circ}$ , we must, I think, suppose that the general heat of the man would also be  $104^{\circ}$ .”

Other experiments were made by provoking inflammation in the internal secreting surfaces of wounds; as the rectum and vagina of dogs and asses; and it was found that the most vivid inflammation that could be excited by injections of corrosive sublimate did not raise the temperature above that of the blood generally.

But that which was rendered probable by the common instincts of mankind, and which the experiments of Hunter were too coarse to disprove, which Liebig also affirmed on *a priori* grounds, namely, that the heat of an inflamed part is really

increased, has been rendered more probable still by some delicate thermo-galvanic experiments performed for Mr. Simon by Dr. Edmund Montgomery. "An inflamed part is no mere passive recipient of heat, but is itself actively calorific. The arterial blood supplied to an inflamed limb is found less warm than the focus of inflammation itself—the venous blood returning from an inflamed limb he found less warm than the focus of inflammation—and warmer than the arterial blood supplied to the limb; thirdly, the venous blood returning from an inflamed limb is found warmer than the corresponding current in the opposite side of the body. Unquestionably, therefore, the inflammatory process involves a local production of heat." (*Simon's Essay on Inflammation, Holmes's System of Surgery*, vol. i. p. 43.)

Thirdly. The redness of inflammation is a direct effect of the increased afflux of blood, and of the preternatural accumulation of red particles; and in various kinds of inflammation it displays very different appearances. It will be influenced by the natural arrangement of the blood-vessels of the inflamed part. Thus, redness of the conjunctiva differs in hue and appearance from redness of the sclerotic coat of the eye. It may be uniformly diffused over a surface, or may be scattered in minute points, corresponding to the apices of the papillæ of skin or mucous membrane. Secondly, it will be modified in the most remarkable manner by the nature of the cause which produces the inflammation, especially if the cause be one which operates through the blood. Common phlegmonous inflammation presents a vivid bluish colour, gradually fading into a delicate pink. Erysipelas often is bounded abruptly. The redness in many inflammations is of a dusky or livid colour; sometimes arising from general debility, sometimes from approaching disintegration or gangrene accompanied by a complete stagnation of blood in the capillaries. Sometimes the colour is modified by an extravasation of blood accompanying the exudation, and the subsequent alteration of the colouring matter, as often happens in boils and in erythema nodosum. Sometimes the colour appears modified by a peculiar alteration of the surface, as in lepra, especially the syphilitic lepra. Suffice it to state the general truth, that almost every kind of inflammation has something peculiar in the tint of its redness; and lastly, that there is one inflammation—the *phlegmasia alba dolens*—in which the absence of redness in the parts which are the seat of exudation is remarkable, and has been signalled in the name of the disease. We may add that, in any description of external redness, it should always be noticed whether it can be dispelled by the pressure of the finger—that is, whether the vessels can be emptied,—and the degree of rapidity with which they fill again when the pressure is removed should be noticed likewise.

Fourthly. The swelling of inflammation is obviously produced, first, by the hyperæmia, or increased afflux of blood; secondly, by the various matters which pass out of the blood-vessels by rupture or exudation; and what we have observed respecting pain and redness may be repeated respecting swelling—namely, that it will vary according to the mechanical and vital properties of the part in which it is situated, and still more according to the exudation which is poured out. There are some parts, the sudden swelling of which is diffi-

cult or almost impossible, as bone, ligament, and parts confined under fascia, whilst in parts abounding in loose tissue, swelling may be rapid and immense. But still more is swelling influenced in its character by the nature and quantity of the exudation. It may be soft, œdematous, and readily *pitting* under the pressure of the finger; or may be firm and brawny, as in the case of carbuncle, erythema nodosum, and phlegmasia dolens, in which the textures are infiltrated by almost solid exudation.

To the fullness of blood-vessels, and interstitial exudation, may afterwards be added a swelling from increase of the number and size of the elementary parts or cells of the inflamed part, in other words, by incipient *hypertrophy* or by *hyperplasia*, the first consisting in enlarged size of the elements of an organ; the second in an increase of their number.

Fifthly. That inflammation must impair the function of the part in which it is situated is almost obvious. It renders the exercise of every action painful and difficult at first; impossible, afterwards. This is remarkably the case with excretory organs, as the kidneys, for when inflamed, their proper secretion is diminished, and mixed with exudation from the blood.

Section 3.—*Analysis of constitutional symptoms: nature of surgical fever, or feverishness.*—The sixth and last symptom of inflammation which we enumerated is *fever*, or, more properly speaking, *feverishness*, a condition depending on certain changes in the blood. But instead of speaking of changes in the blood as *symptoms* or *accidents* of inflammation, we ought rather to say that they are of the very essence, as we shall show hereafter.

The relation of fever to inflammation is twofold. In the first place it may be caused by changes which occur in an injured part. For example, even in a healthy person, if some delicate organ, such as the eye, or some portions of the skin, be injured in such a way as to cause severe pain and sleeplessness, and if pain and irritation be kept up by any circumstance, we shall have *symptomatic* or *traumatic fever* in its mildest degree. There will be slight chilliness, some tightness of the forehead, thirst, white tongue, and loss of appetite, increased heat of skin, and quickness of pulse, with an aggravation of the local mischief. In this case we may suppose that the composition of the blood is altered by the irritation of the nervous system—(and that a nervous system irritated by any cause, mental or bodily, has the power of poisoning the blood, will, we believe, scarcely be disputed)—or by changes wrought in the blood which traverses the inflamed or injured parts, or stagnates in them.

The most striking forms of general infection of the blood, produced by local inflammation, are those to which the name *pyæmia* has been assigned, and which, from the researches of Mr. Henry Lee and others, have been proved, experimentally, to be owing to the entrance of diseased fluid into the veins. This is the nature of *puerperal fever*, usually produced by contamination of the blood with the secretions of the uterus, or with poisonous matter introduced into the vagina during labour. But a malady identically the same may follow an amputation or operation, which Professor Simpson has described as *surgical fever*. But whether the case be one of the slightest feverishness from pain and loss of sleep, or the most



fearful pyæmia, alteration of the blood seems to be the essential condition.

This, then, is fever symptomatic of inflammation. But in a second series of cases the fever is the starting-point. The blood, either by spontaneous decomposition, or by infection with a poison, or defective purification, becomes deranged, and a local inflammation is set up in consequence. This is well exemplified in the common hospital erysipelas, whether attacking the scalp or a wounded part. Here the first symptom is shivering and fever; the local hyperæmia and exudation follow, and this is the case in all *idiopathic* inflammations.

There is yet a third series of cases, in which fever (i. e. a diseased state of blood) is first produced by a local inflammation, and then produces fresh inflammations in other parts. No other mode of accounting for some of the phenomena of what is called pyæmia exists, than the supposition that definite substances in solution find their way into the blood. "To this class," says Virchow, "belongs that metastatic pleurisy which develops itself without any metastatic abscesses in the lungs—that seemingly rheumatic articular affection in which no distinct deposit is found in the joints—that diffuse gangrenous inflammation of the subcutaneous connective tissue, which cannot well be accounted for unless we suppose a more chemical mode of infection. Here we have, as may be seen in cases of variolous and cadaveric infection, to deal with a transference of *corrupted ichorous juices into the body*; and we must admit the existence of a dyscrasia (*ichorous infection*) in which this ichorous substance, which has made its way into the body, displays its effects in an acute form in the organs which have a special predilection for such matters." (Virchow, op. cit. p. 215.)

As this subject may be rendered obscure by the condensed form in which the writer is compelled to express himself, and as a correct understanding of the manner in which local and constitutional symptoms depend on each other is of the most vital consequence to every one who desires to be a successful practitioner, let us recapitulate a little.

Inflammation, in the true sense of the word, involves local symptoms and constitutional; the latter of which are designated by the terms *feverishness*, or *traumatic*, or *symptomatic*, or *inflammatory fever*, or *pyrexia*.

In some cases the local symptoms are the first, as in the case of injuries which inflame. And in these cases those blood-changes, which constitute feverishness, may be caused either by nervous irritation, or by the introduction into the blood of fluids vitiated by the injury and its consequences. An example of this last-mentioned cause, at its climax, is to be found in pyæmia.

In other cases, a change in the blood and constitutional symptoms precede all local symptoms, as in all *idiopathic* inflammations.

In others, again, a diseased state of blood, produced by one local injury, is the cause of fresh inflammation elsewhere.

In any case fever seems to involve the following points—1st, the presence of some deleterious matter in the blood; 2nd, a series of operations for getting rid of the unwholesome blood-material, partly by increased oxydation, partly by elimination, either through the natural excretory glands, or

through the medium of a local inflammation, which is in reality an excretory organ extemporised

The palpable phenomena of fever are these:—

1st. Shivering, which is sometimes accompanied by a real diminution of heat, sometimes appears to be a subjective sensation only. Its real nature is quite unknown, but it evidently shows the moment when changes in the blood commence.

Unknown though its nature be, there is no one symptom met with in the range of surgical and medical practice which is of deeper and more universal importance. Muscular tremors, with sensation of cold, which constitute shivering, evidently refer to the nervous system as the part immediately affected. They may be produced, apparently, by some causes which operate directly on the nervous system, and by others which act through the blood. Of the first set we may mention the direct application of cold, depressing passions, agitation of mind generally, and any actions affecting sensitive parts, as the dilatation of the os uteri, and the introduction of bougies; and, above all, irritation of the stomach. Of the second set we may say that anything which suddenly alters the composition of the blood, whether from without or within, is liable to cause shivering. As we have already said, in article *ABSCESS*, it shows the beginning of an inflammation; and it may, in the progress of the disease, show the time when some fresh blood alteration is taking place. For instance, a patient, three days after a severe burn, was seized with shivering, which was the first symptom of scarlet-fever which followed. But the chief alteration which additional shivering shows in the process of an inflammation is the occurrence of suppuration, and the probable absorption into the blood of liquefied exudation from the seat of disease. (See art. *ABSCESS*.)

"Rigors," says Hunter, "seem to be the effect of any new action on the constitution, and not at the commencement of a disease only. They show plainly the commencement of some new action." (*Lectures, in Palmer's Edition, vol. i. p. 379.*)

Of the precise nature of the change which causes shivering we know nothing. Yet that it is connected with some interruption to the production of animal heat is palpable from the very great coldness of surface, and the other phenomena of the cold stage when severe, which are identical with the symptoms caused by great abstraction of heat from the body—blueness, and lividity, and shrinking of bulk of the extremities, great oppression of the breathing, and intense congestive headache.

Vomiting, also, is a symptom often associated with shivering, in diseases attended with especial blood taint; but not often at the commencement of ordinary inflammation.

Of the final purpose of shivering, or of the share which it takes in producing the subsequent phenomena, we know nothing; and it would add nothing to our knowledge were we to imitate the older surgeons, who speak of nature, alarmed at the invasion of a foe, and calling in all her forces, as into the citadel, to defend the vital parts. Metaphor has never been of much service to medicine.

2nd. *Post horrorem, pulsus frequens*, according to the unsurpassable definition of Cullen. The pulsations of the heart are often raised to 100°, 120°, or even 140°. The character of the pulse as felt at the wrist, whether full or small, hard or

soft, tense or wiry, or jerking, depends on the vital condition of the system, and points to important points in prognosis and treatment.

3rd. With increased frequency of pulse, increased frequency of respiration is combined. In children, in pure febricula, the writer has observed the respirations to be 60 in the minute.

4th. The heat of the body is raised from  $100^{\circ}$  or  $101^{\circ}$  to  $104^{\circ}$ , or higher. This, considered together with the increased rapidity of circulation and respiration, seems to give rise to an increased oxydation of the blood elements, and probably, according to the chemist Simon, of the blood corpuscles.

5th. The skin is dry as well as hot; the mouth dry, with considerable thirst; the urine and alvine secretions scanty. This imperfect elimination of water is remarkable, and utterly inexplicable. Appetite is deficient; but there is usually a craving for water and acid fruits.

6th. The nervous system is deranged, as is proved by headache, difficulty of collecting the thoughts, delirium during the night, and universal lassitude.

7th. The urine shows remarkable changes. Before an idiopathic inflammation the writer believes that it will very often be found unusually pale and copious, yet sometimes before the disease it becomes scanty and high-coloured; during the disease it is almost always so; as the disease declines it deposits copious sediments of lithates, variously coloured, which are probably the representatives of the blood elements that have undergone oxydation, and which constitute the critical sediments of the older physicians. Besides, in the earlier stage of inflammations and fevers, the urine often contains serum (as evidenced by the coagulation of its albumen by heat), and fibrinous casts of its tubules, caused by congestion and exudation. "The following," says Simon, "are the general characteristics of the urine in inflammatory affections. The urine is darker than usual, and is of a yellow-brown, or reddish-brown tint; it has an acid reaction, and is generally of a high specific gravity. With respect to its most important constituents the urea is either absolutely increased, or is at the ordinary physiological average, or may be a little below it; the uric acid is always absolutely increased, and so are the extractive matters, especially the alcoholic extract; the salts are always absolutely diminished, especially the chloride of sodium; the sulphates, on the other hand, either approximate to the physiological average, or are not far below it. (*Simon, Animal Chemistry*, Sydenham Soc. Lond. 1846, vol. ii. p. 208.)

"Assuming, as the means of numerous analyses, that the urea constitutes 39 per cent. of the solid residue of normal urine, I have found it as high as 46.8 in inflammatory affections. (In abdominal typhus, with a quick small pulse, I have seen it as low as 22.)

"The physiological average of uric acid may be placed at 1.5 per cent. of the solid residue. In the phlogoses I have observed it amount to nearly 3; and Becquerel even found it rise as high as 5.9. The quantity of extractive matter, &c., which in normal urine amounts to 23.5 of the solid residue, rises in inflammations to 43. The fixed salts which, in healthy urine, constitute about 25 per cent. of the solid residue, diminish here to 12.

The sulphate of potass, which in healthy urine forms about 10 per cent. of the solid residue, I found to vary in inflammation between 7 and 9.

"The composition of the urine becomes changed if much blood is abstracted during the progress of the inflammation. It becomes clearer, specifically lighter, and the amount of urea decreases absolutely and relatively.

"At the height of the inflammation, or, perhaps, it would be better to say, at the time when the fever puts on the synochal type most strongly, the urine is usually clear and deeply coloured. It subsequently forms a sediment of a yellow or red colour, composed of uric acid and urates."

The chlorides in the urine are of great importance in semeiology, and especially their diminution. The chloride of sodium often almost entirely disappears, especially in inflammation during the exudation stage. In pneumonia the chloride of sodium furnishes a scale of the progress of the disease. In the height it disappears, in the absorption stage it returns. The same is the case in typhoid diarrhoea, and in cholera. (*Franchel und Ravoth, Uroscopie*, Berlin 1850, p. 19.)

Dr. Parkes speaks of the remarkable increase of the urea and uric acid, the representatives of the nitrogenous tissues in "febrile urine;" and as very little food is taken, it is evident that these proceed from the patient's own tissues, which are wasting. The pigment, also, supposed to proceed from metamorphosis of the blood-cells, is increased, as are likewise the sulphur compounds, whether oxydised or unoxydised. (*On the Urine in Health and Disease*, by E. A. Parkes, M.D. &c., Lond. 1860, p. 300.)

The disappearance of chlorides from the urine in pneumonia has been particularly studied by Dr. Lionel Beale, whose attention was called to it by the published researches of Redtenbacher. It appears, as the result of Dr. Beale's enquiries, that the chloride of sodium disappears from the urine entirely, at or about the period when the lung becomes hepatised. The absence of this salt from the urine shows that it is deficient in the blood, or at least that the blood contains less than its normal quantity. Notwithstanding this deficiency in the blood and urine, Dr. Beale shows that the sputa in pneumonia contain a greater quantity than healthy pulmonary mucus does, and that the hepatised lung tissue contains more than the healthy lung does. Soon after resolution of the inflammation the chloride becomes restored to the urine, and often in considerable quantity; and at this period the serum of the blood is found to contain a greater amount of chloride than in health." From these facts it is not unfair to conclude that, during the stage of hepatisation, there exists a preternatural attraction in the lung for the chloride; and that when the disease ceases this attraction ceases likewise, and the salt is restored to the blood, and appears in the urine as usual.

Dr. Beale shows that "a large quantity of chloride of sodium is usually present wherever active cell developement is going on; that, for example, the growing femur of a six months' fœtus contains more than 10 per cent. of chloride, according to Lehman, whilst the ash of the same bone in the adult contained from 0.7 to 1.5 per cent.; and that those secretions which contain abundance of cell growth contain far more chloride than those whose secretions contain little or



no cell growth. Hence he infers that the presence of abundance of this salt may fairly be expected in those pathological changes in which cell formation takes an active part, since diseased actions are, doubtless, governed by the same laws as the healthy, although under different circumstances. (*Lionel S. Beale, M.B., On the Diminution of Chlorides in the Urine, Med. Chir. Trans. vol. xxxv. 1852.*)

8th. The state of the blood during acute inflammation has always been considered to afford the strongest evidence that this fluid takes an important part in the disease, either primary or secondary.

The reader does not need to be reminded that healthy blood drawn from a vein soon *coagulates* into a mass of gelatinous consistence and uniform red colour. After this a spontaneous separation takes place. Drops of a clear or yellowish serum begin to ooze out from the surface and edges, and soon the uniform red mass divides into two portions—serum and crassamentum, or clot. The former contains the albumen and salts; the latter the fibrine and solid particles, red and white.

The mechanism of coagulation, according to Mr. Wharton Jones, who has studied this subject more minutely than any living physiologist, is as follows:—The red blood corpuscles arrange themselves, by a sort of mutual attraction, into rows, resembling rows of pieces of money; and the interlacement of these rows forms a sort of network, uniformly diffused throughout the *liquor sanguinis* or *plasma* (the fluid part of the blood containing the serum and fibrine). Next, the fibrine of the *liquor sanguinis* solidifies, this being the essential condition of coagulation; and lastly, the fibrine containing the red particles with it contracts itself and squeezes out much of the serum from the solid clot which floats therein.

The blood drawn from the veins of a patient labouring under acute inflammation almost immediately displays on its surface a bluish or yellowish-white layer of liquid, the colour of size; whence inflamed blood was formerly called *sizey*. This layer forms the surface of the blood when it has become solid, both before and after the clot has separated from the serum. It generally contracts so as to make the upper surface of the clot smaller than the lower and concave. From the colour of this layer, and from its concavity, blood which presents these appearances is commonly said to be *buffed* and *cupped*.

The explanation given by Mr. Wharton Jones of this phenomenon is as follows:—The red corpuscles of inflamed blood have their mutual attraction much increased, so that they form themselves into rolls much more quickly than those of healthy blood do; for example, in healthy blood this change takes place in half a minute, in inflamed blood, almost instantaneously. By virtue, moreover, of the same increased attraction, the network of red corpuscles begins to contract itself, and to sink in the fluid plasma before the coagulation of the fibrine has begun: hence it leaves a layer of plasma, or *liquor sanguinis*, at the surface, colourless, as was described fully by Hewson and by Babington many years ago. (*Med. Chir. Trans. vol. xvi. 1834.*) This it is which forms the bluish sizey layer we have spoken of, and the fibrine of this forms the buffy coat.

There are many other conditions which were

formerly supposed to have a share in the production of the buffy coat. For example; inflamed blood usually coagulates more slowly than healthy blood does. This was abundantly shown by the experiments of William Hewson, whose "*Inquiry into the Properties of the Blood*" is a model of precision in language, and well deserves the place which it holds as a medical classic to the present day. Hewson well knew that "the size is merely the coagulable lymph, separated by the subsidence of the red particles, as will appear evident to any one who will, as Sydenham directs, move a finger or a teaspoon through the blood when he observes its surface becoming transparent, for in this case the blood, that otherwise would have been sizey, will now have a natural appearance, or be without size, from the red particles being prevented from subsiding." (*Hewson, Experimental Inquiries, Lond. 1772, p. 38.*)

And Hewson proved, by repeated observation, that inflamed blood is slow in coagulating. "Where there was no size," he observes, "it was found to coagulate completely in seven minutes; but in one of the others, where the size was very thick, it did not completely coagulate in less than an hour and a half." But he knew perfectly well "that something more than merely a lessened disposition to coagulate is necessary for the forming of the crust or size;" for he made the experiment of confining a portion of blood (by two ligatures) in the jugular vein of a dog, and ascertained that, though it was slow in coagulating, it presented no vestige of a buffy coat.

Increased specific gravity of the globules, and increased tenuity of the plasma, are conditions to which the formation of the buff has been ascribed; but the former is not proved, and the latter rendered improbable by the experiments of Wharton Jones and others, which tend to show that the subsidence of the red particles is promoted by whatever renders the blood more viscid. (*Wharton Jones, in British and Foreign Medical Review, April 1844; and Astley Cooper, Prize Essay, On the State of the Blood and Blood-vessels in Inflammation, Guy's Hospital Reports, New Series, vol. vii.*)

We must not overlook the important part which the *white corpuscles* of the blood take in the formation of the buffy coat. "It is generally assumed," says Virchow, "that only two of the morphological elements of blood are perceptible to the unaided eye, viz., the red corpuscles and the fibrine. But the colourless corpuscles, whenever they are present in considerable numbers, become distinctly manifest to the practised eye. They have the qualities of *viscosity*, which causes them to tend to adhere to the coats of the vessels and to each other. Hence when there exists a large number of colourless corpuscles in the blood, and death occurs as it does in ordinary cases, after a gradual weakening of the propelling force, the colourless corpuscles collect in vessels of every description into small heaps, and generally lie upon the outside of the later formed blood-clot. So also after venesection, the red corpuscles subside first, and most deeply, the white corpuscles subside less slowly, and are found in masses on the under surface of the buffy or fibrinous layer. The white clot formed of white corpuscles constitutes, not a continuous, but an interrupted layer, composed of little heaps or nodules adhering

to the under side of the buffy coat. Hence, Piorry, who was the first to observe this appearance, but completely misinterpreted it, seeing that he referred it to an inflammation of the blood itself (*hæmitis*), and established the doctrine of pyæmia upon it, termed this form of buffy coat *crusta granulosa*. It really consists of nothing more than large accumulations of colourless corpuscles." (*Virchow*, *Op. cit.* p. 155.)

So far concerning the visible properties of the blood. Now we must mention the changes in composition which have been detected by modern chemists.

We must refer to the article BLOOD for a detailed account of the Composition of this Fluid in Disease and Health. Here we must remark in starting that, so complex is this fluid, and so little at present does our knowledge penetrate into the mysteries of its composition and changes, that it is dangerous to be too positive as to the facts, and still more so, to rely so much upon any inferences derived from them as to let them form the basis of treatment.

The following summary of the changes in blood during inflammation is given by Becquerel and Rodier:—The specific gravity is always below the natural standard; the globules always diminished; the fibrine invariably increased; an increase, which commences with the invasion and declines with the subsidence of the inflammation; the amount of which is proportionate to its intensity and severity; which exists in greatest degree in acute articular rheumatism, yet exists in all cases, whether inflammation be the original disease, or whether it spring up as an accidental complication; which is not diminished by blood-letting, nor disappears until the inflammation subsides. The cholesterine and fatty matters are increased, the albumen diminished. (*Pathological Chemistry*, *Trans.* by G. T. Spear, M.D., Lond. 1857.) (See HYPERINOSIS.)

But whence the fibrine? whence the *hyperinosis*? Various views on this point will be found in articles BLOOD, HYPERINOSIS, &c., to which must be added Virchow's doctrine, that excess of fibrine does not arise from primary changes in the blood,—oxydation, for example,—but that it, as well as a superabundance of colourless corpuscles, is the work of the lymphatic glands. "That the fibrine in the blood itself," says Virchow, "is produced by a transformation of the albumen is a chemical theory which has no other evidence in its favour than the fact that albumen and fibrine have a strong chemical resemblance, and that on comparing the questionable formula for fibrine with the equally questionable formula for albumen, it is very easy to imagine how, by the abstraction of a couple of atoms, the transition from albumen to fibrine might be effected. But our being able in this manner to deduce one of the formulæ from the other, does not afford the slightest proof that an analogous transformation occurs in the blood. It may possibly take place in the body, but even then it would at any rate be more probable that it was accomplished in the tissues, and that from them the fibrine was conveyed away into the blood by means of the lymph." "*Fibrine generally, whenever it occurs in the body, extends to the blood, is not to be regarded as an excretion from the blood, but as a local production.*" "Whilst it had previously been the custom to regard the altered com-

position of the blood in inflammation, as a condition existing from the very outset, and especially denoted by a primary increase in the fibrine, I," says Virchow, "have, on the contrary, shown the causes to be an occurrence depending on the local inflammation. Certain organs and tissues have inherent in them, in a higher degree, the power of producing fibrine, and of forming the increase of large quantities of fibrine in the blood, whilst other organs are by far less adapted for its production. I have, moreover, pointed out the fact, that these organs which with especial frequency exhibit the peculiar conformation of a so-called phlogistic state of the blood with a local inflammation, are generally abundantly provided with lymphatic vessels and connected with large masses of lymphatic glands; whilst all these organs which either contain very few lymphatics, or in which those vessels are scarcely known to exist, do not exercise any influence worth naming upon the amount of fibrine in the blood." The brain contains no lymphatics, or nearly none; in inflammation of the brain the *phlogistic crisis* is not met with;—the respiratory organs are provided abundantly with lymphatics, and it is in inflammation of those organs that the buffy coat is most evident. (*Op. cit.* p. 162.) Lymph contains a *fibrinogenous* substance; a substance differing from ordinary fibrine in that it requires exposure to the air, more or less prolonged, before it coagulates. But this is a substance which is found in the blood, and which communicates to that fluid its own slowness of coagulation, especially in inflammations of the respiratory organs. The ordinary slow coagulation of inflammatory blood is thus, according to Virchow, due to the admixture of the slowly coagulating imperfect fibrine brought in by the lymphatics; and whilst, in some cases, the blood is remarkably slow in coagulating,—possibly even a week,—in others there are two coagulations, one early and one late. Altogether, with regard to *hyperinosis*, Virchow concludes that "an increased supply of lymphatic fluid is introduced into the blood, and that the matters which are afterwards found in the blood are not the products of an internal transformation of its constituents, and that therefore the original source of the fibrine must not be sought for in the blood itself, but in those parts from which the lymphatic vessels convey the increased supply of fibrine."

The above, then, are the constitutional symptoms present in a typical form of inflammation.

Section 4.—*General account of progress and results of inflammation.*—We have selected as the type of acute inflammation a case of injury by which the nutrition of some part is deranged, occurring in a patient who has irritated the injured part, and whose blood is in such a state that inflammation takes the place of repair, properly so called. All the local symptoms of inflammation are developed—heat, pain, tenderness, redness, swelling, and impaired function; and all the constitutional symptoms, as feverishness, dry skin, thirst, quick pulse, and the remarkable changes in the blood and urine that have been described. But acute inflammation can neither persist indefinitely, nor exist long without leading to important results; and the results which may ensue are these:—

The leading phenomena of inflammation are *hyperæmia*, i.e. blood-vessels turgid with blood, and *exudation*. Theoretically, it is supposed that



serum alone is first exuded, and this exudation constitutes *inflammatory oedema*. There are some inflammations of which serous exudation constitutes the most remarkable phenomenon, as the oedema glottidis, hydrocephalus, pemphigus, &c. and in which fibrinous exudation is doubtful. In all inflammations the outskirts of the inflamed part are copiously infiltrated. Thus serous exudation may be considered the first of the results or effects of inflammation.

The cases are rare, however, in which the serum is exuded without its share of that fibrine, the increased quantity of which is so constant a characteristic of inflamed blood; and when the serum with fibrine has been exuded, the latter solidifies partially, and constitutes the substance of the inflammatory swelling. The exudation and coagulation of fibrine constitute the *adhesive stage* of inflammation, or, as it is technically called, *adhesive inflammation*, which may be classed as the second effect.

Now, if the inflammation have proceeded no further, it may pass into that happiest result which is known by the technical term *resolution*, which consists in complete subsidence and recovery. It will be our duty in a subsequent section to point out the manner in which this may be promoted by art, in the cases in which it is possible, for it is not possible in *all* inflammations; some run their course without possibility of resolution. Neither is it possible in any inflammation, if the exudation have undergone certain changes. When it occurs, the local symptoms gradually vanish; and at the same time the skin becomes moist and cool, the urine is more copious, and deposits a sediment, usually brick-red or *luteous*; sleep and appetite return, pain, swelling, and tenderness vanish.

So soon as the blood is relieved of the material, whence the exudation proceeds, and local irritation is abated, the hyperæmia ceases, the exuded matters are absorbed (see *ABSORPTION*), and the patient is convalescent.

If the fibrinous part of the exudation be incapable of being quickly absorbed, it remains in a more or less solid lump, constituting *induration*, or, as the ancients called it, *scirrhus*, or in bands of *adhesions*, and undergoing a process of development into fibro-plastic cells, which result in the formation of a kind of fibrous tissue. (See *ADHESION*.)

In the indurations, thickenings, opacities, and interstitial deposits, produced by the remains of inflammation in the simpler tissues, that process approaches to *HYPERTROPHY*.

Another common consequence of inflammation is degeneration; loss of the force by which any organ maintains its own nutrition and force. Hence dilated heart, the staphylomatous cornea, and some cases of emphysema, phthisis, and kidney degeneration.

If the inflammatory hyperæmia continue, and resolution do not occur, then the exudation, instead of being absorbed, or undergoing slow development into fibrous tissue, softens down into a creamy liquid, called pus, and *suppuration* is said to occur, or an *abscess* to form. (See *ABSCESS*.) We have already described the steps by which this takes place, so far as outward symptoms are concerned, and shall hereafter have occasion to describe its minute mechanism. (See *SUPPURATION*.) Pus once formed may be absorbed, and the inflammation ter-

minate by resolution, but far more frequently, pus once formed must be discharged, and the formation and discharge seem in most cases *critical*—that is to say, after the occurrence of suppuration the disease seems to have spent itself, as though it had accomplished the end that was designed, and convalescence commences. The establishment of suppuration and discharge of pus, and the immediate subsidence of local and constitutional symptoms thereupon, is a fact which well deserves the attention of the student, as it points emphatically to the causes of inflammation, and the purpose it serves in providing an extraordinary organ of elimination, whereby noxious elements floating in the blood may be separated and expelled. Suppuration is commonly described as a third effect or result of inflammation.

When pus has been formed in the substance of an inflamed part, it is usually discharged by an opening on the surface. The process by which this opening is formed is commonly called *ulceration*, which is often described as another result of inflammation. The mechanism will be described hereafter; suffice it to say, that it seems to consist in the progressive degeneration and liquefaction of the ulcerating tissues, and of the exudation which is intermingled with them. Tissues may ulcerate which have not inflamed; yet there are few or no cases of ulceration in which some amount of inflammatory exudation does not occur.

A very constant result of inflammation is *hæmorrhage*. The capillaries, crowded with blood corpuscles—in obedience to that hyperæmic force, which is the prominent element of inflammation—burst, and blood is discharged into the interstices, if it be a solid organ that is inflamed, or from the surface, if it be a membranous surface. We have already pointed out the analogy between hæmorrhage from an inflamed mucous membrane and the natural menstrual flow. And whilst in inflammation of the substance of organs the hæmorrhage may be in minute uncertain patches, in some inflammations of mucous surfaces there is a genuine shedding of the layer, and of its capillaries likewise. This is especially the case in dysentery, and in acute cystitis. But there is no severe inflammation which may not be attended with hæmorrhage,—*æ. gr.*—pleurisy, pericarditis, bronchitis, and gonorrhœa. The blood effused in cutaneous and subcutaneous inflammations, as boil and erythema nodosum, often remains, and gives a peculiar tinge to the part after the inflammation has subsided. Hæmorrhage, then, must be reckoned as another effect of inflammation. (See *HÆMORRHAGE*.)

Inflammation may cause so intense a disturbance of the nutrition of the affected part, the capillaries may be so crammed with stagnant blood, and the exudations may so cut off the circulation by pressure or distension, that the inflamed part may lose its warmth and circulation, become livid and cold, bloody serum ooze out under the cuticle, and more or less of it die, or mortify, or perish by gangrene. This does not often happen in ordinary inflammation, unless the injury which caused it have been so intense as already greatly to have impaired the vitality, or unless the exudations poured out from a poisoned blood are venomous in themselves. Gangrene, too, may be produced by many other causes besides inflammation—in fact, inflammation does but imitate the common conditions of strangulation; yet it is usual to treat

of gangrene as another of the consequences or results of inflammation.

Lastly, inflammation may prove fatal to the life of the patient. This may happen—1st, if the organ inflamed is necessary to life, as the heart, lungs, and brain, so that life cannot go on if its functions be interfered with; 2ndly, the pain, irritation, and exhaustion may cause fatal syncope, as in the case of peritonitis and inflammation of the abdominal viscera; 3rdly, exhaustion may occur through extensive spoiling of the blood, or the drain of large and long-continued suppuration.

Section 5.—*Minute anatomy of inflamed parts.* 1st. *Morbid appearances of various inflamed tissues in various stages.*—"Without doubt," says an eminent writer, "every tissue in which inflammation takes place has properties which influence its progress; without doubt, also, some tissues are prone to particular modes of inflammation, and exempt from others." (*James, On Inflammation*, p. 266.) Accordingly, in *post-mortem* examinations of inflamed tissues, very different appearances are met with, depending not only on the stage which the disease had reached, but largely also on the nature of the tissue and organ inflamed.

"If the palm of the hand be chafed by long-continued friction, as for example in rowing a boat, the first thing that will be observed will be that the skin is redder than natural, implying that the vessels are abnormally loaded with blood, and, if the irritation be continued, the cuticle will be raised in the form of a blister. If now the loosened epidermis be artificially removed on the earliest occurrence of effusion, a scarlet raw surface will be exposed; and, on pressing the tender dermis firmly with the finger and suddenly removing the pressure, it will be found that while the redness will, for the most part, have momentarily disappeared, there will be many minute red points from which the blood cannot be expelled. This shows that while the blood is in part still free to move, there are some minute vessels completely clogged with it." (*Lister, On the Early Stages of Inflammation*, in *Phil. Trans.* for 1858, p. 645.) Here are shown the simplest morbid appearances of an inflamed part—congestion, *not wholly removable by pressure* and effusion. But all inflamed textures, almost from the commencement of inflammation, present a third morbid characteristic; viz., a change in their own physical condition, consisting in a greater or less softening or breaking down of their intimate structure. "This change commences in the first stage of inflammation, and may proceed to such a degree in the second, as to render even the bones soft and fragile, and convert all the tissues into a mere pulp. It appears to affect the uniting cellular element, more than any other, of tissues and organs; and to do so in proportion to the degree of inflammation by which it has been preceded." (*Carswell, Elementary Form of Disease*, Fasc. 1.) Microscopic investigation, however, shows, as will presently be pointed out, that it affects equally the minute structure of all tissues. Every inflamed tissue or organ, therefore, presents, in varying degrees, a combination of these three morbid changes—a breaking up of its own structure, congestion, and effusion.

A distinction has been drawn between the inflammation of the so-called 'parenchymatous' organs, and that of membranous surfaces. In the former the inflammatory exudations are necessarily

retained in the part, mingled with the inflamed textures themselves; in the latter, on the other hand, these exudations are, for the most part, poured out on the surface of the membranes, and therefore become, as it were, foreign to the inflamed texture. It will presently be seen that the term *parenchymatous* inflammation has been recently employed by Virchow in a very different sense.

The precise morbid appearances of different inflamed tissues are described at length under their several heads. (*See articles on ERYSIPELAS, SCROFULA, CARBUNCLE, DISEASES OF BONES, JOINTS, EYE, TESTIS, &c.*) It is proposed here to bring together merely the leading peculiarities, so far as is necessary for a full comprehension of the pathology of the disease.

Cellular or areolar tissue is liable to two general forms of inflammation—circumscribed and diffuse. The former has been adopted by us as the type of inflammation in general. If a part so inflamed be cut into, there ensues, from its whole thickness, an immediate copious flow of blood, still fluid, but containing numerous small reddish flocculi. The general appearances are well described by Gendrin: "If one dissects the cellular tissue round a large wound during the violence of the inflammation before suppuration, one sees that on the borders of the wound, beyond the granulations, the cellular tissue is red, hard to the touch, and yet easy to tear; it is no longer extensible or retractile; a homogeneous, opaque, and gelatiniform matter is infiltrated in its areolæ, and, as it were, incorporated with it so completely that it cannot be washed out. Pressure only squeezes out a red, flocculent, opaque serosity, often bearing with it fatty detritus. These characters are less and less marked in proportion to the distance from the wound." It is only at a considerable distance beyond the direct area of inflammation that the cellular tissue has recovered its normal elasticity. All the vessels are swollen, and more evident than in health. This is rendered especially manifest by injection, which, however, cannot be made to penetrate the focus of the inflammation. The serous infiltration extends beyond the limits of inflammatory redness, more or less in proportion to the laxity of the tissues. Mixed with it are commonly air bubbles of *post-mortem* origin. The œdema extends deeply between, and even into the substance of the muscles. "The fatty tissue is converted into a reddish or yellowish soft, semi-diffuent pulp, which, at a later period, mixes with the pus." If the inflammation is continued some days, the natural quantity of fat in the part appears to be considerably diminished. In the centre of the inflamed area, there are commonly some small extravasations of black blood mixed with the serum, and some small vessels may be seen to be ruptured. (*Gendrin, Hist. Anat. des Inflammations*, p. 14-16.)

As the inflammation proceeds to suppuration, the redness is less intense, and still less so after the pus is fully formed. "The cellular tissue is then a spongy texture, penetrated and infiltrated with puriform serosity, which soon becomes true pus." At this time, the tissues bounding the inflammation are found hardened from infiltration of fibrin, which at a still later period forms the boundary of an abscess. But, beyond this thickening, the effusion is more and more serous, gradually losing itself in the surrounding cellular tissue. (*See Art. ABSCESS.*)



If, however, resolution of the inflammation takes place, the redness gradually diminishes, the change progressing, of course, from the circumference towards the centre; and, simultaneously with the change in the circulation so indicated, the effusions are found to have disappeared, the fibrinous remaining the longest. At all stages of the inflammation, the inflamed tissue, if macerated, soon breaks down, and is reduced to a red pulp.

In severe inflammation cellular tissue very readily mortifies. This tendency forms the special morbid character of carbuncle, and is even more marked in the diffuse form of cellular inflammation. In this "the whole cellular tissue, subcutaneous and intermuscular, is found enlarged, grey, or ash-coloured, and distended with blood-coloured fluid or serum, sero-purulent or purulent matter. It is detached extensively from the several tissues which it connects in the healthy state." Between the muscles are long sinuous caverns filled with dirty ash-coloured fluid: "sloughs or mortified shreds are seen here and there hanging from aponeurotic sheaths, tendons, or even blood-vessels; and while in most cases shreds or filaments of the subcutaneous or subfascial cellular tissue are the only traces of its existence, in not a few instances the muscles are detached from the periosteum, and the periosteum from the bone. These shreds are mortified pieces or sloughs of filamentous tissue." (*Craigie, Elements of General and Path. Anatomy*, p. 37. See also Art. ERYSIPELAS.)

The appearances of areolar tissue, however, after it has been the subject of chronic inflammation, as, for example, in elephantiasis, are very different. The tissue is thick, dense, compact. It scrunches under the knife. It is hard and unyielding, and tears without stretching. If macerated, it is readily reduced to a greyish diffuent pulp. It has lost all its redness, except where it is exposed to the air. In some cases it is uniformly injected with a semi-gelatinous coagulated fluid, such as is seen forming the sides and base of old ulcers. In others this secretion is more fluid; but it is never true pus, but sero-purulent. A portion of it may have become organised into a cyst. The limits of the diseased tissue are well defined and abrupt.

If acute inflammation has supervened on a chronically inflamed part, the characters incidental to the two conditions are combined. For, besides the re-accession of congestion, the tissue is more readily torn than even under ordinary acute inflammation; and soft pulpy quagmires are surrounded by dense greyish red walls. The tissue, under these circumstances, very readily mortifies.

*Skin.*—On membranous tissues the effects of inflammation vary somewhat, but both the appearances and results have a general analogy to some or other of those observed in areolar tissue. In inflammation of the skin, the increased redness varies greatly in different diseases, both in intensity and in its mode of diffusion, whether uniform or in patches. The first effect of the inflammation is effusion of serum beneath the cuticle, as seen after the application of a blister, and in the vesicles and bullæ of certain diseases, as erysipelas, eczema, &c. At the same time, a certain amount of fibrinous effusion takes place into, and sometimes beneath, the skin itself, causing its thickening and condensation. If the inflammation is of long duration, or, still more, if it be aggravated by repeated irri-

tation, the secretion becomes purulent. Under similar circumstances the inflammation very commonly leads to ulceration, and, less frequently, to gangrene.

*Serous Membrane.*—The first change observed in an inflamed serous membrane is "diminution or loss of its transparent and glistening appearance. It becomes opaque, dull, and in some instances dry." (*Craigie*, ut supra, p. 759.) At the same time, red vessels appear, either in isolated spots or over a considerable extent. They are generally arborescent, or parted into minute ramifications. The subserous vessels also enlarge, and can be readily injected. The thickening of the membrane itself has been denied by some pathologists. But, as Gendrin points out, the blending of the serous membrane and its subserous tissue is so gradual that no actual line of demarcation can be raised. He explains that, as this subserous tissue always inflames, serous effusion into it constitutes the first stage of the thickening. "In those membranes (says he) which are easily resolved into cellular tissue, the least degree of inflammation determines infiltration in all their thickness—that is, a general thickening." This is especially the case with the arachnoid. Not unfrequently air is infiltrated in the subserous tissue. This tissue, being connected with that in the organ which the serous membrane covers, serves as a medium for the extension of the inflammation to this organ. Hence the viscera usually, but not always, partake in the inflammation of their investing membranes; and the membranes, though less frequently, in that of their viscera. "From the commencement of inflammation of a serous membrane, serosity is effused into its cavity. So long as the inflammation is moderate, and especially while it occupies only a small extent, the exhaled fluid is soon reabsorbed, and no effusion is found" (*Gendrin*, p. 70)—a condition often seen in the arachnoid, less commonly in the pleura, and least of all in the peritoneum. The effused serum, in greater or less quantity, soon becomes loaded with lymph, which either imparts to it a jelly-like consistence, or separates in the form of white or yellowish flakes. A layer of this same lymph, of greater or less thickness, invests the serous surface. As the inflammation subsides, this layer commonly becomes more or less organised: it shrinks, becomes firm, and adherent to the surface of the serous membrane, and to the similar layer opposed to it. Thus the two serous surfaces become adherent to each other over a greater or less extent; and if the inflammation has been universal, the serous cavity may be entirely obliterated.

If, however, the inflammation is of long continuance, or in a person of weakly constitution, the effusion becomes more or less purulent—a change most commonly seen in the pleura. But even then, in favourable cases, the pus is commonly bounded by fibrin, so as to constitute one or more circumscribed abscesses. This is especially the case in the peritoneal cavity.

Ulceration is not very common in serous membranes as a result of inflammation, but is occasionally seen, especially in the pleura, and less frequently in the parietal peritoneum. It may lead to the escape of the inflammatory effusions from the serous cavity.

Chronic inflammation of a serous membrane causes thickening and increased density of the

membrane itself, so that it is difficult to tear, and considerable roughness of its surface may be noticed, depending on small vascular elevations surrounded by red areolæ. The membrane in this condition often appears to have lost its power of absorption, so that for months, or even for years, a dropsical secretion is constantly accumulating in its cavity. In many cases, the membrane becomes shrivelled or puckered up—an effect frequently seen on the surface of the liver; and a similar change occasionally affects the lining membrane of the heart or its valves, and the inner membrane of arteries and veins.

*Synovial Membrane.*—The effects of inflammation on synovial are precisely analogous to those seen in serous membranes. "It occasions (says Sir B. Brodie) —1st, a preternatural secretion of synovia; 2ndly, effusion of coagulated lymph into the cavity of the joint; 3rdly, a thickening of the membrane, a conversion of it into a gristly substance, and an effusion of coagulated lymph, and probably of serum, into the cellular texture by which it is connected to the external parts; 4thly, in some instances, adhesion, more or less extensive, of the opposite surfaces of the reflected membranes to each other." (*Brodie, Diseases of Joints*, 5th ed., p. 13.) Occasionally also it leads to ulceration. It differs from inflammation of serous membranes in its greater tendency to produce thickening of the membrane itself, to such an extent that in some cases, after long-continued inflammation, not only does the vascular and thickened membrane "project into the articular cavity, covering the margin of the cartilaginous surface," but also "vascular fringes project from it into the cavity of the joint, which, in a more advanced stage of the disease, become converted into a number of membranous processes, containing a fatty matter, and a good deal resembling the appendices epiploicæ of the great intestine." (*Brodie, ut supra*, p. 75 and 77.)

*Mucous Membrane.*—"The first character of inflammation of a mucous membrane is redness, which varies from rose to blackish brown, from the lightest and most superficial injection to layers of a uniform colour, occupying all the thickness of the membrane." (*Gendrin*, p. 509.) The surface of the inflamed membrane "is slightly rugous, especially where it is covered with papillæ: these eminences are swollen and puffed up to such a degree, that they stand out separately, and cause an appearance of fissures between them." (*Gendrin*.) Inflamed mucous membranes are always thickened in proportion to their vascularity, the number of follicles they contain, and the amount and density of the subcutaneous cellular tissue. The membrane becomes opaque and soft: it easily tears. If it is very thin, a serous infiltration takes place beneath it, as in oedema glottidis; if thick, into its substance. In some cases, this effusion contains more lymph, which subsequently condenses and becomes more or less organised, causing a permanent encroachment on the mucous canal, as in the formation of stricture. Small extravasations of blood are frequently mixed with these effusions. The mucous follicles are inflamed, red, and enlarged, together with the membrane. The inflamed membrane is at first unnaturally dry, even its ordinary secretion being suspended or diminished. After a while, however, its secretion returns, increased in quantity and greatly altered in quality, being at first thin, serous, and acrid, but becoming

subsequently more and more purulent, till it at last assumes, in many instances, all the characters of genuine pus. In some special cases, lymph is thrown out, forming false membranes, as in croup, and, in a less decided manner, in dysentery.

The exudation in or beneath the membrane may, and often does, become purulent, giving rise to pustules (*pustular inflammation of Gendrin*) and aphthæ. Ulceration is a very common morbid appearance in inflamed mucous membranes, especially in the intestinal canal, where every degree of ulceration is met with, from simple softening and abrasion of the epithelium to the deep excavated ulcer with hard borders. Such ulceration especially affects the seat of the follicles. Occasionally, too, parts of the membrane are found mortified.

A mucous membrane affected with chronic inflammation is rough and wrinkled, hard and tough. Its glands are enlarged and hard, and more or less confused with the submucous cellular tissues. The secretion is but little changed from its normal character, but is excessive. If, however, the inflammation is considerable, the secretion is unnaturally serous. Should acute inflammation supervene on a membrane in this condition, it rapidly softens and breaks it down.

*Vessels.*—The results of inflammation in vessels are usually stated to be redness of the internal coat, with more or less thickening and friability. A fibrinous effusion takes place beneath and into the substance of the inner coat—an effusion which, in chronic inflammation, undergoes a fatty transformation, producing in arteries what is known as *atheroma*. Chronic inflammation is frequently followed also by calcareous deposits in the same membrane. (See *ARTERITIS*.)

*Muscle.*—The character of inflamed muscle is also softening. Its structure is weakened, so that it readily tears, and gives way under pressure. After inflammation of the heart, for example, its fibres are in many instances permanently attenuated, loose and relaxed. And a similar condition is found, in a minor degree, as the result of inflammation in the intestinal canal. On the other hand, when muscular tissue has been subjected to long-continued irritation from inflammation in its neighbourhood, its fibres may become hard and hypertrophied—a condition frequently to be seen in the bladder, when the mucous membrane of that viscus is in a state of chronic inflammation.

*Nerve.*—Inflamed nerve tissue also very early becomes soft and diffuent, so that it breaks down, and may be washed away by a gentle stream of water.

*Fibrous tissue*, being firm and but slightly vascular, does not at first present such manifest indications of morbid change. In the early stages of inflammation, though the tissue may be pink from increased vascularity, there appears to be but little swelling: it is only after some time, or under a severe attack, that lymph is found either in its substance or on its surface, causing its enlargement and roughening. At the same time the tissue itself is evidently weakened, as is shown by the friability of inflamed periosteum; by the loosening of joints whose ligaments have been frequently subjected to inflammation; and even more conspicuously in the eye, by the formation of staphyloma as a result of inflammation of the



sclerotic. In chronic inflammation of the perosteum, the effusions become ossified; and the same thing happens, but less frequently, in other fibrous tissues.

*Bone.*—The direct effects of inflammation in bone are increased vascularity, with softening and breaking down of its intimate structure, so that it crumbles under pressure and is easily cut by a knife. All its cells and cavities are enlarged, and frequently, as in caries, portions of its substance are altogether gone, leaving a cavity; and if there is any discharge from the inflamed part, it will be found to contain debris and small pieces of bone. "Perhaps the most striking instance of softening in inflammation (says Mr. Paget)—and it is the more so, because the softening probably precedes the other evident signs of inflammation—is to be found in bones. The change depends partly on an absorption of the earthy matter of the bone, this constituent being removed more quickly, and in greater proportion, than the animal matter; but the entire material of the bone is softened." "The most striking change is a more or less extensive and wide separation of the concentric laminae of the walls of the bone, so that the longitudinal section of the enlarged wall appears composed of two or more layers of compact tissue, with a widely cancellous tissue between them. In the first periods of the disease, the cancellous tissue between the separated layers of the wall has wide spaces, which are usually filled with a blood-coloured medulla; but this tissue, like the often coincident external formation of new bone, appears to have a tendency to become solid and hard, and its fibrils and laminae may thicken till they coalesce into a compact ivory-like substance, harder than the healthy bone." (*Paget, Lect. v.*) So that the effect of chronic inflammation is *enlargement with induration*; the bones being frequently, at the same time, as Mr. Stanley points out, "indurated, enlarged, and altered in their form—probably from the pressure they have received in an early stage of the disease when their texture was softened: thus the head of the femur becomes broad and flattened, and of irregular figure, with corresponding changes in the acetabulum." (*Stanley, On Diseases of the Bones, 1849, p. 23.*)

*Viscera.*—The tissues entering into the formation of the parenchymatous viscera, and their morbid appearances in inflammation, are so varied that any detailed account of their changes would exceed our limits, and would be, perhaps, superfluous. Suffice it to say that, besides the morbid changes in their areolar and mucous tissues, the special texture of the organs themselves undergoes a process akin to disorganisation. Thus, for example, in inflamed glands, as the breast or liver, the ducts are enlarged, the lobules become greyish red and soft, and unnaturally distinct and separated, so that they may be readily torn and crushed by the fingers. "Such softening also may be found in the lungs: the peculiar brittleness and rottenness of texture, which exist with the other characters of hepatisation, are evidently due to changes in the proper tissue more than to incorporation of the products of inflammation." (*Paget, ut supra.*)

The appearances and results of inflammation in *non-vascular tissues* are of singular interest, because in them the three essential characters, viz., structural changes, hyperæmia, and effusion, may

be observed separately. While the exudation and the structural changes proper to the minute texture of the parts take place in its tissue, the hyperæmia is round and beyond it. In inflammation of the *cornea*, there is partial redness of the adjacent sclerotic, and in the cornea itself at first haziness, more or less complete, involving a portion or the whole of the thickness of the cornea, and accompanied by a granular condition of its surface. Subsequently, if the inflammation be sufficiently prolonged or severe, it leads to ulceration of one or both surfaces. Similarly, in inflammation of *articular cartilage*, the congestion is in the vessels of the adjacent bone. The change in the cartilage is either simple ulceration, or a change into a fibrous, velvety texture. The ulceration may commence either on the free surface or the deeper portion adjacent to the bone. Within less than fifteen years ago, these changes were ascribed by pathologists to the action of the adjacent vascular tissues, either the synovial membrane or the bone; and it will presently be seen that it was the minute study of them by Dr. Redfern that paved the way to a better comprehension of the true nature of inflammation. (See *JOINTS, DISEASES OF.*)

Such, then, are the general characters and naked-eye results of inflammation in various tissues.

Next let us come to the consideration of

2. *Microscopical Observations and Experiments on the Changes of the Blood-vessels.*—"There are (said a learned Professor many years ago) two hypotheses, which at present divide the opinions of pathologists, respecting the state of the capillary vessels affected with inflammation." According to the first of these hypotheses, the inflamed vessels are in a state of increased action; according to the second, they act with less force than the trunks from which they are derived. (See *Thomson, On Inflammation, p. 64.*)

The first of these opinions, according to Dr. Thomson, was suggested by the views which Stahl took of the animal economy, and his ideas respecting the tonic or vital action of the capillary vessels. The doctrine, however, was more particularly insisted upon by his disciples and followers, especially De Gorter. The doctrine which supposes the action of the inflamed vessels to be diminished, or to be proportionally less than that of the trunk or trunks from which they are derived, was, as far as Dr. Thomson can learn, first stated by Vacca, an Italian physician, in a small treatise on inflammation, published at Florence in 1765, entitled "*Libro de Inflammationis morbosæ, quæ in humano Corpore fit, Naturâ, Causis, Affectibus, et Curatione.*"

Dr. Wilson Philip, about the year 1800, endeavoured to ascertain, by means of the microscope, the state of the vessels in the various stages of inflammation, both in the warm and cold blooded animal. It was observed by Mr. James, that "analogies between the higher and lower orders of animals, the chief subjects of these experiments, cannot be deemed conclusive." (*On some of the General Principles of Inflammation, p. 29; Lond., 1821.*) And subsequently Dr. Macartney went so far as to deny the occurrence of inflammation in all the lower animals, including the reptiles. (See *Macartney, A Treatise on Inflammation, 1833, p. 5.*) [But all the evident phenomena of inflam-

mation in these animals are, as will presently be shown, so precisely similar to those observed in man, that there is no reason for questioning the similarity of the vascular changes.] From his observations, Dr. Philip came to the conclusion that the state of the smaller vessels in an inflamed part is that of preternatural distension and debility. "In short (he says), inflammation seems to consist in the debility of the capillaries, followed by an increased action of the larger arteries. The motion of the blood is retarded in the capillaries, in consequence of the debility induced in them; an unusual obstacle is thus opposed to its motion in the arteries preceding them in the course of the circulation, which are thus excited to increased action."

Respecting the inference made by Dr. Philip, that the circulation is slower in inflamed than uninfamed arteries, Dr. J. Thomson states: "From a number of experiments which I have made, I am inclined to believe that a diminished velocity of the blood in the capillary branches is by no means a necessary, constant, nor even the most common effect of incipient and moderate degrees of inflammation." (P. 75.)

In order to reconcile this difference in the statements made by the only two writers who had then examined this subject by experiment, Dr. (now Sir Charles) Hastings repeated their microscopic investigations. [It may here be remarked that all the early microscopic reports are more or less vitiated by two circumstances: 1st, the want of knowledge, at that time, of the intimate structure of the three orders of vessels; and 2ndly, the then prevailing theory, to which all observed facts were made more or less to bend, that all vital processes were effected by, and were therefore in direct relation to, the action of the vessels.] Dr. Hastings's conclusions were, "that certain stimuli applied to living parts produce an increased velocity of the blood's motion, and a contraction of the blood-vessels. *During this state of excitement, the part affected is so far from giving anything like the appearance of inflammation, that the size of the vessels is diminished, and the part paler.* But, if the stimulus be long continued, or increased in power, the small vessels, which, in the natural state, admit only of one series of globules, become so dilated as to allow an accumulation of a much less fluid and redder blood in them, which loses its globular appearance, and *moves much more slowly* than that which previously passed through the vessels. *The part now appears inflamed.* If the stimulus be removed, the vessels do not soon regain their original state: time is necessary to allow them to recover their contractile power. If the stimulus which produces the inflammation be of a very acrid nature, debility of the vessels is frequently produced without any previous excitement. The blood in all the smaller vessels becomes very red, circulates very slowly, and in some vessels stagnates." (*Hastings, On Inflammation of the Mucous Membrane of the Lungs, &c.*, p. 90-92.)

Dr. Hastings therefore considered that the term inflammation should be confined to that stage of the process in which the blood was stagnant or nearly so. And with respect to the conclusion drawn by Dr. Thomson from his experiments, that inflammation in moderate degrees consists in an increased action of the vessels, Dr. Hastings argues that this belief arises from his having denominated that a

state of inflammation which ought not to be so called, but is only that temporary excitement of the capillaries, generally preceding their debility, which is inseparable from inflammation. (*Hastings*, p. 98-101.)

Mr. J. W. Earle adopts nearly the same view. He asks "whether either of the variations in the state of the capillaries, and in the flow of the blood, which have been described by Dr. Thomson, was accompanied with an effusion of lymph or pus, or by mortification, which are the usual attendants upon the state of inflammation, and by which the existence of that condition might have been distinctly recognised." He deems the evidence adduced by Dr. Philip a complete proof that *no sign of inflammation can be detected while the velocity of the blood's motion is increased, but that inflammation is immediately recognised when it is retarded.* (*Lond. Med. Gazette*, vol. xvi. p. 40.)

Mr. J. W. Earle quotes from M. Gendrin the following particulars respecting the nature of the process of inflammation: "If (says M. Gendrin) we continue the irritation of the tissue, the blood flows towards the point irritated. The globules of the blood are then seen crowding into the capillaries, which are dilated, and which all carry the blood towards the point irritated. This movement is so evident that one need only place a red-hot needle upon the course of the minute vessel, in which the flow of the globules has been distinctly noticed, in order to see them instantly *retrograde* towards the point irritated. The capillaries around this point dilate, and are seen to multiply themselves. The globules arrive; they are crowded together; their motion is retarded, and at length suspended. They *revolve* upon themselves, and at last remain entirely at rest." (See *Gendrin, Hist. Anat. des Inflammations*.) This drawing of the globules from all sides towards the part irritated is one of the most important facts in the phenomena of the circulation during inflammation.

Mr. Travers, who made a series of observations in order to compare the phenomena resulting from ordinary irritation with those observed during the healing process of wounds, also traced the relation of inflammatory effusions to the varying conditions of the circulation. He pointed out especially the necessity of regarding all the observed phenomena as mutually dependent. "Some (he says, speaking of the condition of stasis) have represented this remora as mechanical, others as chemical, others again as a nervous phenomenon. To constitute inflammation, it must be all or neither; for the mechanical, chemical, and vital properties are all implicated and altered by inflammation. With whichever we commence, the remaining changes are unavoidable." (*Travers, The Physiology of Inflammation, &c.*, 1844, p. 4.)

Mr. Wharton Jones, who, partly from his own observations, and partly aided by the writings of Virchow, Vogel, and Henlé, described the principal microscopic appearances more at large than any of his predecessors in this country, having employed for the purpose of irritation a strong solution of salt, fell into the error of ascribing the stasis and its accompanying serous exudation to exosmosis, caused by the salt. "It appears to me (he says) that the adhesion of the red corpuscles to the walls of the vessels, and to each other, on which the stagnation depends, can be attributed only



to a change in the state of the blood itself, produced by the action of the salt—a change consisting in inspissation of the plasma as regards its albuminous and fibrinous constituents." He was led into this belief from the fact that the adhesiveness of the corpuscles, out of the body, is increased by the addition to the blood of albumen, gum, &c. He continues: "The mode in which the salt acts in producing inspissation of its plasma I consider to be principally by withdrawing water from the blood by endosmose." (*W. Jones, On the State of the Blood and Blood-vessels in Inflammation*, Guy's Hosp. Reports, New Ser., vol. vii.) But the error involved in this purely mechanical view is fully exposed by Mr. Lister, who observes that not only are the effects of other irritants, which cannot act by endosmose, as chloroform, mustard, and especially mechanical and chemical irritation, precisely similar to those of the salt; but also the unbroken web of the frog's foot is only with great difficulty permeable by liquids. Some substances, as chloroform, which produce rapid stasis, with well-marked cohesiveness of the corpuscles, actually diminish or entirely destroy this cohesiveness when added to the blood out of the body. "That the effect on the blood within the vessels of a part inflamed by chloroform is secondary to a change in the tissues is further proved by the circumstance that abnormal accumulation of slowly-moving corpuscles may last for hours together without stagnation, as a consequence of the application of this irritant for an extremely brief period. Long after all the blood which could possibly have been directly acted on by the chloroform has left the vessels, successive fresh portions continue to experience precisely similar changes in passing through the irritated area." (*Lister, On the Early Stages of Inflammation*, Phil. Trans. Part ii. for 1858, p. 663.)

Kaltenbrunner, in fact, long ago pointed out the relation of the degree of inflammation and of its accompanying fever to the intensity of the local irritation. He showed that the first effect of a drop of alcohol applied to a frog's foot was merely acceleration of the circulation—*active congestion*. If the dose of alcohol be increased, the congestion increases, and extends over a larger space, till at length points of stagnation appear. And if the dose be still further augmented, not only does the inflammation extend, but the whole circulating system partakes in the excitement. The circulation in the web of the opposite foot is as much accelerated as in the foot irritated. "If the word congestion had not a local meaning (says he), we might call fever a general congestion." (*Kaltenbrunner's Répert. Gén. d'Anatomie*, tom. iv.)

Mr. Paget, in comparing and confirming previous observations, endeavoured to set aside the objection founded on the circumstance that the frog, on which most of those observations had been made, is a cold-blooded animal, by making his experiments on the bat's wing. He found only a few small and unimportant differences, depending chiefly on the peculiar arrangement of the vessels, which have much freer anastomoses than in the frog's foot. (*Paget, Lectures on Inflammation*.)

Not long after this, a very important addition to the knowledge of the subject was made by Dr. H. Weber, of Giessen, who discovered that complete stasis, in all respects identical with that observed in the ordinary experiments, may be induced in the frog's foot by irritation, *after the entire arrest*

*of the circulation* by ligature (*Weber, in Müller's Archiven*, 1852); and Schuler afterwards ascertained that the same thing occurs in an amputated limb. (*Würzburg Verhandlungen*, 1854.)

There is now such a general agreement as to the principal phenomena of the circulation in inflammation, that a general account of them, culled from the works of the later writers, may be given.

For the purpose of observation, various methods of irritation have been employed:—mechanical violence; the galvanic shock; desiccation of the tissues; dry heat; the actual cautery; hot water; intense cold; and numerous chemical irritants, such as alcohol, caustic ammonia, a strong solution of common salt, carbonic acid, acetic acid, tincture of iodine, chloroform or its vapour, oil of turpentine, mustard, capsicum, tincture of cantharides, and croton oil—anything, in short, which impairs the integrity of the tissues.

If, then, the web be irritated by any of these means, the first effect observed is, *generally*, constriction of the small arteries and veins of the part. The amount and duration of this constriction (which of course does not affect the non-muscular capillaries) is very variable, depending on the nature of the irritant and the degree of irritation. Mr. Wharton Jones mentions four varieties of it. "1st. Constriction may take place slowly, and be slowly succeeded by the normal width." This is the effect of sulphate of atropia. "2nd. Constriction may quickly take place, and be soon succeeded by the normal width, or a width not much exceeding the normal," as after the application of moderate cold, mechanical irritation, and galvanism. "3rd. Constriction either does not take place at all, or it rapidly yields to great dilatation," as is seen after a strong solution of chloride of sodium, or a solution of sulphate of copper mixed with vinum opii, or spirit of wine. "4th. Dilatation slowly yields to permanent constriction." This is the effect of concentrated sulphate of copper. (*Guy's Hosp. Rep.* vol. vii. p. 8.) The constriction produced by the actual cautery lasts for several hours. But that after many stimuli it is very slight and transient, is proved by the fact that it appears to have been altogether overlooked by so careful an observer as Mr. Travers, who not only makes no mention of it anywhere, but distinctly says: "The first effect of a drop of stimulant fluid or of a wound upon a transparent web is to arrest the circulation of the part: the vessels are dilated, and in proportion their fulness is increased, and their pink colour heightened." (*The Physiology of Inflammation*.) And Virchow says: "In small vessels with few muscular fibres, it often seems as if the stimuli induced no contraction, in consequence of the extreme rapidity with which a state of relaxation is seen to set in." (*Virchow's Cellular Pathology*, by Chance, 1860, p. 119.)

The veins appear in general, according to Paget, to contract less than the arteries, and in the frog often not at all. The same observer states that, after constriction has yielded to dilatation, a higher stimulus than before is requisite to reproduce it. In some of Mr. Lister's experiments, however, water of the same temperature (100°), produced constriction of the same vessels again and again (see *Lister*, ut supra, p. 659)—a difference due, perhaps, to the more rapid exhaustion of irritability in the warm-blooded animal.

Some of the early observers of these phenomena

stated that the flow of blood was accelerated during constriction; but this is now well known to be an error. "Nor am I sure (says Mr. Paget) that I have ever seen what is commonly described, the acceleration of the flow of blood in the contracting vessels." (*Paget*, Lect. i.) "When the constriction of an artery is taking place (says Mr. W. Jones), the flow of blood is sometimes seen to become at first retrograde, sometimes at once interrupted. The retrograde movement seems to be owing to the constriction of the artery taking place from the branches towards the trunk." (*Supra*, p. 17.) The opposite idea appears to have arisen from a hasty application of the physical principle of the adaptation of the velocity of a stream to the calibre of its channel, and perhaps from a comparison of the relative rapidity of the stream in the constricted arteries and the non-constricted capillaries arising from them, in which it was, of course, comparatively slow.

After a longer or shorter interval, then, this constriction gives way, and is succeeded by actual dilatation of *all* the vessels, arteries, veins, and capillaries. And such dilatation, unlike the preliminary constriction, is a constant and necessary phenomenon of inflammation; for "although (says Mr. Paget), in certain parts, as the cornea, and vitreous humour, and the articular cartilages, some of the signs or effects of inflammation may be found where there are naturally no blood-vessels, yet I doubt whether these ever occur without enlargement of the vessels of the adjacent parts, and especially of those vessels from which the diseased structure derives its natural supply of nutritive material." (*Paget*, ut *supra*, Lect. i.) The dilatation always extends some way beyond the actual focus of the inflammation. Its amount is various. "It may be hardly perceptible, or it may increase the vessels to twice or three times their natural diameter." (*Paget*.) In consequence of this general enlargement, several capillaries which previously contained only the fluid portion of the blood are now able to admit red corpuscles, and thereby are rendered visible. This has given rise to a statement, by Kaltenbrunner and others, that new vessels are formed. But although new vessels arise in the subsequent organisation of inflammatory effusion, all modern observers agree that none are formed so long as the inflammation lasts.

The vessels, at the same time, not unfrequently undergo two other changes, secondary to this dilatation. 1st. They are commonly enlarged in all respects: in other words, they are elongated as well as dilated, and thus are thrown into curves, and those which are naturally curved become more tortuous. This is readily seen in an inflamed conjunctiva in man. 2nd. The other change is the formation, in the small arteries, of aneurismal dilatations, involving the whole, or a part only, of the circumference of the artery. "All the varieties of form which we find in the aneurisms of the great arteries are here found in miniature. This may (Mr. Paget suggests) be a mere accident to the inflammatory process, due to some weakening of the vessels;" or it may perhaps be "a disturbed effort for the production of new blood-vessels by dilatation or out-growth."

Of course, to this dilatation of the vessels are to be ascribed the redness and much of the swelling of an inflamed part. But Mr. Paget points out that the redness is always out of proportion to the

enlargement of the vessels, being increased by two other causes—viz. crowding together of the red corpuscles, and sometimes an "oozing of the colouring matter of the blood into the interspaces between the corpuscles, and through the walls of the small vessels into the adjacent tissues." Some of the dilated small vessels may, indeed, burst—in many inflammations they always burst—either in this or the next stage, and then hæmorrhage into the tissues is added to the other changes.

The dilatation of the vessels is always accompanied by an immediate and great acceleration of the flow of blood *towards and through* them (*active congestion*, or *determination of blood*, of authors), so that the inflamed part not only contains, but is also traversed by, an increased amount of blood. But, in a space of time, short in proportion to the intensity of the irritation, the flow of blood is again retarded, without, however, any further change in the calibre of the vessels, which continue fully dilated. This retardation is coincident with a marked change in the properties of the blood itself, manifested by a tendency in the corpuscles to adhere to each other and to the sides of the vessels. In a healthy state of the circulation, the corpuscles keep in the centre stream of the capillaries, where they cannot be individually distinguished, in consequence of the rapidity of the flow. But now they lag behind, as though the liquor sanguinis was draining off from them, as Mr. W. Jones expresses it; and, becoming "applied to each other by their flat surfaces, with their diameters more or less nearly at right angles to the axis of the vessel," they accumulate in gradually increasing quantity, encroaching more and more on the marginal streams of the liquor sanguinis, becoming more and more sluggish in their course, oscillating backwards and forwards, till at length they stagnate, entirely blocking up the streams of the invaded capillaries. Then is seen the condition known as capillary stasis, or stagnation. Whole groups of capillaries, more or less extensive in proportion to the severity of the inflammation, are thus blocked. From the capillaries the stagnation extends into the small veins and arteries. "The stagnant red corpuscles are so closely agglomerated together that they present the appearance of a uniform red mass." (*Wharton Jones*.) The condition of the neighbouring parts is thus described by Mr. Paget: "As one surveys an area surrounding the part in which the blood is stagnant or moves slowly, one sees the streams increasing gradually in rapidity; and often, when there is stagnation in a considerable artery, one may see the blood above or behind it pulsating with every action of the heart, driven up to the seat of stagnation, and then carried off by the collateral branches; while, in the corresponding veins, it may oscillate less regularly, delaying till an accumulated force propels it forward, and, as it were, flushes the stream. Again, in the same area, or in the area beyond it, one sees the full and rapid and more numerous streams of active congestion, and this may extend over a space altogether uncertain." (*Paget*, Lect. i.)

Thus, at the very height of the inflammation, there are always to be seen some capillaries pervious, which the blood is traversing with extreme rapidity. This is more manifest in the bat's wing than in the frog; hence (says Mr. Paget) "my impression is, that in strong and active warm-blooded animals, stagnation of blood would be



found in only the most severely inflamed parts; in others, I think, retardation alone would exist." (*Paget*, Lect. 1.) It is to be observed that, except in mortified parts, the stagnant blood never coagulates in the vessels.

Now, from the above account, it is clear that there is no necessary and constant relation, in the nature of cause and effect, between the mere size of the vessels and the rate of circulation. For it has been pointed out by Mr. W. Jones that the same artery may frequently be seen of different calibres in different parts of its course; and Mr. Lister states that he has, when watching an uninjured artery, seen the rate of its circulation change without the slightest change in its size. And the inability of mere quiescence of the blood to cause the observed aggregation of red corpuscles in the vessels is also noticed by Mr. Lister, as proved by the fact that in an amputated limb, or in one whose circulation has been entirely arrested, such aggregation only takes place in the area of direct irritation. (*Lister*, ut supra, p. 668.)

The aggregated corpuscles adhere to one another with more or less tenacity in proportion to the degree of irritation. The power of this mutual cohesion is well shown in a case figured by Mr. Lister, in which is seen "a rouleau of red corpuscles projecting from a stagnant mass into a vein through which the blood was flowing rapidly; yet the rouleau, though its free end was moved to and fro by the current, was prevented by the mutual adhesiveness of its corpuscles from being broken up or detached." Thus it was evident (he continues), "that, in the capillaries of the space, the red corpuscles had an abnormal tendency to adhere both to the walls of the vessels and to one another, and were on *this account* accumulating and sticking within them." (*Lister*, p. 662.) Yet Mr. Paget states that he has never seen anything to support the belief that their natural cohesiveness is increased. (*Paget*, Lect. 1.) And Mr. Lister, after carefully testing the point, by comparison, out of the body, of blood from an inflamed part with healthy blood, came to the same conclusion. "Numerous observations (he says) have tended to establish that, on the one hand, the red corpuscles in the vessels of a perfectly healthy part are free from adhesiveness; and, on the other hand, the adhesiveness which they acquire in inflammatory congestion, though varying in proportion to the degree of irritation, is never greater than occurs in the blood of a healthy part, *when withdrawn from the body*" (p. 669). The persistence of stasis after death affords a mode of determining the previous existence of inflammation as distinguished from mere active congestion, all signs of which may disappear.

The behaviour of the colourless corpuscles during the above changes was first described by Dr. C. J. B. Williams (see his *Principles of Medicine*), but attracted little notice till Mr. W. Jones directed attention to it. He observed that, as the circulation flagged, these corpuscles were to be seen in unusually large numbers rolling sluggishly along the sides of the vessels, and that their accumulation would sometimes obstruct the channel of a small vessel, or choke its entrance. Mr. Paget, however, doubted the accuracy of the observation, for not only had he never observed any accumulation of these corpuscles in the vessels, either during life or after death, but he had been quite unable to

satisfy himself that the blood drawn from an inflamed part contained them in unusual quantity. Mr. Lister, however, entirely confirms Mr. Jones' observation, and even goes beyond him. "In most cases (he says) in which irritation is applied to the web while the blood is circulating through it, *one of the earliest* abnormal appearances is that of white corpuscles adhering in large numbers to the walls of arteries, capillaries, and veins, as first described and accurately figured by Dr. Williams." (*Lister*, p. 670.) Again he says, "Not unfrequently red corpuscles are stopped in their course and adhere among the white ones, and sometimes, especially in young frogs, capillaries become obstructed throughout their entire length by white corpuscles alone, and, when this is the case, they are apt to escape notice from the inconspicuous character of their contents." "Thus the affection of the white corpuscles is in all respects strictly parallel to that of the red discs, while the greater adhesiveness of which the former are capable renders the facts regarding them more obvious and unmistakable."

It has been already stated that the time required for the production of the above changes is very variable. In some they occur with extreme rapidity. Mr. Lister mentions that a drop of chloroform, which may be seen to evaporate wholly in two or three seconds, induces all the phenomena of stagnation in that very brief period. And, on the other hand, the effects may last many days, as in another case mentioned also by Lister, in which he observed the "capillaries of an area which had been pinched still transmitting languid streams of blood, containing great excess of corpuscles, several days after the injury had been inflicted." The variations in time appear to be regulated not solely by the degree of irritation employed. Dr. Schuler endeavoured to ascertain the influence of variations in the composition of the blood; and he succeeded in showing that the more liquid the blood, the more rapidly was stasis induced by the same degree of irritation; and *vice-versâ*: in other words, the time required for the production of stasis was in proportion to the facility with which the liquor sanguinis transuded through the walls of the capillaries. (*Schuler*, in *Constatt's Jahresbericht*, 1854, vol. ii. p. 101.)

The return of the vessels to the normal state during resolution is effected in a simple manner. If stagnation has not existed long, resolution easily occurs. The corpuscles begin to oscillate, and are readily detached from each other, so that at every stroke of the heart some are forced into neighbouring vessels, and, sometimes, all those in one vessel are thus set afloat *en masse*. If stagnation has existed a long time, the corpuscles do not at first separate individually, but the masses, "having become loose in the vessels, and being at every stroke of the heart made to protrude a little into the neighbouring vessels into which they open, pieces of them are detached in the form of irregular flocculi, which are carried along in the stream of circulating fluid, where the red corpuscles appear to be at last separated from each other." Sometimes this process of breaking up is going on at one part, while fresh stagnation is occurring at another. And the vessels may be observed still for some time to contain an unusual quantity of colourless corpuscles accumulated on the inner surface of their walls; and some red ones also continue here and there

adhering to the walls, pale and distended. "It is some time before the dilated vessels fully recover their usual calibre." (*Wharton Jones, Rep. in Br. and For. Review*, 1844, p. 269.)

But the inflammation, instead of ending in resolution, may lead to mortification. In that case, "in the part which has mortified there is no longer any appearance of blood and blood-vessels. Next the mortified part the web is red from vascular injection. Under microscopical examination, the blood is seen to be completely stagnant in some of the injected vessels, oscillating in others. In the arteries leading towards the mortified part, blood flows as far only as to the first considerable branches above. By these the stream passes off, and from them the capillaries and veins bordering on the slough into which blood may still enter, receive the blood. In the part of the web bordering on the slough there are spots of extravasated blood. A slough of the web having separated, the network of vessels at the margin of the living part eventually comes to present all the characters of a capillary network. The larger vessels which have been truncated by the mortification become obliterated as far up as their connection with some important branch above. As this goes on, the blood contained within vessels which become obliterated disappears, being extravasated and absorbed." (*W. Jones, Guy's Hosp. Rep.*, vol. vii. p. 50.)

As has been already suggested, there is every reason to believe that what is seen in cold-blooded animals "represents fairly the state of inflamed parts in all warm-blooded animals." "I am quite conscious (says Mr. Paget) that the most one can see with the microscope is but a faint picture of such inflammations as we have to consider in practice—that it is very trivial in both its appearance and its results. Still it is a picture of a disease of the same kind; and a miniature, even faintly drawn, may be a true likeness. Besides, all that can be observed of the complete process of inflammation in man is consistent with what we can see in these lower and lesser creatures. The bright redness of an inflamed part testifies to the fulness of its blood-vessels, and the crowding of the red corpuscles; the occasional duskiess or lividity of the focus is characteristic of stagnation; the throbbing in the part, and about it, and the full hard pulse in the ministrant arteries, are sure signs of obstruction to the passage of blood; the gush of blood on cutting into the tissues near an inflamed part, or in bleeding from one of their veins, tells of the determination of blood in these, and of the *tension* in which all the containing blood-vessels are held." (*Lect. I.*) Dr. Philip points out this great determination of blood towards the part. "In inflammatory affections of the jaw and head (for example) a greatly increased action of the maxillary and temporal arteries is readily perceived by the finger." (*On Febrile Diseases*, part 2, introd.) And it is strikingly illustrated by Mr. Lawrence's experiment. In a case of inflamed hand and forearm, he opened a vein in each arm at the same time. Three times more blood flowed from the vein of the inflamed limb than from that of the sound one in the same period. Finally, the actual condition of the capillaries in an inflamed part after death was observed by Mr. Lister "in the brain of a man who had died of tetanus, complicated with incipient meningitis; the *post-mortem* appearance of the latter being maculiform congestion of the pia mater.

Having stripped off a portion of the affected membrane," Mr. Lister "applied the microscope to one of the affected spots, and found that all the minute vessels were filled with crimson blood, while those of the surrounding parts were comparatively pale. It was evident that the red corpuscles were, in the former, so closely crammed together as to produce the appearance of a uniform mass, while in the latter they were present only in their usual proportion to the liquor sanguinis." (*On the Early Stages of Inflammation*, p. 646.)

3. *On the Changes in the Exudations and in the Ultimate Organic Elements or "Cells."*—Our present purpose is to describe phenomena, and not the theories by which they are explained. Yet it may be convenient to state here, that the most modern pathologists differ entirely in their explanations of the most cardinal facts. For instance, exudations may be regarded as poured out from the blood; or they may be regarded as extracted from it by the action of the tissues among which the blood circulates. The cell growths, and new tissue formations of the "adhesive inflammation," may be regarded as products of the liquids which are exuded, and in which they may be supposed to arise after the manner of the earlier cell theories;—or, with Virchow, we may regard them as outgrowths and offshoots from the pre-existing tissues;—not as arising from solidification of a liquid blastema, but produced by proliferation and multiplication of existing cells. Again, this latter theory may be held by those who accept Dr. Lionel Beale's doctrines of the growth and constitution of organic tissues. He discards the "cell" doctrine. "There are many objections," he says, "to the use of the term 'cell' as indicating the elementary unit of structure." The fatal objection is, that in many cases no cell or vesicle can be shown to exist. All tissues consist of living active growing *germinal matter*, which is *forming*; and of *formed material*, which has been produced by the activity of the germinal matter; and surrounds it. In the cases in which real "cells" exist, the nucleus represents the active living germinal matter; and the cell-wall the *formed material*. Whether, therefore, the word "cell" be used or not, it will be understood that it is the living growing portion of tissue which is signified.

The exudation, which has been said to constitute one of the essential characters of inflammation, may be either cast out on the surface of the inflamed tissue, or infiltrated in its substance. In both cases the effusions are identical, but in the former, being isolated from the textures, they may be more readily examined.

"The materials that may be effused from the blood-vessels of the inflamed parts (says Mr. Paget) are chiefly these:—serum—blood—lymph, or inflammatory exudation especially so called—and mucus." (*Paget, Lect. ii.*)

An effusion of serum alone is a rare effect of inflammation, and generally it is characteristic of only the lowest degrees of the disease. Among the instances of it are, probably, the cases of the chronic forms of hydrops articuli, some forms of hydrocephalus, and some cases of inflammatory œdema of the mucous membrane, as in the œdema of the glottis, and chemosis of the conjunctiva. Mr. Paget mentions two forms of what is usually regarded as serous effusion: one, a fluid containing fibrine in small quantities, which may remain fluid



in the body for days, or even weeks; and another which, "though it does not coagulate, contains a material capable of organisation into cells;" as the fluid of herpes or eczema.

Blood is never effused except from rupture of vessels. But the exudations are occasionally stained by imbibition of the dissolved colouring matter of the blood. These "blood-stained effusions are among the evil signs of the products of inflammation during typhus, and other low eruptive fevers, in syphilis, and scurvy." (*Paget, ut infra.*)

Lymph, also, varies greatly in its properties. There are, according to Mr. Paget, two chief forms of lymph, which he denominates the *fibrinous* and *corpuscular*. "To the fibrinous variety belong, as typical examples, all the instances in which inflammatory lymph, effused as a liquid, coagulates into the solid form." "In the corpuscular variety, no coagulation of lymph, in the ordinary sense of the word, takes place; but corpuscles form, and float free in the liquid part. But, in a large number of examples of inflammatory lymph, the fibrine and the corpuscles occur together, mixed in various proportions, the one or the other preponderating." Now, according to Mr. Paget, the nature of the effusion, whether fibrinous or corpuscular, determines its destiny: the fibrinous having a tendency to become developed into tissue—the corpuscular, to degenerate into pus. "In other words, the preponderance of fibrine in the lymph is generally characteristic of the adhesive inflammation; the preponderance of corpuscles, or their sole existence, is an essential feature of the suppurative inflammation. And the conditions which determine the production of one or the other variety of lymph seem to be three:—1st. The state of the blood; the power of which is evident, in that the same material may be exuded in many inflamed parts in the same person; in that this material may exhibit peculiar characters correspondent with those of the blood itself; and in that, in different persons, an inflammation excited in the same tissue, and by the same stimulus, will produce different forms of lymph, corresponding with differences in the blood. 2nd. The seat of the inflammation, and the tissue or organ affected, of which the influence is shown by cases in which, with the same condition of blood, different exudations are produced in different parts or organs. 3rd. The severity, and acute or chronic character, of the inflammatory process, according to which the product deviates, more or less, from the character of the natural secretion or blastematous effusion of the inflamed part."

An increased secretion of mucus has not been so generally recognised as an inflammatory exudation. Mr. Paget indeed says, "I am disposed to think that we should not draw a strong contrast between the inflammatory products of mucous membranes and those of serous membranes, and other parts, except in relation to the material with which, in the several cases, the inflammatory lymph is mixed." But Virchow distinctly points out the intimate relation between the secretion of mucus and that of lymph. After referring to the fact that mucous membranes do not generally furnish fibrinous exudation, he says, "In the whole series of the so-called gastric inflammations we find, especially at the commencement of the process, scarcely anything more than an abundant secretion of mucus. If, therefore, we still call these catarrhal inflammations inflam-

mation, we must admit that there may exist a mucous as well as a fibrinous exudation in inflammation, and that the inflammations with a mucous exudation form a special category, appertaining to certain organs." And in the inflammation of certain mucous membranes he traces the passage, as it were, of one secretion to another, fibrinous inflammations arising, "as in aggravation, out of mucous ones." In ordinary croup, for example, the secretion is at first only mucous or muco-purulent. "Not until after a certain lapse of time does the fibrinous exudation appear, and then it does so in such a manner that we can trace the transitions in the same false membrane, and see that a certain portion is manifestly mucus, another manifestly fibrine, whilst in a third part it can no longer be affirmed with certainty whether the one or the other is present. Here, therefore, *both substances appear as substitutes for one another.*" (*Virchow, Cellular Pathology, 1860, p. 390-1.*) The relation of mucus to inflammatory exudation will be still further illustrated presently.

It appears, then, that the inflammatory effusions ordinarily recognised are two: serum and fibrine—but to these must be added, under certain circumstances, mucus. Mucus is both an exudation and an overgrowth; and when we speak of *mucus*, which is commonly understood to be the product of a *moist* epithelial membrane, we must not forget *dry* products of the skin; the abundant scales of cuticle which fall from the leper as "white as snow," and which, in an aggregated form, constitute the corns which arise from irritated skin.

Exudations cannot remain dormant. They rapidly undergo changes, either in the way of development or degeneration.

The development of lymph into tissue can only take place under certain favourable conditions. And the existence of these conditions implies (says Mr. Paget) "a cessation of the inflammatory process. So long as inflammation lasts, no high development of the exudation already formed will take place: rather fresh exudation will be continually formed, hindering the due process of development. The history of the subsequent development, and of the tissues that may be produced, belongs rather to the subject of Repair. Suffice it here to say, that the direction of the development is determined by two circumstances:—1st. The natural tendency of the lymph to form fibro-cellular tissue; and, 2nd. Its tendency to assume, more or less, the characters of the tissue from which it exuded, or in place of which it is formed. (See Art. REPAIR.)

Microscopically, the characteristic of all inflammatory effusions must be said to be, that they contain, in greater or less abundance, "cells," which, in the earlier periods of their existence, show signs of rapid and monstrous growth; but afterwards, being incapable of development, become abortive, and pass through various stages and forms of degeneration.

The degeneration of effusions are, according to Mr. Paget, four—viz., withering, fatty, calcareous, and pigmental degenerations. But of these the most certain and constant is the fatty degeneration.

The fatty degeneration of fibrine is seen especially in the coagula found in the lower forms of inflammation, in which the fibrine is found to be turbid, and dotted with numerous minute shining granules, which are drops of oil. Such fibrine, or

as it is called, aplastic lymph, is found in many inflammations of serous membranes; and, mingled with pus, in inflammations of mucous membranes. It is also found in scrofulous matter, and in most parenchymatous inflammations. But the most marked case of fatty degeneration in lymph is seen in its cells. These cells become gradually filled with minute shining granules, soluble in ether; the cell-wall being at the same time more and more distended. These are the so-called "granule" cells of Vogel, or the "filled" cells of Henlé; and were first demonstrated by Reinhardt. (Traube's *Beiträge*, b. ii. p. 217.) Afterwards, the cell-wall disappears, but the granules still holding together for a time constitute the "compound inflammatory globule" of Gluge. Meanwhile, the nucleus disappears, and at last the granules separate, the cell breaks up into a pulpy mass, and is absorbed.

It has been repeatedly pointed out that these changes of inflammatory effusions are precisely analogous to the similar fatty metamorphoses of other tissues in a state of degeneration—such as the softening of clots of blood within the cavities of the heart, as demonstrated by Mr. Gulliver; and the fatty degenerations of the cells of the liver or kidney, or the fibres of the heart. As the result of inflammation, this form of degeneration is well seen in the atheroma of arteries.

The "withering" of inflammatory effusions is seen in the dry, horny, change of vegetation on the valves of the heart or in the arteries; and in the dried-up pus of chronic abscesses, and in the stationary scrofulous enlargements. Calcareous degeneration is rare (except in the placenta, where it is very common), and pigmental degeneration is only seen in the lymph from certain inflammations, especially in that of the bronchi, the mucous membrane of which contains naturally much pigmentary matter.

The most notable form of degenerated lymph is pus. In it the new corpuscular elements of the lymph appear to have undergone simply fatty degeneration. The pus cells, at least those from deep-seated abscesses, are apparently lymph cells in a certain stage of their degeneration. The typical pus cell is a thin-walled globule, about  $\frac{1}{2000}$  inch in diameter, irregular on its surface, wrinkled or granulated, and containing a bifid, trifid, or even quadrifid nucleus. Now all the cells in inflammatory exudations have a tendency, as it were, to assume this typical form. Cells of every variety of shape and size are to be found, according to the particular stage of development which they have been able to reach before their degeneration commenced. For they may succumb at any period of their existence, and according to the period will be their appearance.

Pus cells also may undergo any of the previous forms of degeneration—and its commonest degeneration is the fatty. In all cases where pus is absorbed, it has probably been thus changed. "The pus (says Virchow) is not reabsorbed as pus, but first undergoes a fatty metamorphosis. Every single cell sets fatty particles free within, breaks up, and at last nothing further remains than fatty granules and intervening fluid." (*Cellular Pathology*, p. 182.) In all cases fatty transformation appears to be essential to the absorption of organic products, whether inflammatory exudation cells, or the normal tissues of the body. (See *Puget's Lectures*, iv.)

If, now, a section be made through an inflamed part, say an area of inflamed areolar tissue, and it be examined at different points, cells in all the above varied stages of development and degeneration will be successively met with. In proceeding from the healthy parts to the outskirts of the inflammation, and thence to its focus, we meet first with cells which appear to have outgrown themselves: unnaturally large, their nuclei dividing once, twice, or more, till they become filled with fresh cells; these afterwards assuming various forms of development, but, as we approach the focus of inflammation, degenerating into pus cells, assuming some one or other of the forms of degenerated cells, mixed more and more abundantly with fat cells and granules; till at last, in the centre of the inflamed part, little is to be seen but the débris of degenerated and dead matter, among which the original textures of the part can scarcely be recognised.

Now this combination, side by side, of growing, proliferous cells on the one hand, and degenerating cells on the other, is manifestly the result and indication of an excessive production of the ordinary blastema of the part; which, failing to meet the conditions of healthy nutrition, miscarries, and, being unable to form new tissue, degenerates, and has to be removed, either by expulsion from the part, or absorption. So far, these cells have been considered as separate from the tissues among which they lie, as seen, that is, in effusions or exudations; their actual origin has hitherto escaped observation, and can only be deduced by analogy. But there are cases of inflammation in which perfectly identical changes have been traced from their commencement in the cells of the textures themselves, in which, therefore, there is, in the early stages of the inflammation at least, no effusion in the ordinary sense of the word. To such forms of inflammation Virchow applies the name of "parenchymatous" inflammation. (See *Virchow's Archiv*, t. iv.) And he considers that in all cases the so-called effusions have a similar origin from the cells of the part itself. "I am of opinion (he says) that in the sense in which it has usually been assumed to exist, there is no inflammatory exudation at all, but that the exudation which we meet with is essentially composed of the material which has been generated in the inflamed part itself, through the change in its condition, and of the transuded fluid derived from the vessels. If, therefore, a part possesses a great number of vessels, and particularly if they are superficial, it will be able to furnish an exudation, since the fluid which transudes from the blood conveys the special products of the tissue along with it to the surface. If this is not the case, there will be no exudation, but the whole process will be limited to the occurrence in the real substance of the tissue of the special changes which have been induced by the inflammatory stimulus. In this manner, two forms of inflammation can be separated from one another: the *purely parenchymatous inflammation*, where the process runs its course in the interior of the tissue; and the *secretory (exudative) inflammation*, which belongs more to the superficial organs. That there are two different forms is clearly shown by the fact that they occur, for the most part, in different organs. Every parenchymatous inflammation has from its outset a tendency to alter the histological and functional character of an organ. Every inflam-



mation with free exudation in general affords its certain degree of relief to the part : it conveys away from it a great part of the noxious matter with which it is clogged, and the part, therefore, appears comparatively to suffer much less than that which is the seat of parenchymatous disease." (Virchow, *Cellular Path.*, p. 392-4.)

First in the category of parenchymatous inflammation, not only because in it the process is traceable in all its stages, but also because it was the first to be recognised and traced out by Dr. Redfern, is inflammation of articular cartilages. In fact, the best illustrations of the process would naturally be expected in the least vascular tissues. In the ulceration of cartilage Dr. Redfern found that the first departure from health (at the point of cartilage most distant from the ulcer) consists in an enlargement of the cells to five or six times their natural size. At the same time, they become irregular in their distribution in the cartilage : their nuclei divide so that, according to their size, they contain a smaller or greater brood of new cells. As they advance towards the surface, they enlarge still more, till the original cell-wall disappears. And in the larger cells, the nuclei or new cells, gradually degenerate into the form of pus cells, the remaining contents of the cell becoming granular. At a later stage still, the whole cell and its contents become nothing more than a mass of glistening granules, or large bright drops more or less scattered, which are readily recognisable as fat globules. Meanwhile "the hyaline (or intercellular) substance splits into bands and fibres, and is subsequently disintegrated, and removed from the part." (Redfern on *Abnormal Nutrition in Articular Cartilages*, in *Edinburgh Monthly Journal of Medical Science*, 1849, p. 967, et seq.) Redfern thought that so long as cartilage alone was affected, no pus could be produced. But it appears that the degenerated cartilage cells may themselves become pus cells. (See a paper by Professor Weber, in *Virchow's Archiv*, vol. xiii.)

Similar changes are observed in the inflamed cornea, changes which have been followed out especially by Strube and His. An admirable example of the kind is mentioned by Virchow ; a specimen from a case of keratitis. "If," says he, "in this case we follow the process with a higher power, we discover, what may easily be shown to be the case in every form of keratitis, that the change is essentially seated in the corpuscles or cells of the cornea, and that, in proportion as we approach the clouded spot either from without or within, the little narrow cells continually become larger and more cloudy. At last we find them presenting almost the appearance of sacculated canals or tubes. Whilst this enlargement of the elements, this acute hypertrophy, if you will, is going on, the contents of the cells are at the same time becoming more cloudy, and it is this cloudiness of the contents which in its turn occasions the opacity of the whole coat, for the proper basis substance appears to be altogether unaffected. This cloudiness of the contents is in part occasioned by particles which are of a fatty nature, so that the process seems to have begun to assume the character of a degenerative disease." (*Cellular Pathology*, p. 305.)

So, too, in the inflammation of tendon, the earliest changes are seen to be overgrowth and opacity of the normally transparent so-called "nuclei" of

tendon. And these bodies may be seen gradually to assume varied forms of degeneration, to that of genuine pus.

A precisely similar process, viz. the generation of pus from the natural elements of the textures themselves by "proliferation," or excessive endogeny within the cells of the part, and their subsequent degeneration, has been traced in mucous membranes. Dr. Burckhart has described minutely the stages of the process in the mucous membrane of the bladder, showing that the deeper cells, having their origin in the dermis, divide, and multiply, and gradually degenerating, are ultimately cast off as pus cells. (See Burckhart's paper in *Virchow's Archiv*, vol. xvii. ; and a review of it in *Br. and For. Med. Review*, 1859.) And Virchow well traces the process in various membranes. "If," he says, "we investigate the history of suppuration, we immediately discover that we must distinguish two different modes of pus formation, according as pus proceeds from epithelium, or from connective tissues. Whether there are also forms of suppuration proceeding from a tissue of the third class, from muscles, nerves, vessels, &c., is at least doubtful. As long as the pus is formed out of epithelium, it is naturally produced without any considerable loss of substance, and without ulceration. But this is in every instance the case when pus is produced in connective tissue. *Pus is not the dissolving, but the dissolved, i.e. the transformed tissue.* If you follow the development of pus upon the skin, when the process is unaccompanied by ulceration, you will constantly see that the suppuration proceeds from the rete Malpighi. It consists in a growth and development of new cells in this part of the cuticle. In proportion as these cells proliferate, a separation of the harder layers of the epidermis ensues, and they are lifted up in the form of a vesicle or pustule. In the deeper layers we may watch how the cellular elements, which originally have only single nuclei, divide, how the nuclei become more abundant, and single cells have their places taken by several, which in their turn again provide themselves with dividing nuclei. Precisely the same is the case with mucous membranes. A mucous membrane is all the more in a condition to produce pus without ulceration, the more completely the epithelium it possesses is stratified. The intestinal mucous membrane, especially that of the small intestine, scarcely ever produces pus without ulceration ; while on other mucous membranes, as, for example, on that of the urethra, we see enormous quantities of pus secreted, as in gonorrhoea, without even the slightest ulceration being present on the surface. This depends essentially upon the presence of several strata of cells, the upper forming a kind of protection to the deeper ones, of which the proliferation is thus for a time secured. If, now, pus, mucus, and epithelial cells be compared with one another, it appears that there certainly does exist a series of transitional forms, or intermediate stages, between pus corpuscles and the ordinary epithelial structures. Pus, mucus, and epithelial cells are therefore pathologically equivalent parts, which may, indeed, replace one another, but cannot perform each other's functions." (*Cellular Pathology*, p. 455, et seq.)

In other textures, the earliest stages of this process have not been so distinctly traced, perhaps because the textures themselves have not the same

distinctive cellular characters. But all the later stages, the progressive destruction of the textural elements, and their degeneration into fatty matters, have been distinctly recognised. In inflamed muscle, from the earliest period observed, the structure of the muscle is changed, its striæ disappear, so that the muscle appears, for a time, almost homogeneous, and afterwards minutely granular—then large granules, which are manifestly oil drops, appear, having more or less the arrangement of the original “sarcous” elements, from which it cannot be doubted that they have their origin; and subsequently the limitary membrane dissolves and disappears, and the whole muscular material is absorbed, and now replaced. In inflamed nerve, too, the medullary cylinders of the nerve fibres break up, and gradually assume the character of oil.

It is impossible not to see that these destructive changes, revealed by the microscope, are exactly analogous to the more conspicuous destructive acts of inflammation which produce ulceration and gangrene. In all cases the proper tissues of the part are destroyed, the difference being simply those of degree and rapidity.

Dr. Lionel S. Beale endeavours to explain the rapid production and growth of pus cells, and their varying characters, by referring them to an escape of the growing, “germinal” matter of cells. Having supported the doctrine that every cell consists of “germinal” matter in its interior, and “formed material” externally, he considers that the living germinal matter may be set free by the destruction of the formed material, or by its softening. “When germinal matter comes into contact with nutrient material under favourable circumstances, its power of infinite multiplication becomes apparent. The germinal matter of any tissue in the body is capable of growing in this way. If we look at suppuration in this light, the cause of the different characters of pus becomes evident. In gangrene the germinal matter is killed: in suppuration it grows freely. And if this process did not occur, there are cases in which the death of the tissues must result.” (*Report of Dr. Beale’s Lect. on the Structure and Growth of the Tissues*: Br. Med. Jour. 1861, p. 522.)

Section 6. *Causes of Inflammation*.—Abnormal distribution of blood has been shown to be the chief agent in bringing about the changes which ensue in the course of inflammation. Now, although we protest most strongly against the doctrine that mere hyperæmia, or excited action of blood-vessels, can be considered the essence or starting-point of inflammation, still, whatever be the conditions which create inflammation, they must be such as include the power of disturbing the circulation, and of causing local accumulations of blood.

If we exclude the coarser mechanical agency of the heart, whose force tells in all parts alike, we shall find that the circulation through any given part is influenced by the work done in that part; by the amount of function carried on; of tissue worn and requiring renewal; in fact, by the demands of the part for the nutrient material which the blood furnishes. Thus, in the natural state, exercise, development, and functional activity, draw supplies of blood. Even so the enlarging womb, and the consumption of material in the growth of the fœtus, causes the uterine arteries to become both more capacious and tortuous. And, in the second place, the local circulation is in-

fluenced by the state of the blood. A thin, poor, hungry blood, that whizzes noisily through the veins, may yet stagnate in the extremities; whilst blood loaded with nutriment sets the heart beating vigorously, makes the face flush and the eyes bright, and its effects on the brain are soon told by exhilaration and good spirits.

The elective power of certain substances contained in the blood, which causes them to seek certain organs or channels of elimination, is, like all facts of its class, to be accepted as ultimate and inexplicable. We do not know what gives turpentine and cantharides an affinity for the kidneys, nor why croton oil should be eliminated by the bowels, and anise oil by the lungs; neither can we tell why aloes should vex the rectum, and iodide of potassium the upper air passages; why morphia should cause itching of the skin, and quinia ringing in the ears; why henbane should make the throat dry; cubebs produce a papular rash; mercury sloughing of the gums; savine a hæmorrhage, and ergot a constriction of the womb; strychnine an excitement of the spine; lead a paralysis; nor why chloroform and alcohol should accumulate in the nervous centres. It is sufficient for our present purpose to remember, that by introducing certain substances into the blood, we can materially modify the circulation in many organs; that we can produce secretion, and, if we please, hyperæmia and exudation or hæmorrhage, *i. e.* inflammation; and that thus we can gain an insight into the manner in which local inflammations are produced by constitutional causes.

But, thirdly, besides the nutritive work in any given part, which attracts blood towards it, and besides alterations in the composition of the blood which cause it, as it were, to fly to certain organs, there is the *nervous system*, of which we know just enough to be able to comprehend its immense power in regulating the distribution of blood. Its power in health is exemplified by the common acts of blushing with shame, and of watering of the mouth when victuals are presented to a hungry man. In disease, its power is illustrated by the fact, so well urged by Macartney, that if “irritation of the nervous system” be prevented by certain remedies whose sedative action on that system is matter of experience, inflammation after injuries will either be absent altogether, or very much mitigated.

The practical value of correct pathology is so great that it may be well to enlarge on this point. It is proved both by physiological experiment and clinical observation, that as with the vascular supply, so with the nerves, they not only influence local changes, but are themselves influenced thereby. Changes in a nerve may produce great changes in the part to which the nerve is distributed; and, conversely, as Claude Bernard says, “the properties of a nerve are greatly modified by the state of the organ in which it terminates. If the sensibility of a cutaneous nerve be ascertained in the healthy state, it will be found that after scalding or blistering the parts to which its ramifications are distributed, a considerable increase of its excitability has taken place; a galvanic current, which is scarcely felt on the opposite side, provokes instant pain when applied to the nervous trunk which spreads to the injured region.”



Thus far, then, we see that irritation of the ramifications of a nerve produces increased sensibility of the trunk. But from the trunk, the increased sensibility radiates, in a reflex manner, to the neighbouring ramifications; hence the extension of *tenderness* to a distance around an injury.

A common example of reflected nervous irritation is seen in some cases of ovarian disturbance in women; and as I have before said, it is in the female generative system that the true natural type of inflammation and its processes is to be found. In a patient affected with irritation or neuralgia of the right ovary, I have often seen the whole right leg and foot crimson, warm, and with its veins turgid, whilst the opposite foot and leg were pale and cold.

Again, there is direct evidence showing the influence of the spinal nerves in creating, or at least promoting, general febrile disturbance after local injury. "When a horse," says Claude Bernard, "has injured itself by stepping on a sharp stone, or a pointed fragment of metal, the general phenomena (fever and inflammation) with which similar accidents are usually attended, will not take place if the sensitive nerve leading to the wound be divided, and none but local symptoms will in this case be observed. If, on the contrary, instead of cutting the nerve, we create a local hyperæsthesia by dividing the spinal cord on that side, the opposite effects will be produced; the pain, fever, and inflammation resulting from the wound will acquire at once additional intensity."

Hitherto we have spoken of the spinal nerves; but of the direct influence also on the circulation of these nerves which are derived from the sympathetic, there can be no doubt, although there is much yet to be learned on this matter. It seems to be established that the blood-vessels are under the influence of two sorts of nerves: one (vasomotor) probably directly derived from the spinal cord, which accelerates the circulation, and produces dilatation and increased flow of blood; the other derived from the cord through the sympathetic, which produces contraction of them and diminishes the flow of blood. "The division of the nerves belonging to the system of organic life," says Claude Bernard, that is, of the latter or sympathetic class, "gives rise to three great classes of morbid phenomena: 1st, an acceleration of the passage of the blood through the vessels; 2nd, an increase of temperature; 3rd, an exaggerated activity of the secretions;" besides which, the part can resist cold for a longer time, and is very much more sensitive. If one cervical branch be divided in a rabbit, the corresponding ear becomes hot and vascular, and not only so, but the corresponding side of the brain and its membranes as well. All these effects are reversed if the peripheral extremity of the divided nerve be galvanized so as to restore its contractile effects. The antagonist nerve to the sympathetic, *i. e.* that which produces dilatation of vessels, has been demonstrated in an isolated state in the *chorda tympani*; this nerve excites the circulation of the submaxillary gland, and its function is antagonistic to that of the sympathetic, and it exerts its force uncontrolled when the sympathetic is divided. (See *Claude Bernard's Lectures on Functions of Spinal Cord*, Med. Times and Gaz., 1861.)

If we may attempt to show by a rough analogy the relative share which the nutritive action of a tissue, the composition of the blood, and the influence of the nervous system, take in modifying the distribution of blood, we may liken the organic actions in any given tissue to the consumption of coal in a furnace—the blood to the coal—the nerves to the persons by whose agency the coal is fetched. Then it will be manifest that the quantity of coal consumed will depend partly on the amount of work to be done, or of steam to be raised by the furnace; partly by the quality of the coal and its power of quick combustion; and partly by the activity of the persons whose place it is to bring it.

We will now examine the various causes of inflammation, which may be divided into two heads, local and constitutional, or *solidist* and *humoral*. Each kind requires to be carefully studied and analysed, although it must not be supposed that they are often met with absolutely distinct in nature. "A true, severe inflammation, *local* only, that is produced by local irritation without any concurrent blood disorder, is most rare, because local inflammation may poison the whole blood.

1. The *local causes* are those which disturb the nutrition of the part, which interfere with the steady development of the elements of tissues, or which produce premature wear and tear of them, or hinder the removal of their debris, when effete. Of these the chief and most frequent is *over-exertion*, or the compelling an organ to do more work, that is, to go through the processes of disintegration and renewal more frequently than it is well able to do so. Inflammations of over-worked mammæ and eyes are examples. *Alterations of temperature*, which perplex and disturb the changes going on in the blood, and alter the relation of the tissues to oxygen; of which chilblains and sunburn are examples. *Injuries* of every sort, whether mechanical or chemical, or injuries produced by those poisons which have no force save upon living matter, as the zymotic or septic poisons. Not that injuries are of necessity followed by inflammation: for after almost any amount of injury, even including destruction of the vitality of a neighbouring part, a part may tranquilly undergo reparation. Yet those injuries which leave parts half killed, or so circumstanced that the processes of repair are interfered with, or the development of exudations hindered, or the fluids about the wound made to undergo putrescent changes, are sure to inflame. Thus a simple cut, nicely closed, may not inflame. But if it be not brought together, or if it be rudely torn open again, so as to interfere with the vitality of the reparative exudation whilst still tender, or if the reparative material be allowed to putrefy, or come in contact with decomposing animal matter, inflammation is sure to result. The more complex an injury, such as a torn wound, or one in which foreign bodies are entangled, the more liable is it to inflame. The poisons of animals, as snake bites, and stings of all sorts; vegetable irritants; putrid and decomposing animal matters; and the discharges from inflamed surfaces, mucous or serous, applied to the like parts in the same body or another, are also common causes of local inflammation.

It was an observation of John Hunter, that putridity of the blood in a wound is a common cause of inflammation. Most assuredly there are

many "low" inflammations of wounds after operations in hospitals, the name of which, if translated into other words, would be "tainting of the animal fluids in and about the wound." I have verified the fact, that meat and milk, if exposed to sewer vapour, undergo speedy putrefactive change. We might therefore well imagine that the liquid exudations of wounds would do so likewise in the vile air of hospitals, if we had not learned it as a fact from the history of erysipelas and hospital gangrene.

The *modus operandi* of contagious diseases may be explained under two forms—by chemical action, *per se*, or by chemical action combined with vital growth. For example, we may regard some septic or morbid poisons—say those of erysipelas, pyæmia, hospital gangrene, charbon—as substances undergoing chemical decomposition *simpliciter*, and communicating that state to the fluids of any healthy body with which they come into contact, just as a lighted torch communicates its state to a hay-rick. On the other hand, some morbid poisons, the true *zymotic*—which produce exudation with copious "cell" growth—as those of gonorrhœa, contagious ophthalmia, small-pox, and the like, may be compared with yeast, whose chemical action is proportionate to the amount of growth of new organic form. The former class, or assumed class, of poisons may be supposed to arise wherever the chemical conditions necessary for their presence are found. Wherever, for example, there is an ill-kept hospital, there hospital gangrene may arise, and may linger in any patient to an indefinite time. On the other hand, the spontaneous and independent origin of morbid poisons which are allied with something of vital growth is less certain: they possibly require a pre-existing germ for their development. They, too, usually present a definite specific course; small-pox, for example, runs its course, lasts a given time, and then disappears; nor can it be produced again readily in the same patient, at least till some time has elapsed.

If the efficacy of such poisons as the virus of vaccine depends on *living*, and not on mere chemical agency, it must be admitted that living matter may exist in a pellucid liquid, and therefore without form and of inconceivable minuteness.

The contagion of the truly *zymotic* poisons is as material an act as the transplantation of a growing plant or its seeds into a new field where it may increase and propagate. The pus of gonorrhœa applied to the urethra or eye, may be supposed not merely to set chemical changes going, but to undergo division and multiplication, and to communicate its own mode of growth to the epithelium in which it is deposited. It is highly probable that most catarrhal, mucous, and cutaneous inflammations would be found to be contagious, if as much care were taken with the engrafting of secretions containing living matter as is taken with the vaccine disease. Dysentery, serous diarrhœa, various forms of vaginitis, ophthalmia, and common catarrh, are undoubtedly contagious.

It is worth noticing that *cancer* is usually reckoned a non-contagious disease. True it is that inoculation with dead and decomposing debris from a cancerous ulcer fails to convey the disease. Yet experiments on animals have shown that *living* cancer cells, injected into the blood, may

propagate and grow when arrested in the lungs. And it is important to notice that some cases of contagion of cancer have from time to time been recorded; as by Gooch and Herbert Mayo and others. These were cases of *epithelial* cancer, in which the essence of the disease is the overgrowth of epithelial cells. They were cases of epithelial cancer of the organs of generation, communicated from husband to wife—doubtless by the communication of living germs of morbidly growing epithelium. Warts, too, are notably contagious. All these facts illustrate and confirm the mode of propagation of those inflammations which we hold to be contagious.

*Parasites*, vegetable and animal, are occasional causes of inflammation; amongst parasitic vegetables of the fungus family, the *Trichophyton tonsurans* seems to produce the varieties of ringworm, sycosis, and tinea decalvans; the *Achorion Schonleinii* produces favus; the *microsporon*, the pityriasis versicolor; and a very formidable disease of the bones and other structures of the foot (*Fungus foot* of India) is caused by the infection of the *Chionephe Carteri*. The *oidium albicans* is found in the epithelium of the mouth and fauces, particularly in thrush and diphtheria, but seems an accidental complication, not a cause. Amongst animal parasites, the louse causes prurigo and eczema, and the itch insect scabies. The immature young of the tæniæ, in the form of cysticercus, echinococcus, and other *hydatids*, may produce inflammation and abscess of the organs they infest. Various kinds of the small worms known as *Bilharzia* produce in Egypt a condition resembling dysentery (*Aitken, Science and Practice of Med.* vol. i. p. 863, Ed. 1866); and at the Cape of Good Hope they infest the kidneys, and cause hæmaturia. (*John Harley, Med.-Chir. Trans.* vol. xlvii.) The guinea-worm, *Dracunculus*, may be a cause of great inflammation and abscess in the areolar tissue; the chigoe, or pulex penetrans, may cause abscess of the foot; and there are the Delhi boil, Lahore boil, Aleppo boil, and other hardly yet sufficiently explored local inflammations, which are probably due to animal parasites. (*Fleming, Smith, Aitken, in Army Medical Report for 1868*, pp. 319, &c. *Cobbold on Entozoa*, Lond. 1864.)

Lastly, among local causes of inflammation, I shall consider one which scarcely ought to be called local, inasmuch as it is often connected with the whole vital history of the individual. This is, original defect in the intrinsic vital force and nutritive energy of any given organ, and defective structure. As a first example, I may quote the ill-developed, or over-developed bulky brain of rachitic and scrofulous children, which upon slight provocation falls into a state of acute hydrocephalus, so called. Secondly are the teeth, in which delay of *cutting* is a fruitful source of inflammation in infant life, whilst caries is an equally fruitful source in early adolescence. Thirdly, the female generative system. There is little doubt but that, as stated by my friend Dr. Farre (*Art. Uterus, Todd's Cyclop.*), many of the "inflammations" of uterus and ovaries are effects of ill-development and non-performance of the proper functions of ovulation. Lastly, in the decline of life, organs lose their vital power—their power of self-restoration and renewal—at various epochs, in some men early, in others late; then come degenerations and degradations



of structure, and upon these, inflammation. Bulging varicose veins, glaucomatous eyes, emphysematous lungs, and other instances, where the decay of structure is the precursor of inflammation, will readily suggest themselves to the practitioner.

2. In the next place, we will speak of altered innervation as a cause of inflammation. But here we tread insufficiently explored ground. That the nerves have a share in the mechanism of all inflammations is certain, but when we come to specify altered innervation as a substantial and palpable and original cause of inflammation, we are somewhat at a loss.

There are some classical cases, which are quoted in most books, of inflammation or some more destructive change, following injury to nerves. For example, in experiments on animals it has constantly been found that section of the ophthalmic division of the fifth nerve is followed by inflammation of the conjunctiva, ulceration of the cornea, and even destructive inflammation of the whole globe of the eye. So, too, inflammation of the lungs may be induced by division of the pneumogastric. And similar phenomena are not unfrequently witnessed by the practical surgeon, notably in the ready formation of sloughs on the sacrum, hips, and ankles, and in the rapid inflammation of the bladder after injuries to the spinal cord. Mr. Simon mentions a case of inflammation of the two inner fingers in consequence of laceration of the ulnar nerve (*Simon's Lect.*, 1850).

More than one explanation has been offered of such cases. At first, the fact that the injured nerve is commonly a sensitive one, seemed to justify the opinion that the phenomenon was reflex, dependent solely on the influence of the nerves on the local circulation. But it is, to say the least, doubtful how far this explanation would account for the production of the various incidents of inflammation beyond the hyperæmia. A more plausible explanation was suggested by Sir B. Brodie, and has been largely supported by experiment: viz., that the inflammation is caused by the continued irritation of foreign bodies, from the contact of which the part, deprived of all sensibility, is unable to defend itself. It is argued, for example, that the inflammation of the bladder, in cases of paralysis, depends solely on the retention of the decomposing urine, which the bladder is unable to expel, and that it may be prevented by the careful use of the catheter, and by washing out the bladder—that the rapid formation of sloughs in the same cases depends on the continued pressure on the most exposed points, & pressure of which the paralysed patient is unconscious, and which he therefore makes no effort to relieve. (*See Art. on Fractures of Spine.*) So, again, Dr. Snellen has shown that, after division of the fifth nerve, inflammation of the conjunctiva may be warded off for a time, if not altogether, by stitching together the eyelids, and drawing the ear of the animal over them for a still further protection to the eye; and in the case of inflammation of the lungs after division of the pneumogastric, much is to be ascribed to the mere congestion of blood consequent on the slower respiration; and Traube has shown that it, too, may be, to a certain extent, prevented by precautions against the inhalation of foreign bodies, which the insensible lung makes no effort to discharge. But

after making every allowance for these mechanical explanations, as they may be called, there is still a residue of phenomena that cannot be so set aside, especially some remarkable experiments by Graefe, in which he proved that mere exposure of the globe (by removing the eyelids and lacrymal gland) without injury to the fifth pair is not nearly so destructive to the eye as the section of the nerve alone.

That residuum derives its explanation in part from the researches of Claude Bernard. We have already mentioned the fact, which seems to be supported by abundant evidence, that the sympathetic nerve seems to exert a controlling or restraining force over the circulation; that when this nerve is divided, the vessels of the part—the rabbit's ear, for example—to which it is distributed, seem to be impelled under the influence of an opposite system of nerves (?) to pour in as much blood as possible. The vessels enlarge, the surface reddens, the part is hotter and more sensitive; more blood can be got from the veins in a given time, like as in that classical example of Mr. Lawrence's, when he caused a man suffering under an inflamed hand to be bled from both arms, and found that 15 oz. flowed from the diseased side, whilst only 3 flowed from the sound side. The blood in the veins is *arterial*, *i. e.*, it has not lingered long enough in the capillaries to deposit its oxygen and undergo the change to venous. The process of *absorption* is likewise greatly exaggerated, for, as is well known, the amount that can be imbibed by one side of an animal membrane depends on the amount which can pass from the other side. This, then, being the condition of a part whose sympathetic nerve has been divided, let us see what follows.

"As long," says Claude Bernard, "as the animal is kept in good condition, the symptoms observed are entirely local; circulation is accelerated, absorption is carried on with greater activity, and the temperature rises in the part which corresponds to the operation. This state of things continues almost indefinitely till some morbid cause makes its appearance. *If the animal is momentarily deprived of food*, inflammatory symptoms speedily arise in the organs withdrawn from the action of the organic nervous system; when the cervico-cephalic branch has been cut, the conjunctiva, the pituitary membranes, and other mucous surfaces, enter at once into suppuration; the lungs, the pleura, or the great internal viscera become the seat of disease when the operation has been performed on the corresponding ramifications of the splanchnic nerves." The explanation which Claude Bernard gives is this: that "the blood being impoverished through privation of food, the animal begins to feed upon itself; and the tissues, no longer receiving the nutritive elements which support them in the physiological state, are rapidly destroyed, more particularly so in the parts where the intensity of absorption is carried to its utmost pitch. Another result of our experiments is, that after the section of the sympathetic nerve, the blood contains a larger amount of fibrin than usual, and is more easily coagulated, as in the case of ordinary inflammation." (*Op. cit.*)

The instances of disease produced by injury or irritation of nerve are numerous. Ligature of the œsophagus produces congestion and secretion in the stomach and bowels, efforts at vomit-

ing, &c. Irritation of stomach and secretion of acrid gastric juice may be produced by piles, according to Dr. Chapman, of Philadelphia, and Whytt (quoted by Brown-Séguard in *Lectures on the Central Nervous System*, Philadelphia, 1860). Irritation of one eye may produce disease of the opposite organ, which can only be checked by removal of that one first affected. Abundant evidence of this is given in *Haynes Walton's Ophthalmic Surgery*, 2nd edition; although the ophthalmoscope has shown that the cases of blindness following blows on the forehead, which used to be attributed to injury of branches of the fifth nerve, are really for the most part due to a participation of the eye in the original injury. The lachrymation and redness which affect both eyes when only one is irritated is a familiar example. Orchitis may arise from irritation of the ureters. The ulceration of the duodenum which follows severe burns is ascribed by Brown-Séguard to reflex nervous action. There are three causes, says Brown-Séguard, to which this inflammation of the viscera after burns has been ascribed—alterations in the blood by the heat, diminution of the functions of the skin, and reflex nervous action. That the last is the true cause, has been found, he says, by experiment. Dogs whose legs were scalded with boiling water, and whose spinal cord was divided at the level of the third or fourth lumbar vertebra, so as to cut off all nervous irritation, presented no trace of visceral congestion: on the other hand, if the division of the cord were made so high as the third dorsal vertebra all the abdominal viscera were found in a state of congestion with serous infiltration and ecchymosis after the same injury. The paralysis and blindness which follow diphtheria have been explained on the same principle. Moreover, there is an increasing disposition with pathologists to refer herpes and some other forms of skin disease to nervous irritation.

"There are two modes of action of the nervous system upon the production of the phenomena of nutrition and secretion. By one of these actions the nervous system determines an increase in the attraction of blood of the living tissues, and in this case the phenomena are accompanied by a dilatation of the blood-vessels, while the reverse exists when the nervous system, instead of acting on the parenchyma of the tissues, acts upon the walls of the blood-vessels, and produces a contraction. In the first case, the quantity of blood passing through the part on which the nervous system has acted, is increased, while in the second case it is diminished: in the first case the secretions are increased, in the second diminished; in the first case nutrition is more active, and there is a tendency to hypertrophy and an augmentation of the vital properties of nerves and muscles; lastly, in the first case there is an augmentation of the temperature, while in the second there is a diminution." (*Brown-Séguard*, Op. cit. p. 172.)

Brown-Séguard concludes, that mere absence of nervous influence has little effect on nutrition, secretion, and repair; that most of the alleged ill-consequences are indirect—i.e., atrophy of muscles arises from rest; ulceration from friction; changes of secretion, from paralytic dilatation of vessels, &c.: but that if absolute disease be induced, it is through reflected irritation.

Thus it has been proved that the blood-vessels

may close spasmodically, so as to cut off the nutrient supply; and it is to this influence that Brown-Séguard ascribes the gangrene which occurs so readily in paralysed parts.

There is, moreover, now plenty of evidence of the influence of an irritated or injured nerve in producing inflammation of the parts to which it is distributed. Such effects "do not belong to cases of complete destruction of the nerves. They occur in patients who have received slight or severe nerve wounds, provided always that these latter do not separate the part entirely from its nerve centres." (*Gunshot Wounds, and other Injuries of Nerves*, by S. Weir Mitchell, M.D., George R. Moorhouse, M.D., and William W. Keen, M.D., Philadelphia, 1864, p. 79.) Such effects include the "glossy skin" described by Mr. Paget as a consequence of nerve injury (*Med. Times and Gaz.* Mar. 26, 1864), eczema, neuralgic pains, and painful swelling and inflammation of the synovial membranes of joints. Mr. Stanley (*Med. Chir. Trans.* vol. xxiv.) and Dr. Benjamin Ball have also called attention to inflammation of joints as a consequence of disease of the spinal cord, especially the *locomotor ataxy*. (*Med. Times and Gazette*, 1869, vol. ii.)

To sum up, then, what we have said on this point:—1. *Absence* of innervation seems to have no effect on nutrition; wounds, &c., will heal in paralysed parts as well as in others. 2. Many ill consequences of division of nerves are accidental and indirect, and due to the injuries which insensible or paralysed parts are liable to. 3. Some ill effects are due to rapid circulation and absorption. 4. Some to a reflex irritation of those nerves, which cause preternatural afflux of blood. 5. Some to reflex irritation of those nerves, which constrict the blood-vessels and cut off the supply of blood. 6. Some to a direct irritation propagated from a diseased nervous centre, or from nerve trunk injured, but not divided.

3. The state of the blood as a cause of inflammation may be discussed under three heads: *a*, variation in *quantity*; *b*, in the *proportions* of its normal constituents; and *c*, the presence within it of *poisonous* matters, whether generated within or introduced from without.

*a*. Increased quantity of blood or *plethora* is a very common condition, and it no doubt predisposes to inflammation. The best examples of it are seen in stall-fed animals, fattening for the knife. In these animals, plethora combined with obesity, produces fatty degeneration of the heart and voluntary muscles, and torpor of the brain; but the leading disease to which they are subject, is hæmorrhage into the brain, spleen, or kidney. Men and women who are great eaters, and have good digestive powers, become bloated and fat, with their superficial veins turgid with blood; but yet they may go on for many years without any inflammation. Their tendencies are rather to congestion of the lungs, hydrothorax, heart-disease, and apoplexy. They may live long and indulge in the pleasures of the table, if their excretory organs be active. Yet under certain circumstances their blood easily *breaks down*, and becomes poisoned. There is a numerous class of patients who have plethora without fat—spare persons of nervous temperament; women excessively thin, who menstruate violently, and young scrofulous or rickety children whose skin is pale, though their



lips are dark cherry red. But in any case, the share which plethora takes in creating inflammation seems to be this—if the blood be inclined to undergo morbid decomposition, then the presence of a surplus which the excreting organs are not active enough to purify, will be an important predisposing cause.

b. As no amount of plethora by itself will cause, so no diminution of quantity nor poverty of blood will avert, inflammation. Nay, when the blood is starved, local congestions and inflammations follow; want of some elements renders others morbidly predominant. Inflammations of a low type, and diseases of the skin and mucous membranes complicated with parasitic growths, are liable to follow want of nourishment. It is said that the ringworm has disappeared from the children in Christ's Hospital since an extra half-pint of milk was given them every day.

Practising as I do in London, where, as Mr. Lawrence observes, every luxury abounds, and, together with plenty, the disposition to enjoy it, yet more cases of inflammation are found to arise from poverty than from excess of blood. The acute hydrocephalus and acute bronchitis of infants, the two inflammations more destructive to infant life than any others, attack ill-nourished children by preference. Croup is more prevalent amongst the poor than the rich, and pleurisy more frequently occurs with than without a tendency to phthisis. In proportion as human beings are deprived of fresh air, and of the habit of free exposure to it, so does the aliment which they take, and which is destined for combination with oxygen, require to be select and abundant. But the majority of townspeople have not the means of procuring a diet adequate to their wants. The children of the rich are often kept upon an absurdly monotonous diet, on the plea of excluding unwholesome things. The children of the poor in towns are too dependent on white bread and watered milk. Apprentices, shopmen, milliner's girls, governesses, servants in small families, clerks, young growing boys who leave school and have their living to get as errand boys, &c., are all, to my knowledge, liable to hard work, bad air, and imperfect diet, although the servants of the wealthy, aristocratic, and trading part of the community in the same town may be indulging in disgraceful waste. Men, too, may eat their beefsteaks and drink their porter, whilst their wives and families dine on tea and bread. The existence of great luxury, and waste, and intemperance is no proof, therefore, that a considerable part of the community may not be suffering from a want of food, either of sufficient quantity, or of sufficiently varied quality. Suffice it to say, that there are few inflammations of spontaneous origin in a town population in which the practitioner is not called upon to order an improved diet, either along with, or soon after his first "evacuant" remedies. In the experiments of Magendie, the common accompaniments of death by starvation were found to be inflammation of the mucous membranes, conjunctivitis, and ulceration of the cornea. Our present knowledge of animal chemistry does not enable us to refer all such cases to their efficient causes. But remembering that, according to Magendie's experiments, feeding on sugar alone is equivalent to starvation; remembering, too, Dr. Garrod's theory of the dependence of the occurrence of scurvy when fresh

vegetables are absent, on the absence of potash (or at least of vegetable and animal matter containing that alkali) from the food, we can scarcely doubt that many, if not all, of the inflammations arising from insufficient nourishment spring directly from the want of definite chemical elements in the blood.

c. As definite local inflammation may be produced by the artificial introduction of matters into the blood—for example, catarrh by iodide of potassium, gastritis by arsenic, nephritis with rash by cubebs, dysenteric symptoms by aloes, and uterine irritation by savine—and as it is equally certain that some organic poisons introduced into the blood produce definite local inflammations (as those of syphilis, variola, and the like) so it is probable that most if not all idiopathic inflammations are produced by the generation within the blood of some poisonous element. Whether this be absolutely true or not, we have no means of deciding; but it is allowable as a hypothesis. Herpes, psoriasis, and other skin eruptions; croup, pneumonia, bronchitis, and coryza, all follow the same rule as do diseases whose origin in "morbid poisons" is incontestable.

To quote from an able French writer, "Toute modification du sang possède dans l'organisme ses localisations à elle, et qui en constituent en quelque sorte l'expression caractéristique et différentielle." (*Baudin, Traité des Fièvres intermittentes*, Paris, 1842.)

Many morbid poisons seem to reproduce themselves in the body, as yeast does. The poison acts, not so much *per se*, as by a transformation which it excites in the living fluids with which it is intermixed, and which reproduce it. This doctrine of the probable development of *specific* poisons in the blood, was held by Sydenham (see Section 8). But it has been stated anew in our own day by that profound philosopher, Dr. Wm. Farr, who, as is well known, has given the name *zymotic* to that class of diseases whose poisons (however generated) are capable of reproducing themselves.

"Certain matters which have not yet been analysed produce small-pox, glanders, hydrophobia, syphilis, measles, scarlatina, and other diseases; and as it was before proposed to give names to the well-defined diseases produced by poisons, so, for the purposes of reasoning, it will be equally useful to name these specific matters or transformations of matter by which diseases are propagated either by inoculation and contact (contagion), or by inhalation (infection). The following list exhibits the popular and scientific names of diseases in juxtaposition with the proposed names of their exciters.

<i>Diseases</i>		<i>Zymotic Principles</i>
Small-pox	variola	Varioline
Cow-pox	vaccinia	Vaccinine
Glanders	equinia	Equinine
Hydrophobia	lyssa	Lyssine
Syphilis	syphilis	Syphiline
Infection in dissecting	necusia	Necusine
Erysipelas	erysipelas	Erysipeline
Puerperal fever	metria	Metrine
Measles	rubeola	Rubeoline
Scarlet fever	scarlatina	Scarlatinine
Whooping-cough	pertussis	Pertussine

<i>Diseases</i>		<i>Zymotic Principles</i>
Dysentery	dysentery	} Enterine Cholerine
Diarrhœa	diarrhœa	
Cholera	cholera	
Influenza	influenza	Influenzine
Typhus	typhus	Typhine
Plague	pestis	Pestine

The existence of gangrenine, ergotine, ophthalmine, tetanine, miliarine, diphtherine, parotine, aphthine, tracheine, may also be admitted. It is maintained by some pathologists, that the same specific poison produces several of these diseases—erysipelas, necusis, and metria for instance; but while the diseases are described as distinct, it will be most convenient to consider their exciters as distinct, although they may be convertible into each other, and be as nearly related as varioline and vaccinine.

"The chemical composition of these principles is at present unknown, but as salts are distinguished from each other by their relations to other bodies, and, though they may have the same appearance in solution, are found to differ by the compounds which they form with other bodies in solution, so the existence is demonstrated by the effect, of the matter here called 'lyssine,' on animals, although it cannot be detected by the rough analysis of artificial chemistry. The smallest quantity of 'lyssine' imaginable inserted under the skin of a dog produces hydrophobia; and the bites of the infected dog will throw other dogs, and even human beings, into a state similar to that of the dog from which the charge of lyssine originally came. Varioline in the same manner produces small-pox, if the patient has not previously undergone its influence or the influence of vaccinine, a modification of varioline. . . .

"It must be admitted, with respect to all the forms of these diseases, that the body, in the cycle of external circumstances through which it passes, may run into them spontaneously; for it is impossible to trace them invariably to infectious sources; it is not *à priori* more improbable that they, than other diseases, should arise spontaneously, and it is impossible to account for their existence in the world upon any other principle than that of spontaneous origin. Still the property of communicating their infection and effecting analogous transformations in other bodies, is as important as it is characteristic in these diseases, which it is proposed therefore to call in this sense *zymotic*.

"Some of the morbid principles are fixed, others are volatile; but the greater part of them are fixed and volatile in different circumstances. Necusine, pestine, syphiline, lyssine, equinine, and vaccinine are most frequently fixed; they give rise when placed on the skin, particularly when the epidermis is removed, to their peculiar diseases; but contagion is not invariably the result of their contact; indeed, in several of them it is the exception rather than the rule. Either there is no matter in the organisation susceptible of transformation, or the specific transformation is overpowered by the vital energies; for in every case, if the morbid principle tends to impart its movement to the organisation, the organisation, animated by the natural forces, has a tendency to continue its own processes, and to impart its conservative movements to all the organic matters which are brought within its sphere. . . .

"The blood which pervades the whole system is the primary seat of zymotic diseases; but this does not diminish the importance of the local phenomena with which they commence, proceed, and terminate; for they affect (as poisons do) particular organs more extensively and frequently than others, give rise to specific pathological formations or secretions, and derive their character from the lesions and affected organs."—*Fourth Report to Registrar-General*, quoted also in *Cholera Report*, 1849–54.

Thus the poisons which may be supposed by hypothesis to be the causes of various inflammations, may either be introduced or set going from without, or may arise by spontaneous change within. In the latter case it may be supposed that they may be constituted by "retained secretions;" or, as we prefer to say, by changes which take place in the blood in consequence of the presence of matters which ought to have been excreted.

The excretions, whose retention may give rise to inflammation, are those of the liver and bowels, the skin, the kidneys, and the womb.

Retention of the excretions of the liver and bowels, indicated by furred tongue, fetid breath, muddy complexion, and fetid dejections, predisposes to low and irritable inflammations generally, especially of the eyelids, gums, and sebaceous follicles of the skin. Retention of the exhalations of the skin, and especially of oily and odoriferous matters, may be caused by neglect of exercise, washing and friction, and by exposure to cold. The former condition, viz., that of a dry, rough, hide-bound skin, like a torpid state of the bowels, predisposes to any disease. As for cold, the suppression of cutaneous exhalation is, as we shall show presently, but a very small part of its morbid effects. The influence of the womb, as an excrementitious organ, as I have shown in a paper read before the Medical Society of London, amounts to this: That whenever the blood is in a morbidly loaded state, as shown by acne or other signs of irritation; or when the secretions of liver and bowels are defective, then the womb acts as an occasional organ of elimination; and menorrhagia, with membranous exfoliation, or purulent discharge, or diseased placenta and abortion if the patient should be pregnant, are the consequences. Numberless congestive and nervous disorders, and threatenings of inflammation, are relieved by the appearance of the menses. Hippocrates declared that hæmoptysis in women was relieved by the breaking forth of the menses; and, conversely, that women are seldom liable to gout unless their menses be stopped. There is a kind of rheumatism, or rheumatic gout, to which women are subject—petty annoying pains in the joints, attended with headache, or with dyspepsia, and in which menstruation often carries off all the symptoms for the time.

But of all the secretions, the urine is that which seems to have the greatest relation to inflammation; and although the subject is still too obscure to admit of positive statements, it seems probable that there are two distinct sets of conditions which may be met with. One is that which exists in certain persons whose blood appears to be loaded with superfluous matter, which ought to undergo the change into common urinary matter, but does not; this on some provocation breaks down into poisonous matters, which create inflammation or other disease; until at last they are more fully



oxydised and eliminated by bowel, kidney, or skin. Such persons are, in common parlance, exceedingly liable to "inflammation." If they meet with a wound it is sure to *fester*; if with a bruise, it is liable to form an abscess. They very easily "take cold." If they undergo unusual bodily toil, or mental effort, they are sure to suffer from headache, languor and feverishness, until they are relieved by bowels or skin, or lateritious sediment in the urine. They are liable, from time to time, to spontaneous nervous or bilious headaches; often with great discharge of yellow bilious, or acid matters, or both. They cannot take opium; and if of dark complexion, steel and tonics very seldom agree. They are liable to headaches and sickness after taking wine or other alcoholic liquid; not, be it observed, that the alcohol is a poison primarily; it produces no evil symptoms till the next day, when the blood becomes loaded with noxious matter arising from imperfect assimilation, oxydation or elimination. If of the female sex, they are liable to puerperal convulsions. After forty they become liable to gout in some form, open or concealed, and then become less prone to the headaches and vomitings. The urine is usually—not scanty—but pale and copious, and of low specific gravity, before an attack of illness. In such patients "inflammation" is apt to cease suddenly, after which the urine becomes full coloured, and of high specific gravity, and deposits a copious "lateritious" sediment. But it can be proved that it is not an accumulation of "urinary matter" which is the cause of disease in these cases, because there are no signs of gradually increasing illness, but the patient often feels himself unusually well up to the very moment when he is taken ill. It is, rather, the accumulation of matters which ought to become urinary, but do not, and, instead, break down into poisons, whose existence we assume from their effects.

Such is a description, from the life, of the patients in whom the greater number of "inflammations" are met with that are seen in private practice in London: the inflamed eyes, throats, and bronchial mucous membranes; whitlows, the cases of obscure gouty and quasi-gouty pains spasms and inflammations; and the cases of injuries which do not heal kindly. But every other constitutional cause of inflammation is thrown into the shade by those degenerative diseases of the kidney, known as "Bright's," in which it may fairly be assumed, and often can be proved, that real urinary matter is formed and not excreted. In such patients injuries and surgical operations are liable to be followed by irretrievable collapse; or, if not, the actions of reparation are slow and imperfect, the exudations liable to degenerate or decompose, and inflammation to follow. These too are the patients in whom erysipelas and inflammations of serous membranes are most frequent; so much so, that in the event of any inflammatory attack of head, or of convulsions, or inflammations of larynx, or pericardium or peritoneum, in the absence of other palpable causes, the practitioner never fails to enquire for serum in the urine. Children, after scarlatina, are liable to successions of inflammatory attacks, especially pleurisy, and a kind of rheumatism, to be traced to the same morbid condition of kidneys.

It is especially on patients who are "predis-

posed" by one of these morbid conditions of the blood depending on want of production or elimination of urinary matter, that cold is likely to produce its worst effects. Cold, no doubt, does harm, in so far as it checks perspiration. I know well-marked cases of persons who, in a state of perspiration after exercise, or hot baths, have put on damp linen, or exposed themselves to currents of cold, air and have been seized with ophthalmia, or acute serous diarrhoea. But, then, suppression of perspiration is not all; continuous chilling is rather equivalent to a suppression of all the processes of life. Applied to a small part of the body cold will, under usual conditions, cause chilblain, frostbite, &c. But under other conditions, when applied slowly, by a current of cold air, or when applied in such a way as to lower the temperature of the whole blood, it seems to act on the delicate processes going on in the blood, just as it would on a fermenting loaf or vat of wine, or egg in process of hatching. All chemical processes can only take place within certain limits of temperature. As is the lumpish bread, or the sour wine, or the added egg, whose chemistry has been interfered with by cold, so is the entire mass of blood spoiled. The lungs are usually the earliest sufferers; they receive the venous blood, whose temperature has been lowered and its chemical processes deranged; they are irritated, and bronchitis follows. All the gelatinous tissues are apt to suffer, as, for example, in rheumatism. Violent headaches, sometimes serous apoplexy, result. A very common, and sometimes very tragical effect of a thorough chill, is *neuralgia*. It is a kind of malady in which a large quantity of red blood has perished. This is shown by the patient's yellowish pale colour, hollow features and rapid emaciation. Enormous quantities of food are taken, and enormous quantities of urea secreted. But the blood globules do not increase and multiply, and the patient's colour remains yellowish wan. Meanwhile there are symptoms of feverishness, probably intermittent, like ague; and paroxysms of acute pain in the course of some nerve—often the frontal, often the dental, but possibly any other. These fits of pain may last for months. Cold is the most frequent cause of tetanus. If the kidneys be diseased, or if the formation and elimination of urinary matter be imperfect, there is no inflammation known to nosologists which cold may not excite.

We must not pass on without devoting a few words formally to *malaria*, or *marsh poison*, as a cause of inflammation, because, although far more prevalent in England than is sometimes thought, it is by far the most frequent cause and complication of inflammations in hot countries, and requires a peculiar and decisive mode of treatment. So closely allied are many of the effects of malaria to those of cold, that some writers have denied that there is a marsh poison other than the chill of dews, fogs, and the like. For example, Minzi (*Sopra la Genesi delle Febbri intermittenti*, Roma, 1844) denies the existence of marsh poison. This poison, he says, has never been demonstrated; not one of the gases produced by the rotting of vegetable and animal matter under a hot sun, neither the compounds of hydrogen with carbon, sulphur, phosphorus, nor any putrid vapour, nor yet any plant that has been demonstrated, is proved to be a cause

of the diseases which infest marshes. But marshes are notoriously infested with fogs and dews; and sudden falls of temperature, especially at night in marshy districts, are existing and sufficient causes of fever. Moreover, the preventive of so-called malarial disease is *warmth*, to wit, the lighting of fires in houses; and the thing which is most pernicious to a person already labouring under such disease is cold to the skin. But no aerial poison could be counteracted by fires and flannels. Moreover, quinine is as efficacious in many diseases contracted from cold and damp as it is in so-called malarial fevers. The same line of argument is expressed by Dr. Oldham in his treatise, "*What is Malaria?*" (Lond. 1871). "Whether," he says, "in hot or in cold, in wet or in dry climates, the affections which accompany and are intimately connected with malarious fevers are those which are almost universally admitted to arise from exposure to chill." On the other hand, the powerfully wrought chain of facts and arguments collected by John Macculloch (*On Marsh Fever and Neuralgia*, Lond. 1828), by La Roche (*On Pneumonia, Autumnal Fevers, and Malaria*, Philadelphia, 1854), and many others, place the existence and morbid agency of malaria beyond a doubt. It is certain that heat and damp alone do not generate malaria, without their action upon the earth in a peculiar state; that land loaded with vegetable debris and exposed to a hot sun is dangerous, not when covered with water, but when first moistened after drought, or when drying after the wet season; that ships' crews moored close to shore may be attacked with fever, when ships a little further out to sea are exempt; that the superficially dry sandy beds of watercourses in hot countries are very dangerous in summer; that malaria can be conveyed by wind and arrested by trees; that it affects animals, and even the *fetus in utero*; that it impresses a peculiar character on the inhabitants of paludal districts; besides innumerable other properties which it would be beside my purpose to recount. Although, then, it may be granted that some inflammations arising from "thorough chill" have much in common with malarial disease, yet no surgeon who fails to recognise malaria will treat the diseases of hot or even of temperate climates satisfactorily.

The inflammations caused by malaria are those which accompany the fevers—deadly remittents in the tropics, mild intermittents in colder climates. On this point, says Macculloch, "The inflammatory or local affections, be they what they may, may be slender and truly supplementary; but they may also prevail so far above the fever, that they may appear to be a distinct disease or the superior one," if, for example, "the local affection should be permanent or continuous, when the fever has its intermissions and perhaps long ones, as in quartan, or if, still further, that fever may not be very conspicuous compared with the local symptoms." (*On Malaria*, p. 280.) In remittent fevers, there may be inflammations of the brain, of the lungs, or the pleura, of the throat, of the bronchial membrane (catarrhs), of the stomach, the intestines, the liver, the spleen, the peritoneum, of the muscles and ligaments (rheumatism)—all of these varying in their intensities in whole epidemics, as in individuals, and thus at one extreme producing cases which, under peculiar characters also in the essential

fever, may simulate or almost equal cases of phrenitis, pleurisy, and so forth. (*Macculloch*, p. 279.) In temperate climates the effects of malaria and those of cold and damp upon the nerves seem identical—neuralgia, that is, intense pain in the course of a nerve; or tenderness of a nerve trunk, with tingling, or paralysis of the parts supplied, as in the common paralysis of the portia dura; every species of spasmodic affection depending on irritated nerve trunks; and above all others, dysentery, catarrhs, and rheumatic inflammations of the eye. It belongs to the next section to describe the general characters of these inflammations.

Mental conditions, too, are most powerful predisposing and exciting causes of certain low inflammations. It is unnecessary to repeat what is of common observation respecting the power of "attention" to direct the current of blood to certain organs. The digestive organs and the genital are those whose organic diseases are most directly influenced by the mind. Dr. Brinton, in his valuable essay on "Ulcer of the Stomach," tells us of a patient suffering from disease of the stomach who was compelled to check any current of desponding thought by the aggravated suffering it occasioned; and any physician who sees uterine disease must know to how great a degree congestion, swelling, mucopurulent discharge, and hæmorrhage, may be produced by fretting and anxiety. *Anxiety of mind*, that most severe disease, as the Rev. Professor Haughton justly calls it, not only deranges the distribution, but alters the composition of the blood—it uses it up more quickly than the severest bodily toil does, and leaves it polluted with excrementitious matter. I have seen a female patient just cured of eczema, in whom a complete relapse followed a fit of intense grief.

*Embolism as a Cause of Inflammation.*—We have already stated that one local inflammation may be the focus or source of others, which are secondary or situated in remote parts. We have suggested the probability of the opinion that the changes which the blood undergoes in the inflamed part are the causes of that general feverishness which is one of the symptoms of acute local inflammation. We now proceed to notice some phenomena on a larger scale which seem to confirm these speculations.

It is now recognised among the truths of pathology that fibrinous concretions may be formed in the vessels during life, giving rise to serious and often fatal symptoms; and, moreover, that these fibrinous concretions, or portions of them, may be transported from one part of the vascular system to other vessels, or into the capillaries of parenchymatous organs, giving rise to obstruction, congestion, inflammation, softening, or gangrene. Mr. Paget was among the first authors to draw attention to the fact that fibrinous concretions might be formed during life in the pulmonary artery, and his papers, published in the *Medico-Chirurgical Transactions* for 1844 and 1845, contain some very interesting cases and observations in support of this view. (*Medico-Chirurgical Transactions*, vols. ix. and x., second series.) But the honour of the discovery of the phenomena of thrombosis and embolism belongs to Virchow, who in 1846 published some researches on the detachment of thrombi from the veins, and in 1847 on the detachment of fibrin from the valves of the heart, and the occlusion of vessels therewith.



He pointed out the facts that many of these fibrinous concretions were formed during life, in the parts where they were found after death, and such he called *autochthonous*: but that others were not formed at the spot where they were discovered, but were brought from distant parts, having been carried away in the stream of the circulation. Thus, for instance, vegetations on the mitral or aortic valves might be detached and disintegrated, and borne away by the arterial current, till they arrived at some remote vessels, as the cerebral arteries, there causing obstructions which led to softening of the brain, or to an artery of the extremities, giving rise to mortification of the foot or leg. The local autochthonous clots receive the name of *thrombi*, and those which are conveyed from remote parts are called *emboli*. Virchow put his theory to the proof by introducing into the vessels of living animals different animal substances, portions of clots from dead arteries, plugs from veins, and pieces of muscle; he also employed for the same purpose pellets of elder-pith and pieces of caoutchouc. His results may be expressed in his own words:—

“From the introduction of animal substances or elder-pith, violent pneumonia resulted, beginning with inflammatory hyperæmia and soon throwing out fibrinous exudations into the lungs, which either underwent purulent degeneration or gangrene. With the progress of these changes towards the circumference, pleurisy was soon developed, first pouring out fibrinous, clotted, and tenacious exudations over the affected portion of the lung; next, rapidly attacking the other side of the chest with enormous increase of hyperæmia, it produced extravasations into the parenchyma of the pleura and copious watery and bloody exudations into its cavity, with a great tendency to gangrenous metamorphosis. On the affected part of the lung the pleura mortified, afterwards it tore, and pneumo-thorax supervened. The whole series of phenomena developed themselves in less than five days.”

Since Virchow's discovery and the explanation which he offered, a great number of observations have been made confirmatory of his views. Dr. Richardson, in 1855, drew attention to the fact that the fibrinous concretions often found in the large vessels after death, were sometimes produced during life, and were the cause of serious and even fatal symptoms, but it appears that this most acute and able physiologist disapproved of the words *thrombosis* and *emboli*, and does not allude to this condition as a cause of inflammation, or other disease than gangrene or asphyxia from obstruction. He refers to the writings of Dr. Wm. Gould, in the *Phil. Trans.* 1684, who treated of polypi of the heart, and advocated the doctrine of the transportation of minute fragments of the concretion. (Dr. Richardson on the *Coagulation of the Blood*, Lond. 1858, containing a reprint of the author's essay on *Deposition of Fibrin during Life*.)

Dr. Bennett published in the *Monthly Journal of Medicine* of April, 1850, a case showing the relation between obstruction of the arteries and softening of the brain. Dr. W. S. Kirkes, in a paper published in the *Medico-Chirurgical Transactions* for 1852, *On some of the principal effects resulting from the detachment of fibrinous deposits from the interior of the heart and their mixture with the circulating blood*, suggested, as the result of his

observations, the possibility that fibrinous concretions of the cardiac valves might be dissolved during life, producing obstructions of certain internal as well as external organs; and in a similar manner, by simple admixture with the blood, might induce phlebitis, typhus and other analogous blood-diseases. He gives the details of three cases in which death ensued from softening of the brain, consequent on obliteration of one of the main cerebral arteries by a mass of fibrinous material, apparently derived directly from warty growths on the left valves of the heart; and in two of these cases coagula were also found in the iliac and femoral arteries, and in one of them in the renal. He refers to some preparations in the Museum of St. Bartholomew's Hospital, showing the connexion between vegetations on the cardiac valves and local concretions in the arteries of the body, and he states that out of twenty-one cases in which he observed deposits in the spleen, kidneys, and other parts supplied with blood from the left side of the heart, he found cardiac disease in every instance but two. The mere fact of so large a number of cases of so-called capillary phlebitis in internal organs being distinctly associated with the presence of fibrinous material on the valves of the heart is considered by Dr. Kirkes as sufficient to suggest a very close relation between these two morbid states, more especially as in all the cases there was an absence of any other condition likely to induce a poisoned state of the blood. Dr. Kirkes thus developed his views on embolism:—

“The view, however, which I have ventured to take is, that the deposits in the various organs are the direct mechanical results of the arrest of solid particles of fibrine detached from some part of the heart or arteries, and too large to traverse the minute capillary canals to which they are brought by the circulating blood. By the obstruction which their arrest occasions, they may induce coagulation of blood behind them, while by their mere presence, they may act as local irritants, and so induce secondary processes of inflammation and suppuration, like any other foreign body. In either or both of these ways may be produced the various appearances characteristic of these singular deposits. In a fatal case of aneurism of the abdominal aorta, several patches of capillary phlebitis were excited in one of the kidneys, though for the origin of these there seemed to be no other explanation than that afforded by the existence of fibrine abundantly deposited in laminated masses within the sac of the aortic aneurism. It is easy to conceive that portions of such fibrin might be broken up, mingled with the circulating blood, and subsequently arrested within the capillaries of the kidneys or spleen.” (*Medico-Chirurgical Transactions*, vol. xxxv. p. 281.)

Virchow in his *Cellular Pathologie*, published in 1858, claims the priority of discovery of the phenomena of embolism, and in reference to the connexion between the presence of fibrinous concretions in one part of the body and the existence of inflammation in other and remote parts, he thus writes: “Thus we see that as a rule all thrombi in the periphery of the body develop secondary obstructions and metastases in the lungs. I have long been in doubt whether I ought to consider the metastatic inflammations of the lungs altogether as embolic, because it is very difficult to examine the vessels in the small metastatic deposits, but I am more and more convinced of the necessity of considering this

kind of origin as the rule. When a great number of cases is compared statistically, it is shown that whenever metastasis occurs there is thrombosis of certain vessels. We have had lately, for instance, a rather severe epidemic of puerperal fever, and it was found, that however varied the forms of the disease might be, yet all the cases which were associated with metastases in the lungs exhibited also thrombosis in the region of the pelvis or the lower extremities, while in the inflammations of the lymphatic vessels, the metastases into the lungs were wanting." "In the pulmonary artery the portions of thrombus which are introduced penetrate to a different extent according to their size. A portion of the thrombus usually sticks fast where there is a division of the artery, because the vessels into which it divides are too small to admit it. By very large portions the main trunks of the pulmonary artery are obstructed and instantaneous asphyxia is produced, and again other portions enter into the most minute arteries and there they develop very small and sometimes miliary inflammations of the parenchyma." (Op. cit. p. 817.)

Hence it appears to be established that fibrinous concretions in portions of the vascular system may, by being disintegrated and hurried away into the current of the circulation, become the source of local anæmia, softening of parenchymatous structures, congestion of blood, hæmorrhage, inflammation and mortification. The concretions on the valves of the left side of the heart may by such transportation cause the formation of plugs or emboli in the various arteries throughout the body, not only giving rise to mortification of the extremities, but also to various congestive, inflammatory, hæmorrhagic or other diseases of important organs, as the brain, the stomach, or the kidneys, in proportion as the cerebral, the gastric, or the renal arteries may be affected. Fibrinous concretions on the right side of the heart will give rise to local obstruction of the pulmonary arteries, and hence to pneumonia, pleurisy, and bronchitis, or to congestion, hæmorrhage, and gangrene of the lung, and concretions of the portal vein will induce obstructive disease of the liver, with its concomitant phenomena, especially dropsy of the abdomen.

The most complete work which has hitherto appeared on this subject is that of Dr. B. Cohn, of the University of Breslau, who in his *Klinik der embolischen Gefässkrankheiten*, published in 1860, has given not only the history of embolism, but a clinical description of its effects as shown in the various vessels and tissues of the body. The following passages will convey a pretty correct idea of the mode in which embolism induces destructive disease in two of the most important organs. Speaking of embolism of the pulmonary arteries, he advances the following statement:—

"Capillary embolism of the lungs is a common and very dangerous metastasis. Hæmorrhagic infarction is invariably produced by this cause, and lobular metastatic abscess for the most part originates in the same manner. The infarction is in its nature a capillary process, and the bleeding which manifests it is produced through the free streams which pour, under the suddenly and enormously augmented pressure of blood crowding into the vicinity of the numerous embolically obstructed vessels. The infarction is distinguished from other diffuse effusions of blood by the granulation of the surfaces exposed by section and the greater density of the

extravasation. If the capillaries offer greater resistance and an opportunity is afforded of examining the process some time after its commencement, there is developed in the hyperæmic region a process analogous to inflammation: it is thus that lobular metastasis originates, with its rapid transition to formation of abscess. A combination of the two states presents the form of a hæmorrhagic pneumonia or of a so-called inflammatory infarction. The arteries within this deposit, however small they may be, never appear affected, and the clots which fill their canals are always secondary and recent formations. The cure of the process of infarction is very common in the first stage, only exceptional in that which has advanced farther, whilst in metastatic infiltration and abscess it has hardly ever been observed." (Op. cit. p. 353.)

Again, in reference to inflammation of the kidney. Embolism of the renal artery is twofold, either, *a*, astride of a greater or smaller ramification, or, *b*, plugging up the vessel more or less completely; in the first case the cavity of the vessel is not wholly impermeable, and therefore there is neither anatomical nor microscopical evidence of disease of the tissue. Only in so far as the prolongations of the thrombi become loose and oppose themselves to the free stream, do they develop secondary emboli of the peripheral vessels and of the capillaries. The cortical part becomes especially the seat of the development of the infarctions. But when the embolus in the first instance totally excludes the entrance of blood into a vessel, there follows in some parts anæmia, but very commonly an intense hyperæmia with capillary ecchymosis; the plug becomes incorporated with the walls of the vessel and thereby becomes smaller, and partly by this means, and partly by favourable collateral circumstances, this inconvenience, which is usually slight, is removed. Often, however, the plug conceals within it a specifically irritating power, and in this case there is developed not only an inflammation of the coats of the vessel, and a formation of abscess which may lead to perforation within and without, but also an inflammation of the adjoining parenchyma itself, and hence arises a white wedge-shaped infiltration, which may complete the stages of every process of its kind, including abscess and gangrene." (Op. cit. p. 579.)

Dr. G. M. Humphry has written an essay, greater part of which is upon the subject of clots of blood in the veins, and among other conclusions he considers that inflammation of the veins is often caused by the presence of the clots. (*On the Coagulation of the Blood in the Venous System during Life*. Cambridge, 1859, p. 23.)

Mr. Shaw has exhibited to the Pathological Society of London several morbid preparations showing the coincidence of fibrinous obstructions in the middle cerebral artery, with warty excrescences of the mitral valve. (*Transactions of the Pathological Society*, vol. iv. p. 29, and vol. vi. p. 33.)

Dr. J. W. Ogle has shown to the same society several preparations illustrating the same subject, and although in all the cases there was not sufficient evidence of the existence of vegetations on the cardiac valves, yet Dr. Ogle suggests that they might have been removed during life by the action of the blood. (Op. cit. vol. iv. p. 142, vi. p. 31, x. p. 28, and xii. p. 4.)

Dr. J. J. Goodfellow has published in the *Medico-Chirurgical Transactions* for 1862, the parti-



culars of two cases, in both of which there were fibrinous concretions on the mitral valves, and in which there ensued also mortification of the extremities and death. In one of the cases there were coagula in the brachial artery, in the aorta, the celiac axis, the bifurcation of the aorta, the common iliacs, the bifurcation of the iliacs, the internal iliacs, and in the origin of the profunda and femoral; and there were also fibrinous deposits in the spleen and kidneys. "Where there was partial obstruction, as in that portion of the aorta at the commencement of the celiac axis, as well as at its bifurcation, the inflammation was of the kind usually denominated adhesive, and the exuded matter was susceptible of some organisation. Where the plugging was more complete the inflammation was of a more intense character, and was followed by the exudation of an albumino-fibrinous material, mixed with pus, or which soon degenerated into pus." (*Medico-Chirurgical Transactions*, vol. xlv. p. 367.)

The latest writers on the subject of embolism in its relation to the phenomena of capillary congestion are Drs. Lancereau and B. Ball. The former has written a work devoted particularly to the subject of cerebral softening, in its relation to vascular obstructions. He does not maintain that all cases of softening of the brain arise from this cause, but he expresses his opinion that a large proportion of the softenings called essential originate in this manner. (*De la Thrombose et de l'Embolie Cérébrales, considérées principalement dans leurs Rapports avec le Ramollissement du cerveau. Par E. Lancereau. Paris, 1862.*)

Dr. Benjamin Ball, in his treatise (*Des Embolies Pulmonaires*, Paris, 1862), shows how inflammation, gangrene, and cancer of the lungs, may be produced by the transference of contaminated clots. Consecutive inflammations, large and small, may, we hope, now, by the aid of modern observation, be transferred from the list of *vital*, i. e. inexplicable, to that of phenomena whose antecedents are known and understood.

It may be readily understood why inflammations of the lungs are so frequent, and why certain kinds of pneumonia follow amputations in military hospitals—they being the organs first permeated by blood which has become chilled or poisoned in its transit through the body.

*Metastasis.*—In the foregoing remarks, the word *metastasis* has been employed to signify the production of a secondary inflammation through the physical transference of clots or contaminated blood from a diseased part to a healthy one. But there are two other cases in which the word is used. One is, when the heart is affected in rheumatic fever. The other is when inflammation—especially the gouty—suddenly leaves one part and appears at another.

In *Rheumatism*, as Dr. Fuller says, "although rheumatic inflammation of the heart may possibly be connected in some rare instances with the sudden subsidence of articular inflammation and the transfer of irritation from the external parts, it must be regarded in most instances as a mere coincidence and as an extension of local manifestations of the disease." (*On Rheumatism*, Lond. 1852, p. 139.) Certainly the notion that inflammation of the heart during rheumatism arises from metastasis is erroneous and mischievous. It may be the first symptom, and one that might be overlooked by a believer in metastasis. Dr. Fuller

believes that the circumstances which render the heart prone to suffer are whatever renders the organ irritable; in other words, as we have said at p. 32, over-work and under-nutrition of any organ are surely the means of making it inflame during the existence of any great blood disturbance.

In *Gout* the phenomena of metastasis are more common during a fit of acute gout. Sometimes spontaneously the inflammation may shift from one joint to another of the same foot, or to the other foot. It is well known that the application of cold, and sometimes of very hot water, will cause the local inflammation to vanish, and then will come on a furious headache, an attack of spasm or imperfect action of the heart, of difficult breathing, or of violent pain in the stomach. In gout, too, the most worked, worst nourished, feeblest, and injured parts, are most liable to suffer primarily and secondarily.

Section 7.—*Varieties of Inflammation; Classification, &c.*—The phenomena of inflammation display so great diversity, that they have largely taxed the ingenuity of pathologists in the attempt to classify them, and to give names to the several varieties. Some have classified them according to their violence (*acute*); to their relations to time (*chronic*), or to the original strength and weakness of the patient (*sthenic*, and *asthenic*, *low*, *irritable*, &c.); or to the amount of weakness induced by the disease; or to the supposed final cause of the inflammation (*conservative*, *destructive*, &c.); or to the local effect produced, as the *œdematous*, *adhesive*, *suppurative*, *ulcerative*, *gangrenous*, *carbuncular*, &c.; or to the texture of the part involved; thus we used to read of *serous*, *mucous*, *cutaneous*, *fibrous*, &c.; or to the disposition to be limited or to spread (*circumscribed*, *diffuse*, &c.). These classifications require passing notice, as being parts of the literary history of our profession; but for all practical purposes the only classification worth noticing is that depending on varieties of cause, whether that cause be an agent or condition, external to the body, or internal, or both combined.

The term *acute* signifies violence, and usually rapidity and short duration. It points usually to great hyperæmia, heat, and throbbing; these are usually soon succeeded by exudation.

The term *subacute* "is a proper one, because there are cases of inflammation, sometimes occurring idiopathically, oftener perhaps symptomatically, either in combination with febrile or exanthematous disease, or with chronic diseases, functional or organic, which present the symptoms of inflammation, and produce more or less of the effects of inflammation within a short time, but which never attain any great extent or intensity, nor effect great alterations of structure, and can be controlled without any very active treatment. The mucous and serous membranes present many examples of this kind." (*Alison, in Tweedie's Syst. of Prac. Med.*, vol. 1. p. 82.)

The terms *active* and *passive*, *sthenic* and *asthenic*, point respectively to a vigorous patient, with a disease rapidly proceeding to a termination, or to a languid feeble patient with a slow and obstinate disease, benefited by stimulants, general and local.

There is yet another division of a similar kind into *distinct* and *latent* inflammations, the latter term being applied to cases, not uncommon, when internal inflammation takes place, and

produces its usual effects on the textures concerned, with so little of its usual symptoms as not to be recognized, without very unusual care and discernment, during life (*Alison, ut supra*), in consequence either of extreme debility, or of the concurrence of some other disease, which, by impairing the sensibility of the patient, masks the local symptoms.

A second mode of classification is founded on the fact that some forms of inflammation can be generally produced at will and are of daily occurrence, hence they are called *common*; whilst others either are of rarer occurrence, or require the operation of some special train of causes, or some particular kind of constitution to operate on. Thus we speak of the inflammation following a common blow or cut, as *common*, whilst the inflammation which follows certain definite morbid causes, and especially to animal poisons of the zymotic order, is called *specific*. Again, the inflammation produced in certain constitutions may be *specific*. Thus a strain which would produce common inflammation in an ordinary person may provoke gout in a person having that *diathesis* or disposition. The line between common and specific inflammation is not always easy to draw; and the most correct form of statement would be, that every different cause produces a different variety of inflammation, in every variety of constitution. In many cases, as was said in the last section, we assume the existence of a specific cause to account for the existence of a specific form of inflammation. We assume that the cause which produces inflammation of Peyer's patches in the small intestine differs from that which produces dysentery; sloughing sore throat from diphtherite; erythema nodosum from eczema; and so on of the rest.

As for the classification according to local effects, as the *adhesive, suppurative, ulcerative, and gangrenous*, of Hunter, to which he was compelled to add, as being in some respects peculiar, the *oedematous, the erysipelatous, and the carbuncular* (*Hunter's Works*, vol. 3, p. 310), and to which he might have added the *leprous, eczematous, diphtheritic, &c. &c.*, it is evident that it is descriptive partly of certain stages of the disease, partly of differences in phenomena considered in connection with *causes*.

With this mode is closely adjoined the idea of classification according to the *final cause* or purpose in the animal economy which it is supposed that the inflammation is intended to effect. Mr. James's classification is of this kind. He first divides inflammations into two great *classes*: according as the exudation assumes the limited form of coagulable lymph and confines itself within certain limits, or, on the contrary, tends to spread. His *orders* are founded on the degree of vital importance of the organ affected: the *genera*, on the disposition of the inflammation to a particular mode of termination. Thus of spreading inflammations one *genus* is supposed to resolve, as the catarrhal inflammation of mucous membranes and mumps; a second to suppurate, as the cysts of abscesses, boils, and whitlows; a third either to resolve or suppurate, as erysipelas, phlebitis and its congeners; a fourth to ulcerate and slough, as carbuncle, hospital gangrene, cancrum oris; and a fifth to cause rapid mortification, as the inflammation from fevers, from obstructed circulation, &c.: and this disposition is so strong, that it is very difficult in many cases to procure any

other termination. It may happen, however, that there shall be more than one mode in which the inflammation is disposed to terminate, as in either resolution, or suppuration, or sphacelus, &c. (*James, On Inflammation*. Lond. 1832.)

This classification is not now in use. The practical fact that remains is the tendency of certain inflammations in proportion to their unhealthiness to generate exudations that break down into liquid, and hence to spread themselves and the disease along the surface of membranes or through the areolar tissue. To this classification belongs the division of inflammation into healthy and unhealthy, conservative and destructive, of which we have before spoken (p. 10).

Yet another basis of classification has been framed according to the tissue involved—a doctrine known to and refuted by Hunter, supported by Carmichael Smyth (*Med. Communications*, 1790, vol. ii. p. 168), and wrongly ascribed to Bichat. The tissues in question are five, and the doctrine supposes that the inflammation of each is essentially different. The first is phlegmonous inflammation, which affects the cellular membrane, including the parenchyma of the several viscera; the second is inflammation of serous membranes; the third, of mucous membranes; the fourth, which is named erysipelatous, is of the skin; and the fifth, termed rheumatic, belongs to fibrous structure. It is perfectly true that “even in its acute, and still more in its chronic form, inflammation frequently spreads extensively, lasts long, and produces decided lesions in one texture without in the slightest degree affecting others in its immediate neighbourhood.” (*Alison, in Cyc. of Prac. Med., Art. Hist. of Med.*)

Most true it is that whatever tissue is involved will behave in a manner proper to itself. Every tissue has certain modes of feeling. The inflammation of the skin has not the same pain that has inflammation of the bones. A dense tissue like tendon cannot swell nor show redness to the same extent as one that is loose and vascular. Hence there is no doubt that inflammation is modified by tissue.

But whatever may be the influence of texture on the course of the disease, it cannot be admitted as the basis of classification; for, as Mr. James truly says, “there is not the smallest question that different forms of inflammation are liable to occur in the same tissue; that the same kind of inflammation is met with in different tissues; nay, more, that the same inflammation shall be transferred from one tissue to another.” (*James, ut supra*, p. 267.) And Hunter puts the objection even more definitely. “If the doctrine were true,” he says, “we should soon be made acquainted with all the different inflammations in the same person, at the same time, and even in the same wound. For instance, in an amputation of a leg, where we cut through skin, cellular membrane, muscle, tendon, periosteum, bone, and marrow, the skin should give us the inflammation of its kind, the cellular membrane of its kind, the muscles of theirs, the tendons of theirs, the periosteum, bone, marrow, &c., of theirs; but we find it is the same inflammation in them all.” (*Hunter, On the Blood*, cap ii. sec. 7; *Works*, vol. 3, p. 313.)

It has been held indeed that rheumatic inflammation is inflammation of fibrous tissue, and that inflammation of fibrous tissue is therefore rheuma-



tic. This is a kind of syllogism of which, when reduced to plain terms, every reasonable being can see the fallacy. "A is B, and C is B, therefore C is A." Nevertheless this syllogism is a very favourite one with medical and surgical theorists.

It is but justice to state that, although Bichat declares that inflammation derives *some peculiarities* from the tissue in which it is seated, he does not, as is sometimes alleged, assert that it owes every peculiarity to that source. It is a matter of reason that the redness, the pain, and the heat and swelling, must be modified by the structure and sensibility of the part inflamed. (*Anatomie Pathologique*. Paris, 1825, p. 28.)

The varieties of inflammation, or, in other words, the various local effects produced by the great variety of causes enumerated in the foregoing section, on the great variety of constitutions are indicated by differences in the *effects* produced, in the *time* required to produce those effects, and in the *place, form, colour, and size* of the morbid changes wrought. The constancy of the form, size, and duration of these *specific* deviations from ordinary nutrition is astonishing. For example, the vesicle of small-pox with its central depression, followed by pustulation, the vesicles of herpes, the livid nodules of erythema nodosum on the skin, the symmetry of the patches of lepra and psoriasis, the ulcers formed in typhoid fever at one certain and usual part of the small intestine, and the rose spots found in the same malady on the trunk, all these are instances showing the rule of law even amidst disorder, and how precise are the operations, other conditions being equal, of each set of causes. It is the peculiarity of the *specific* inflammations to be the most precise, each in its peculiar manner of form, time, and effect. The effects of remedies in some specific inflammations may also be taken as means of diagnosis.

The influence of diversity of cause in producing great diversity of the phenomena classed under the common term inflammation, is well illustrated by Dr. Budd (*On the Liver*, 2nd ed. 1852, p. 65). Inflammation of the knee-joint, for instance, seems a simple expression, but see the diversity of inflammations produced by different causes! If caused by a penetrating wound with admission of air, rapid suppuration, the acutest feverishness, and destruction of the joint, usually follow. If caused by *pyæmia*, i.e. the presence of decaying animal matter in the blood, there may be little pain or swelling, but suppuration so rapid as to encourage the belief that the pus instead of being formed in the joint had been brought there. From which belief arose the term *purulent dépôt*. If caused by rheumatism there is severe pain and much effusion; but the effused fluid is never purulent and is almost always absorbed as the patient recovers. If of gouty origin, there are great pain and great effusion, which is apt to leave particles of lithate of soda in the synovial membrane and surrounding tissues. If in consequence of gonorrhœa there will be obstinate tenderness, often great effusion, extremely rebellious to remedies, but getting well at last.

It is most essential that the practitioner should know the natural history of each kind of inflammation, in order that he may have grounds both for prognosis and treatment. For instance, knowing that certain natural limits belong to each of

the specific inflammations, *e.g.* that of the skin in small-pox, he will not set to work to extinguish it by too active measures, but will rather nurse the patient through the malady till the time comes when the inflammation may be expected to subside of itself.

On this point hear the immortal Sydenham. The greatest part of diseases, he says, are reducible to some given form or type, in the production and maturation whereof Nature binds herself to a certain method as stringently as she does with plants and animals. The reasons for believing a disease to be a species are equally cogent with those we have for believing a plant to be a species. The rise, increase, progress, and termination of diseases are as regular as those of a plant. If a plant be substantial, and not a mere combination of "principles" or "qualities" so must disease be. The difference is that whereas plants exist by themselves, diseases depend on the humours that engender them. (*Sydenham*, preface to third edition, Syd. Soc. ed. 1848, vol. i. p. 19.)

We will now briefly sketch the leading varieties of inflammation, or endeavour at all events to show the meaning of the terms commonly used in treating of them.

*Common acute* inflammation of traumatic origin has been already taken as the type and model and requires no further description. The best description (for definition there is none) of acute inflammation is that it is often sudden in origin, and marches rapidly to some termination or effect dangerous to life or to the integrity of the part affected; it is also attended with fever from absorption of spoiled elements into the blood.

*Subacute* inflammation is said to exist when some but not all the properties of acute inflammation are found; and this whether as regards violence, or danger to life or to structure. Thus, *mumps* may be defined to be a subacute inflammation of the parotid gland; for although sudden in origin, and severe as to pain and swelling, it rapidly subsides by resolution, rarely leaving mischief behind it.

*Chronic* is the name given to inflammatory phenomena when they tend to last long or even indefinitely. It produces changes of surface and of structure. On mucous and cutaneous surfaces it produces an unnaturally copious immature secretion, mixed more or less with serum, the epithelial cells presenting every form of degradation between their natural shape and pus corpuscles; sometimes a shedding of flakes of consistent epithelium, thickening of the membrane, dilatation of the blood-vessels, weight, pain, and undue irritability to the action of ordinary stimulants. In the substance of organs it produces interstitial exudation; solidification, hardness, weight and swelling from infiltration with fibro-plastic matter in various grades of development; with the presence of exudation, there may be a starving, softening, fatty degeneration, and atrophy of the proper structure; because when the chronic inflammatory exudation shrinks or is atrophied, the whole organ is apt to be found wasted and shrunken, or at least its working elements are so. Chronic inflammation may produce serous exudation, often adhesion between opposite surfaces of serous membrane; fibrinous exudation may decay and undergo fatty degeneration into one of the varieties of "tubercle," or may soften down and constitute the starting-

point of chronic abscess. Chronic inflammation often leads to *ulceration*; i.e. the piecemeal disintegration of the inflamed and infiltrated tissue; rarely to *gangrene*, or sloughing of conspicuous portions, unless some injury or other cause be superadded. Chronic inflammation may be caused by some permanent local irritant, as inverted eyelashes; by some degeneration of tissue, as varicose veins; but more usually by some error in the composition of the blood, whether gouty, rheumatic, or the like.

*Sthenic* inflammation is that met with in vigorous persons, from common causes.

*Asthenic* inflammation exists, either when a common cause operates upon a person in a state of great debility, especially if combined with impure blood and organic disease of kidney or liver, &c., or when some specific cause of itself of a poisonous lowering nature has produced the inflammation—erysipelas, for example.

*Secondary* inflammation is that which may be supposed to arise from the influence of spoiled materials from an existing inflammation, which act as a blood-poison, and produce other inflammations elsewhere. The secondary inflammation of the eyes and joints after gonorrhœa is an example.

*Catarrhal* inflammation is a name often applied to inflammation of mucous membranes, with copious secretion of mucus or muco-purulent matter—very liable to spread from one end to the other of the affected membrane. The term catarrhal is also sometimes applied to inflammations of mucous membrane produced by cold or damp.

*Gouty Inflammation.* Come we now to the consideration of certain definite varieties of inflammation, excited by some definite causes; the existence of which causes is assumed in most cases, from the constancy of the effects. And first of gouty inflammation, that common accompaniment of luxurious life. The persons subject to gouty inflammation are supposed to be those who, themselves or in the persons of their progenitors, have indulged too copiously in animal food and imperfectly fermented liquors, as beer and port wine. Gout may be manifested in a form which is called regular and typical, or may be irregular. Robust persons who have generated gout by their own excesses usually enjoy it in the regular, feeble persons and those who inherit it in the irregular. In the former class of cases, which I call *high gout*, the attack is often provoked by a bout of excess; in the latter, which I call *low gout*, it is usually induced by depressing causes, especially anxiety of mind, overwork, and defective or unwholesome food. In both classes we assume a bad quality of blood, containing some material which is either superfluous or unfit for healthy assimilation; and which is capable of being broken down into poisonous matters which excite general feverishness and local inflammation, till at last they are converted into urinary or other excrementitious matter, and got rid of by bowels, skin, and urine. For a description of the true regular sthenic gouty attack, nothing can be more life-like than Sydenham (*Works*, Sydenham Soc. ed. vol. ii.). Before the fit, some crudity and indigestion, but usually on the very day before it *the appetite unusually good*; patient goes to bed in good health and sleeps, is awaked by excruciating pain in the great toe, shivering and other feverish symptoms, the part

affected hot, red, shining, and exquisitely tender; pain remitting at daybreak, and followed by sleep and perspiration; a series of greater or lesser fits on successive nights, till at last the disease passes off with intense itching and desquamation of cuticle; the urine often pale and copious before the fit, but usually soon becoming scanty and depositing lateritious sediment copiously.

It is not, however, with the regular or high gout that the surgeon has to deal. His chief concern is with latent gout, which is extremely common amongst all classes in large towns, and which produces a variety of symptoms often of the most perplexing and deceptive character, inasmuch that in treating elderly men the surgeon is always bound to be on his guard against gout just as the physician is against hysteria in treating young women. If we except the well known and regular attacks of gout on the foot, the organ most frequently disturbed is the heart, and there are few gouty patients who have not a tale to tell of some faintnesses, palpitations, oppression, and disordered breathing. Gout may affect the seat of any injury, especially bruises, strains, and other injuries of ligament and bone. Gouty inflammation may follow injuries of the head: there are several forms of ophthalmia due to gout (see *IRITIS*): the outer ear is liable to deposition of chalkstone, and the internal structures of the ear to thickening and impaired function from the same. But it is gouty affections of the urinary organs which more particularly interest the surgeon: there is a gouty irritation of the kidneys, which produces all the symptoms of renal calculus: gouty inflammation of the bladder will produce some of the symptoms of stone: the urine *may* be loaded in the latter case with alkaline mucus, whilst itself is intensely acid: crystals of phosphates will be found in the mucus and crystals of lithic acid in the urine. The urethra is liable to gouty inflammation which may produce a muco-purulent discharge, not easily to be distinguished from the results of contagion: the testicles to gouty inflammation and swelling: spasm of the sphincter ani, piles, and many skin eruptions, particularly eczema, are due to the same cause.

How, then, is gouty inflammation to be distinguished? Often by the testimony of the patient to the previous occurrence either of regular gout, or of some of the irregular symptoms which we have just enumerated, and especially of functional disturbance of the heart; by the suddenness with which the attack seems to come on; by its occasional sudden subsidence, or metastasis to some other part; by its access being often determined by a fit of excess, or by some depressing cause, such as fatigue; by its obstinacy until the proper remedies are adopted; by the premonitory symptoms which are always to be discovered if inquired for, particularly by the history of the urine, which, as the attack is passing off, deposits copious sediments of lithates. Lastly, by the Hippocratic rule, "*Curatio morbum ostendunt*:" for gouty inflammations, if they resist the gentle purgatives, the vapour baths and other sudorifics, and the alkalis which are the rational remedies, are often relieved magically by the empirical use of colchicum.

The most *positive* view of the nature of gout is that propounded by Dr. Garrod (in his work *On the Nature and Treatment of Gout*, London, 2nd ed., 1863).



"In true gout uric acid, in the form of urate of soda, is invariably present in the blood in abnormal quantities, both before and at the time of the fit."

We must refer to Dr. Garrod's book for an account of his exceedingly delicate and ingenious test for the presence of uric acid in the blood.

His views are contained in the following propositions:—

1. Gouty inflammation is *always* accompanied with deposit of urate of soda in the inflamed part.

2. The deposit is crystalline and interstitial, and continues during many years, or for life.

3. The urate of soda is the cause and not the effect of the inflammation.

4. The inflammation of the gouty paroxysm tends to destroy the urate of soda in the blood of the inflamed part. This proposition is supported by the experiment of putting on two blisters, one on the inflamed part, the other at a distance, when the serum of the latter is found to contain uric acid, that of the former none.

5. The kidneys in gout appear to lose their power of excreting uric acid.

6. The impure state of the blood, arising principally from the presence of urate of soda, is the probable cause of the disturbance which precedes the seizure, and of many of the anomalous symptoms of gouty persons.

7. The predisposing causes of gout are such as produce increased formation, or else retention of, uric acid in the system.

8. The exciting causes of a fit of the gout are such as diminish the alkalinity of the blood, or increase the formation, or check the elimination, of uric acid.

9. In true gout alone is there a deposit of urate of soda in the inflamed tissues.

It will be evident that there are still many points which Dr. Garrod's propositions fail to clear up: such, for example, as the determining cause of a fit of the gout; and the reason why uric acid may be present in the blood, and may be deposited in the tissues without giving rise to acute inflammation in some cases but not in others. There is still something wanted to account for an attack of acute gout; and we cannot subscribe to the doctrine that the feverishness of the gouty paroxysm is a mere reaction resulting from the local injury. Yet the fact remains that in an attack of gouty inflammation the urate of soda in a crystalline form is discovered in the substance or cavities of the affected parts.

*Rheumatic Inflammation* has been supposed to be caused by the presence of lactic acid in abnormal quantity in the blood, as gouty by that of uric acid. Although this view is largely supported by the experiments of Richardson, it by no means passes unquestioned. In the excellent work in which Dr. Benjamin Ball sums up his observations on this subject (*Du Rhumatisme Viscéral*, Paris, 1866) he has come to the conclusion that it is impossible at present to make a general definition of rheumatism which shall hold good. The lactic acid theory, he says, rests on two hypotheses: one that ammonia is the solvent of fibrin in the blood; the other that cardiac affections of apparently rheumatic character found in dogs into whose veins lactic acid has been injected have been caused by the lactic acid: the inference being that the lactic acid, by neutralising the ammonia, produces the abnormal depositions of fibrin. The former of

these hypotheses is already disproved, says Dr. Ball; the latter is shown to be untrustworthy by the fact that such cardiac affections are extremely common in uninjected dogs.

Rheumatism is a specific disorder, and cannot be created at will; although cold, damp, and malaria are the best established predisposing and exciting causes. Its favourite seat is the white fibrous or connective tissue, especially that of the lining and investing membrane of the heart and the ligaments and tendons; but there is no structure or organ which is at all times exempt. The characteristics of acute rheumatism are great pain and sensitiveness, a skin sometimes hot and dry, but usually soon bathed in sour perspiration, tongue moist, but coated with whitish fur, and acid saliva. The bowels are costive, with dark and offensive stools; the urine scanty and high coloured, loaded with lithates; the pulse accelerated, full, and bounding; the appetite usually fails, and is replaced by thirst, though in some cases there is no variation; nor, unless some complication be present is there any failure of the intellect. There is usually great sleeplessness, and the patient becomes irritable and fractious. The local symptoms are: pains, first migratory, then fixed, usually in some of the large joints, which become hot and red, with great tenderness and pain. Effusion into the cellular tissue soon makes the part tense and shining: and sometimes there is effusion into the joint itself. This articular inflammation shifts itself with great rapidity from one joint to another, and is usually more severe towards evening. It is very seldom followed by suppuration. Ligaments become stiff and short. The duration of the attack may be from a few days to many weeks or even months.

Rheumatism may affect an injured or wounded part, and may then be recognised by its not being confined to that part, and by the presence of the symptoms above mentioned, especially in regard to the perspiration and urine and the want of sleep. Irritation of the bladder and urethra, a not uncommon accompaniment of rheumatism, especially towards the end of an acute attack, may be due, says M. Ball, either to the concentration and irritant character of the urine, or to a rheumatic inflammation of the walls of the bladder itself. The testicle also is sometimes affected, the tunica vaginalis being the usual seat of the disturbance. Meningitis in the skull or the spinal canal is now and then a consequence of rheumatism: in the former case producing delirium, convulsions, coma, and death; in the latter, paraplegia. Other cerebral symptoms are insanity and (rarely) apoplexy. The post-mortem signs are very slight and uncertain; and the effects manifested during life bear a great analogy to those of albuminuria; so that the diagnosis depends on the coexistence of the ordinary signs of rheumatism. The presence of cardiac and pulmonary complications is most often the precursor of cerebral symptoms, and doubtless some of the latter may be ascribed to the embolisms consequent upon the former. The spinal symptoms can be distinguished from those of simple inflammation of the cord and its membranes by the greater severity and persistence of the hyperæsthesia, convulsions, and fever which characterise the latter.

Chronic rheumatic inflammation usually affects the joints and the muscular tissues both external and internal. It has been supposed to attack the

uterus, stomach, œsophagus, tongue, pharynx, diaphragm, and other structures. It is rarely followed by cardiac and cerebral mischief, but cases are recorded of distinct endocarditis and pericarditis, in which the rheumatic symptoms have been manifested in a very slight degree externally. In general it may be said that the nature and effects of chronic rheumatism are those of the acute disease in a very mild form.

The best division of rheumatism is that based on the kind of structure attacked; thus we may describe it as affecting, 1. the fibrous, 2. the muscular, and 3. the nervous tissues; and in each case either in the acute or chronic form.

Of the first of these kinds, the common *acute rheumatism*, or *rheumatic fever*, is the type. Its characteristics, and the points by which it may be recognized when it attacks parts already injured, are given above. The chronic form of this kind of rheumatism affects the patient with aches in ligamentous and tendinous structures, which are aggravated at night and in changeable weather; and, if long continued, result in permanent contractions of ligaments and fasciæ, and effusions into joints and synovial sheaths.

The *muscular*, in its acute form, usually affects some one muscle or set of muscles, whether sound or injured, with intense pain and paroxysms of cramp. Well-marked varieties of it are wry-neck, and inflammatory spasm of the sphincter ani. The term "*pleurodynia*" is applied to inflammatory spasm of the intercostal muscles, which also comes under this head. If muscular rheumatism becomes chronic it may end in permanent shortening of the muscle affected, or in atrophy.

The *nervous* variety is exemplified by sciatica; but no nerve is exempt from it. It is distinguished by very great tenderness and pain in the course of the nerve, with numbness, or more probably intense hyperæsthesia of the part supplied by it. The acute form, if very severe or long-continued, may produce wasting of the nerve and effusion into its sheath, with atrophy of the muscles. But more often it becomes chronic, troubling the patient for years, more especially when he is in bad health, or during bad weather. It differs from functional neuralgia in not being intermittent nor curable by quinine, and by the tenderness in the course of the nerve.

Other tissues, however, may be attacked, as, for example, the periosteum, which is the seat of one variety of the so-called "*neuralgia of the head and face*," an affection excited by decayed teeth, cold, and repletion. Rheumatic periostitis ought to be distinguished from true neuralgia, though the two may co-exist.

In broken-down constitutions it is sometimes by no means easy to distinguish between the effects of rheumatism and those of syphilis.

The disease most liable to be confounded with rheumatism is gout. But it is only in obscure cases, and especially in those of internal rheumatism or gout, that any real difficulty exists. The differences are thus summed up by Dr. Garrod:—Gout is the more distinctly hereditary; it occurs by preference in adult males and high livers; it usually attacks a single small joint, as that of the great toe, with intense pain, œdema, and peeling of the skin, and with moderate febrile disturbance. It does not produce endocarditis nor pericarditis, but commonly deposits urate of

soda in cartilages and ligaments, and externally as chalk-stones. Its paroxysms are periodic and short, not lasting at first more than eight or ten days, and are coincident with the presence of uric acid in large quantity in the blood. In every one of these particulars it is distinctly contrasted with rheumatism. Dr. Ball, whose work is above quoted, says further that in gout atheroma of the arteries is common, with apoplexy as a consequence (p. 156); and contrasts the bronchial catarrh which often accompanies gout with the acute lung diseases produced by rheumatism.

"Gout is to the stomach," he says, "what rheumatism is to the heart" (p. 158). The heart affection that accompanies gout, in the few cases in which any exists, is fatty degeneration of the muscular substance. The effects of rheumatism on the stomach have yet to be demonstrated. The endocarditis and pericarditis which are the characteristic sequel of rheumatism, and the habitual dyspepsia and stomach-pains of gout, mark in most cases the distinction between the two diseases, respectively of external manifestations.

*Chronic Rheumatic Arthritis*, improperly called *Rheumatic Gout*, differs in its nature from both the preceding in the following points: It is a progressive disease of the articular ends of the bones, not complicated with heart or kidney disease, nor accompanied by uric acid in the blood, nor by any considerable fever. Its attacks are of indefinite duration; they affect both large and small joints, in persons of all ages, with or without hereditary predisposition; and are usually excited by cold and depressing causes. The development of the disease is attended with some pain, and with much swelling; sometimes with œdema. Its results are destruction of the articular cartilages, and nodular growths in and around the ends of the bones, the surfaces of which become infiltrated with hard, ivory-like matter, and are sometimes quite smooth and polished by subsequent use. The joints attacked usually become stiff and permanently useless; but never exhibit the chalk-stones of gout.

There is, however, a form of inflammation which may with more propriety be called *rheumatic gout*.

This often occurs in children, affecting the small joints of the hands and feet with the phenomena of true gout. The results of it are seen in a weakened state of the ligaments; which renders the arches of the foot incapable of bearing up the weight of the body, and so produces flat-foot (the "*pes longus*" of Horace) and bending inwards of the ankle.

*Gonorrhœal Rheumatism* is an example of a general inflammation with local effects of a very definite sort, evidently caused by the presence of suppuration in the urethra. It may be considered a petty form of pyæmia. It usually affects young men with light hair and blue eyes. A patient of this type who has gonorrhœa, towards the termination of the discharge, complains of inflammatory symptoms in the eyes, which become irritable and intolerant of light, with aching and burning sensations. There is no conjunctival inflammation, but the bright pink hue of scleritis is easily recognised. Simultaneously, pains and superficial inflammation affect the smaller joints of the feet, and the ankles and knees. The pain is more troublesome at night than in the day, and breaks up the patient's rest. There is no special perspiration nor elevation of



temperature, nor does the urine resemble that of acute rheumatism. After variable periods of time the acute symptoms subside, leaving the affected joints and tendons, especially the tendo Achillis, subject to nocturnal aches, and very painful after exertion. The diagnosis of this disorder is of some consequence to the reputation of the surgeon. The prognosis is always favourable; the eyes, especially, soon recover themselves.

*Malarious, Intermittent, and Neuralgic Inflammation, Neuralgia, &c.*—We have enumerated malaria as a cause of local inflammation, and have laid stress on the fact that in dysentery and catarrho-rheumatic ophthalmia this should be well weighed in the treatment. Some of the greatest triumphs of the healing art are manifested when the practitioner can step in, and by no roundabout or tedious method guiding an abnormal process to a safe termination, but at once, as it were, *pulveris exigui jactu*, cut short the whole phenomena of the disease. "In the treatment of fevers by the ordinary routine," says Torti (quoted by *Alibert, Traité des Fièvres pernicieuses*, Paris, 1809), "the physician acts as a looker-on at the disease and the servant of Nature; but in the treatment by cinchona he acts as master of the disease and teacher of Nature." For on the solid principle, *curationes morbum ostendunt*, the use of bark or quinine not only cuts short many malarial diseases, but is accepted as the first and most emphatic evidence of their real nature. The second test usually accepted as a note of malarious disease is intermittence, and it is this which in this country usually leads to the trial of quinine. During the year 1870, I was attending a young gentleman of 15 with inflammation of the bowels; great pain, tenderness below the navel, heat of skin 102°, and vomiting. He had suffered from a similar attack some months before, which yielded to the ordinary remedies, especially opium and fomentations. But in this second attack there was a provoking tendency to relapse, preceded by chills; and in the intervals the pulse kept above 100, and the skin not under 101°. It soon became obvious that the relapses came on each fourth day; accordingly quinine was given in sufficient doses, and the disease was cut short. Dr. Arthur Farre saw the case in consultation with me. Here there was no evidence of any malaria; it was the intermittence only which guided *probably* to the true cause, and certainly to the true remedy. The late Mr. C. H. Moore (*Med.-Chir. Trans.* vol. 1.) gives two cases of periodic inflammation of the knee joint, pain, tenderness, and effusion; in one case an agueish complication was undoubted; both were more or less benefited by quinine. Sir Henry Holland (*Medical Notes and Reflections*, 3rd ed. Lond. 1855, p. 290) gives instances of periodic cough, vomiting, thirst, tonsillitis, and of epistaxis, connected with ague and cured by bark. The whole train of neuralgic disorders are famous for their intermitting character, and this is *per se* a ground of suspicion of malarious origin or complication in whatever disease it may be observed; that is to say, that if a patient be affected by malaria, any local inflammation is liable to take an intermitting character. It must be noted, however, that not all malarious inflammations are intermittent, nor yet all intermittents malarious. The common acute hectic, caused by deep-seated abscess, is decidedly quotidian. Moreover, some malarious affections are

periodic, and have *definite* intervals; some intermittent, with irregular intervals; and some obstinately recurrent, after long uncertain intervals. In the third place, malarious inflammations are universally attended with lowness and prostration, and are no whit relieved by depletion. Hence Dr. Macculloch speaks of them as not "genuine" inflammations. But as we have shown, it is an error to speak of inflammation as a thing to be universally combated by depletion, or to suppose that "antiphlogistics" are all of one debilitating sort. Fourthly, malarious inflammations haunt certain places, and often affect several persons at a time. Lancisi describes an epidemic inflammation of the air-passages, varying from the merest coryza to strangulatory pneumonia (*Historia Epidemice rheumatice quae per hyemem anni 1709 vagata est*, Romæ, 1711), which raged at Rome in the severe winter of 1709. "It is clear as day," he says, "that in the present epidemic the fever is the chief disease, and that the inflammations are, as it were, its symptoms; for these recur at stated periods, and end generally with those *crises* which are wont to happen in the fevers called by the schools essential." Fifthly, whilst there is no local affection which may not be complicated by malaria, those which most decidedly betray this connection are the neuralgiæ. Here we must distinguish the inflammatory neuralgia, of which ordinary sciatica is an example, which may affect the highly fed and plethoric, and be greatly benefited by purgatives, and the pure functional neuralgia, in which there is pain in nerves, with no local change. In the malarious neuralgia, there is evidence of some local change, though seldom more than some vascularity, with serous effusion at the seat of pain. This is exemplified by the common brow ague, or neuralgia of the supra-orbital nerve; by neuralgia of the infra-orbital or any other nerve. It is distinguished by the four points of diagnosis already mentioned:—curability by quinine, intermittence, prostration, and endemicity. But any very painful, obstinate, and asthenic inflammation, especially of nerve or tendon or periosteum, whether rheumatic or not, is amenable to quinine. Sixthly, we must enumerate the visceral engorgements and inflammations—of the brain, lungs, liver, spleen, stomach, &c.—which occur in the course of the remittents of hot climates, and of which we have little experience here. In the "pernicious" fevers of Italy, pneumonia is a common occurrence, large portions of lung becoming infiltrated with exudation. In the course of a hasty visit to the Ospedale dello Santo Spirito at Rome, I learned from Professor Baccelli, that in the malarious pneumonia the chlorides do not absent themselves from the urine, and that the exudation is more inclined to liquefy than to undergo hepuitization. To complete the outline of the relations of malaria to local inflammation, we may add that wounds are affected by it. C. L. Dumas narrates of the wounds that were treated in the hospitals of Lyons during the revolutionary civil war, that if they were severe, and especially if lacerated, and the patient had suffered much loss of blood, and had been inhaling the air of foul camps or marshes, the patients were liable on the 10th or 11th day to be seized with remittent fever. The symptoms were shivering and great restlessness, followed by intense heat and fever, coming in daily paroxysms, with distinct remissions; the wounds meanwhile

dying, ceasing to suppurate, and yielding a thin bloody ichor. (*Dissertation sur les Fièvres rémittentes qui compliquent les grandes Plaies. Mém. de la Soc. méd. d'Émulation, Paris, An IX.*)

It will not be easy to distinguish between malarious fever and pyæmia when wounded patients in hospital in a malarious district are seized with shivering. In the military hospitals within Metz, during the late siege, where hospital disease, privation, and mental depression were combined with the malaria from a large tract of inundated land, this difficulty of diagnosis was of constant occurrence. Many of the patients speedily recovered under large doses of quinine; and whilst most of the surgeons, with my friend Dr. R. R. Good, saw in this the proof of malaria, others, with possibly less experience and more enthusiasm, were led to believe that they had cured pyæmia speedily with quinine.

*Scorbutic Inflammations.*—The scurvy, inasmuch as it is often manifested in troops and other bodies of men exposed to malaria, may be suspected to be a conjoint element with malaria in some diseases, especially dysentery and ophthalmia in hot climates. The ecchymoses caused by scurvy in the viscera are sometimes followed by inflammation; as, for instance, of the pleura or lung. The swelling of the gums most probably, says Dr. Buzzard, depends on effusion of plastic material. But the scorbutic phenomena most akin to ordinary inflammation are the fibrinous effusions, sometimes organised and vascular, in the interstices of muscles and about the joints. (*Buzzard, in Reynolds' Syst. of Med. vol. i. p. 752.*)

*Scrofulous Inflammation* may be one of two things: First, any inflammation occurring in a scrofulous patient will be modified by the characters of the constitution. In the lymphatic and sanguine variety of scrofula, it will be characterised by great intensity and irritability, with the rapid effusion and partial organisation of plastic lymph, and may be followed by a chronic period of almost indefinite duration. In the torpid or dark-skinned variety, an acute inflammation may be attended with a very small amount of pain, or may be latent, ending in a chronic stage marked by a tendency to ulceration of various tissues, especially of the bones, joints, and glands. The mucous membranes are frequent seats of scrofulous inflammation, as the otorrhœa of children, scrofulous ophthalmia, ophthalmia tarsi, and ozæna. The frequency in times past of the swelled columna nasi and edges of the nostrils, and the pouting and reddened upper lip, irritated by the discharge from the nose, induced Cullen to reckon these amongst the signs of scrofula. Secondly, the specific "tuberculous" inflammation; the condition in which it prevails being called "tuberculosis." This is considered the sign of scrofula *par excellence*. An exudation or cell growth occurs in the substance of gland, bone, brain, peritoneum, or other structure, but especially in the lung. The nature of the new growth is declared by Dr. Burdon Sanderson to be a tissue of lymph corpuscles held together by a network of hyaline connecting substance. There is a close structural analogy between this substance and that of certain follicular organs belonging to the lymphatic system—for instance, to the follicles of Peyer, and the ampullæ of the lymphatic glands. Thus this tissue exists naturally in the favourite seats of tubercle; it exists, for instance, in serous membranes around the

blood-vessels, and in microscopic masses under the epithelium. Tuberculosis, therefore, according to this authority, is an overgrowth of existing elements, and not a new growth. (*Burdon Sanderson in the 11th Report of Medical Officer of Privy Council, p. 11.*) Tubercular infiltration of the lymphatic glands in the neck and in the mesentery, miliary tubercles in the lung, tubercular meningitis and peritonitis, are the commonest examples. We must add, that the exudation, like all other morbid cell-growths, is liable to decay, and to break down into a cheesy mass, known as "yellow" or "cheesy tubercle;" but it must be remembered that the yellow cheesy mass has nothing specific about it, and ought not to be called tubercular, unless it be the *débris* of the true specific tubercular exudation. Under the microscope some of the contents of an old ovarian cyst, portions of any old tumour cancer or enchondroma, may show amorphous globules, oil globules, and perhaps crystals of cholesterine; and these things are sometimes wrongly called "tubercular." Any low inflammatory exudation in the lungs, in the areolar tissue, or in bone, may partly degenerate in this way, partly soften into pus. Such products are most frequent in persons of delicate organisation, and are usually considered strumous, tubercular, or phthisical.

*Syphilitic Inflammation* is, in the first place, an indolent enlargement of the tissues round the Hunterian chancre and the chain of absorbents leading from it; followed by scaly eruptions, mucous tubercles in the throat, and other consequences. It presents peculiarities of colour, form, and order, and affects certain internal organs, especially the liver, the waxy deposits in which, from this cause, are well-described by Dr. Wilks. (For a full description, see *SYPHILIS*.)

*Erysipelatous and Septic Inflammations* are described under *ERYSIPELAS*.

*Dysenteric Inflammation* gets its name from the spasm accidentally associated with it. It is characterised by great injection and exfoliation of the mucous membrane of the large bowel, and is possibly attended with superficial gangrene, giving rise to ulcers.

Inflammations similar as regards exudation, varying in accidents, constitute *dysmenorrhœa*, *cystitis*, *croup*, and *diphtheria*. They are all acute, and produce their characteristic effects rapidly; namely, the evolution of a false membrane, made up of the epithelium mixed with blood, and with the inflammatory exudation passing into pus. But between diphtheria and croup there are unmistakable distinctions. Diphtheria begins in the pharynx or fauces, or perhaps on the conjunctiva, or some part of the skin which has been stripped of its epithelium, or the vulva; it follows any causes of constitutional depression, such as inhalation of putrid gases, fevers, measles, or scrofula, and is propagated by contagion. It is often followed by hæmorrhage from the bared surface, when the exudation is detached, enlargement of the lymphatic glands, anæsthesia, and a peculiar and obstinate paralysis of various parts, especially those whose nerves are affected by contiguity. It differs from croup in all these particulars, though it may perhaps get into the windpipe and exhibit the mechanical and spasmodic symptoms of croup. Moreover it attacks persons of all ages. Croup, on the other hand, is a disease of childhood, dependent usually on changes of



temperature, and peculiarly prevalent during east winds. It has nothing to do with contagion.

*Pyæmia* is a diseased state of the blood, caused by the presence therein of septic matters, and is usually attended with local inflammations, which pass rapidly into the suppurative stage. It most often follows injuries of the bones, which suffer putrid discharges to pass into open veins, or parturition. The local inflammations or abscesses may occur in any part of the body, as the muscles, brain, eyes, joints, &c., and are often symmetrical; or the bowels or the liver may be the organs by which the poison is discharged; or the serous membranes may become inflamed, with rapid effusion of serum or pus. The part to be attacked usually suffers from pain only a few hours before pus begins to be formed. In mild cases the local inflammations may pass off without actual suppuration. Again there may be *diffuse inflammation of the cellular tissue*, beginning with a limited, tense, pale, boggy swelling on any part of the body, and spreading very rapidly; there is great pain, anxiety, and irritability, and the case proceeds like one of phlegmonous erysipelas without the affection of the skin. If the patient be previously weak, if there be frequent shiverings, and if the amount of supuration be great, the hope of recovery is very slight. The patient may sink rapidly, or linger. If he is able to outlast the disease, the natural discharges are for some time loaded with fetid matters. (See Erysipelas, Pyæmia.)

Snake-bites commonly produce the diffuse cellular inflammation in a severe form. So also do dissection wounds and the poison of glanders.

*Phlegmasia alba dolens* is a peculiar inflammation, attended with severe pain, great heat, and a firm, pale, brawny swelling of the affected part, quite different from œdema. It appears to be caused by the effusion of poisonous matters from infected veins into the tissues around. It is not caused by simple obstruction of the vein, as is proved by the fact that veins, simply obstructed, do not cause *phlegmasia dolens*; and that the firm swelling of the limb may remain for years after the attack. The disease usually affects the thigh and leg in women after childbirth, and is attributed to infection of the iliac vein from the neighbourhood of a uterus full of fetid discharges. But cases of the same disease have been known to occur in men, arising apparently from the proximity of foul wounds to the veins of the thigh.

The following case, from the writer's note-book, illustrates the point. A very stout gentleman had for two years a small fistulous orifice in the ham, resulting from a boil. This became the seat of fresh inflammation, and was freely laid open, with great relief. On the fifth day he was rather feverish; there was an obscure, doughy swelling, not œdematous nor fluctuating, over the inner part of the thigh; there was no pain, but a sense of tightness. This increased during the next three days, and became painful, till the whole thigh was greatly swelled and doughy, the leg œdematous. The late Mr. Keate insisted that there must be deep-seated suppuration; and made a long and deep gash on the outside of the thigh. The parts cut seemed gelatinous, and exuded very little blood, no pus, and no serum. The pulse gradually rose; headache, diarrhœa, and delirium came on. As no improvement took place in the state of the thigh, Mr. Keate made deep punctures into its

upper parts with a grooved needle; neither serum nor pus exuded. Death on the twentieth day.

The writer has seen a similar case, but not fatal, in a gentleman recovering from a sloughing sore in the groin produced by scarlet fever.

It is a singular fact that this and similar diseases are more likely to attack parturient women if they have lost much blood. As results of it, if the attack has been merely local, the venous trunks of the thigh are obliterated, with much hardening and swelling along their course; and abscesses sometimes form. If general pyæmia has supervened, the prognosis becomes exceedingly doubtful.

*Embolic Inflammation* results from the stoppage of an artery by a plug of fibrin or other substance driven into it by the force of the heart. The substances set afloat in the arterial circulation must necessarily come from the left side of the heart, or from the lungs; and commonly produce their effects by sudden mechanical occlusion, whether they find their resting-place in the brain, eye, kidney, or elsewhere. The veins, on the contrary, carry any matters which find their way into them to the right side of the heart, and thence to the lungs. A large fibrinous clot causes sudden death. Small bodies of the same kind may cut off the supply of blood from limited portions of the lungs, which wither and die in consequence; and septic or cancerous matters brought in the same way set up their special processes of inflammation or cell-growth. In this way the pneumonia which so often follows wounds and operations is easily accounted for. If the clot in the artery should degenerate, and the fragments of its decomposing fibrin be carried on into the circulation, pyæmia may be the result. Softening of a portion of brain is a frequent consequence of plugging of one of the cerebral arteries. Sudden blindness may result from a plug in the ophthalmic artery. The existence of rheumatic endocarditis, rendering it likely that flakes of fibrin might become adherent to, and be suddenly detached from, the valves or walls of the left ventricle, should lead us to be on the watch for embolism; but it must be said that inflammation by no means is a constant sequence of the plugging of an artery—the ophthalmic, for instance.

The coagulation of blood in veins, from which danger to the pulmonary circulation arises, may occur in the womb after parturition; or in the legs during periods of debility with languid circulation, as in phthisis. It may be followed by *phlebitis*. But idiopathic phlebitis is not a common disease. It may be recognised in superficial veins by redness and swelling, with tenderness along their course, which becomes plugged by the formation of clots. The coats of the vein are thickened and reddened in both cases, especially where they have been in contact with the clot. They may afterwards become softened, and break down into an abscess surrounding the vessel, while the clot softens into purulent fluid, which may escape into the general circulation and cause pyæmia, or the inflammation may quickly subside, and the clot shrink, leaving the vein impervious.

Perhaps the best examples of the varieties of inflammation, including every possible modification of form, colour, duration, and structural alteration, each variety pursuing its specific course with marvellous regularity, are to be found in the diseases of the skin, eye and throat. For a complete account

of skin diseases the reader is referred to the Art. SKIN, and to the works of Erasmus Wilson and others.

Here we shall only speak of them so far as they illustrate the doctrine of inflammation; and more especially the law of the specific difference of various disease-creating causes, in the time, place, form, colour, and size of the effects.

Of the forms of inflammation of the skin, some can be produced at will by applying various irritants, as erythema; some depend on internal causes of which we know nothing definite, as urticaria; and some of the latter cannot be caused at will, and hence are called specific, as psoriasis. Some are evidenced by heat, pain, swelling, and redness of the most transient character. Thus *urticaria* is a transient congestion of the skin, with redness, burning, and tingling, similar to that caused by the poison of the nettle. Wheals of a lighter colour, round, oval, or linear, appear on the red surface. Its most common exciting cause is indigestible food—especially some kinds of shell-fish. It is most common in summer, and is usually accompanied by severe gastric irritation and some congestion of the fauces. Vomiting often puts an end to the disorder, which, however, sometimes becomes chronic and troublesome. We may fairly assume the evolution of some poison in the system, which, circulated with the blood, acts on the skin as nettles do, and to which ammonia is the best antidote. *Roseola* is a clustered, punctated rash of various degrees of brightness, strongly resembling measles. It is associated with congestion of the mucous membrane of the fauces, and with a moderate amount of general feverishness. There is commonly tenderness of the submaxillary and neighbouring glands. Roseolous rashes are sometimes met with in small-pox, cow-pox, rheumatism, and cholera.

Many forms of transient inflammation of the skin, which derive their name *erythema* from the prominent symptom, *redness*, vary from a slight and fleeting redness to the remarkable and persistent swellings of erythema nodosum. This sometimes assumes a more or less perfectly annular shape, from the subsidence of the inflammation at the centre while the edges of the patch continue to spread. In *erythema nodosum* hard oval patches of a bright red colour, most prominent in the centre, and apparently involving tissues deeper than the skin, form on the front of the legs or arms, their long axis corresponding with that of the limb. This form of inflammation chiefly affects young and weakly persons, and is preceded by considerable derangement of the digestive organs. It is often associated with rheumatism. In *scarlatina* the disturbance of nutrition is usually enough to detach the cuticle, and lead to desquamation. In *lichen* the inflammation is localised in the orifices of the follicles, forming *papule*, which end by the desquamation of a petty scale of cuticle. There is a numerous set of inflammations in which the primary effect is a crop of *vesicles*. These consist of exudations of serum under the cuticle, just as after the application of hot water or Spanish fly. In *scabies* they are very minute; in *herpes* they occur in clusters or patches of reddened skin; in chicken pox, small-pox, and vaccinia, the vesicles are dotted over the surface, but are accompanied with more or less deep-seated inflammation of the cutis vera, and with destruction of its surface, leading to a *pit* or cicatrix. Vesicles may attain the size of eggs in pemphigus.

These are examples of acute inflammations, most of them possessing natural limits of place, duration, and violence, so that their course can be calculated within a few hours. There are other skin diseases which present the characters of chronicity to an equally remarkable degree, as, for instance, the chronic eczema. The essence of eczema seems to be an infiltration of the cutis with unhealthy serous fluid, accompanied by more or less of palpable inflammation; and the papules, exudations, vesicles, pustules, fissures, desquamations, and other phenomena which give names to so many varieties of the disease, are merely its accidents, arising from different degrees of inflammation of the hair-follicles and minute glands, the position and circumstances of the eruption as regards friction, exposure, moisture, and the like, and the state of health of the patient. Eczema is contagious;—it is undeniable that the contact of an eczematous surface with the skin of a person of suitable constitution, will produce eczema at the spot subjected to contact; and few contagious diseases can do more. Whereas the surface in eczema is wet and oozing, in *psoriasis* the skin is leathery, and gives out moisture only on being rubbed. The epithelial scales die and become detached in a dry powder. *Pityriasis* most commonly affects the scalp and hairy parts of the skin; it differs from psoriasis chiefly in the greater size and copiousness of the scales thrown off by the epithelium, and by the smoothness of the surface left.

Further examples of specific forms of skin inflammation depending on constitutional causes are afforded by the *elephantiasis* (*E. Arabum*) of hot climates, a disease probably of malarious origin (see SCROTUM), and by the true leprosy, or *Elephantiasis Græcorum*, which is supposed to be identical with the leprosy of the Old Testament. It now prevails chiefly in the West Indies, and in Iceland and Norway. It commences with an erythematous spot, which proceeds to a reddening of a patch or patches of skin, with hyperæsthesia, followed by numbness and thickening, loss of hair, and dry desquamation. The skin sometimes ulcerates over large surfaces. In another variety of the disease the nerves are chiefly attacked; the degeneration, accompanied by a viscous exudation into the sheaths, beginning in the cutaneous nerves, and extending along the trunks to the spinal cord and brain. The nerves first present red spots at irregular distances, and then become nodulated and hardened, and of a brownish colour, especially at the points of junction of cutaneous branches. Anæsthesia and local paralysis follow, and sometimes a bone or entire limb dies and is separated. The face is often attacked. The disease is hereditary, and perhaps contagious.

The inflammations of the *throat* convey the same lesson, viz., that every distinct cause produces its own phenomena. Acute tonsillitis or *quinsey* is generally ascribed to cold, and usually affects plethoric persons; is attended with high fever, and often ends in abscess. A superficial inflammatory blush of the mucous membrane, with more or less swelling and tenderness of the tonsils and adjacent glands, accompanies many fevers and constitutional diseases, as erysipelas, small-pox, measles, and particularly scarlatina. Every degree of putrid miasm produces corresponding degrees of sore throat, and the prevalence of this affection in



crowded houses is almost as sure a sign of the presence of sewer vapour as are diarrhoea and dysentery—both, by-the-bye, often attended with sore throat. There is a sore throat which aggravates the last stage of phthisis, and is caused by contact with the decomposing pus hawked up from the lungs, besides that which accompanies aphtha, and arises from hectic and absorption of miasm. There is a flabby œdematous sore throat, with great pain and copious viscid mucus, affecting weakly persons after cold, and readily cured by wine, purgatives, and a swab with nitrate of silver. Many sore throats are attended with pellicular exudation, slight, partial, and easily detached; but there is one in particular, caused by specific contagion, to which the special name *diphtheria* has been given on that account. Some sore throats are remarkable for the rapid formation of a slough. Every kind of constitutional taint, especially syphilis, has its peculiar variety of sore throat; and so have many poisons, especially mercury, iodine, and arsenic. Of the eye, we need only say that every local and constitutional cause of inflammation produces its own characteristic changes.

Section 8. *Theories and Literary History of Inflammation and its Treatment.*—In the present section I propose to give a succinct bibliographical account culled from a select set of authors, showing the various theories which have been held from the earliest times as to the nature of inflammation and its treatment. No branch of medical study is more instructive. The errors into which various sects and schools have fallen, arose not from causes peculiar to them, but from certain propensities inherent in the human mind. Hence, though the details may vary, errors of the same kind are incessantly coming to the surface in different ages. Such a study furnishes a refutation both of those who despise medicine altogether, and of those who despise all before our own time. It shows that unbiassed observation has led shrewd and able thinkers to virtually the same conclusions in all ages; thus proving that the practice of medicine is based upon truth, and that in every age sensible physicians have practised nearly in the same way. Be it observed that the word *theory* is used in two senses. In the first sense, every rational being must have a *theory*, that is, must devise some such way of viewing any given facts as will connect them with other facts. The other kind of theory signifies a set of doctrines, borrowed from the physical and physiological doctrines of the day, which professes to account for disease and dictate treatment *à priori*. Such were the theories of Boerhaave, Cullen, Broussais, and Rasori. But there is this cardinal doctrine to be observed with respect to medical theories. Enquiries into the nature of disease, and observations on the effects of remedies, constitute two independent lines of study, the results of which may often seem contradictory. But the rational man will rather bend theories to suit the effects of treatment, than make treatment suit theory. Robert Whytt, speaking of Haller's theories, said, that if they were true, surgeons must certainly alter their treatment, "whereby, if there be a mistake in the doctrine, many lives may be endangered or lost." (*Essays, &c., Edin., 1766, p. 92.*)

The effects of remedies on diseased persons are ultimate facts, to be learned by observation

and experience and not to be gathered with certainty from any *à priori* argument without experimental proof. That enlarged acquaintance with chemistry and physiology which each succeeding age gives us, widens the field of observation, enables us to find differences in diseases, and gives us means of accurate diagnosis; but cannot dictate treatment.

Theories of disease cannot be perfect or final till physiology is an exact science. But the propensity to base treatment upon uncertain and fluctuating theory, which renders every age of physic ridiculous to the succeeding ones, arises from one of the chronic imperfections of the human mind. The three leading Medical Sects of the Ancients after Hippocrates, flourish to this day. There are the Dogmatists, or Rationalists, each with his "sound pathological theory," which he affirms to be a necessary guide to "successful practice." There are the Empirics, or Practical Men, who try to find "what will cure what," and despise the flickering light afforded by theory. And there are the Methodists, who have a short cut, *μέθοδον*, to practice, whether by the lancet, brandy, blisters or globules.

A minute classification of the opinions held during twenty-five centuries would be impossible. For our purpose we may make a rough division of the surgical doctrines of inflammation into seven classes. The first is that of ancient surgery, more particularly as represented by Galen, whose doctrines, classification, and very words were copied by succeeding writers, and only became obsolete in the time of Cullen and Hunter. The second began with the beginning of modern science in the seventeenth century, and adopting a vitalistic, or pneumo-pathological basis, continued down, through Cullen and Hunter, to Cooper, Abernethy, and the great surgeons of the last generation. A third may comprise the early microscopic school, by which the capillaries were chiefly studied. A fourth coincides with the development of the "cell" doctrine. A fifth includes the later ideas of the activity and power of protoplasm or "germinal matter," independently of the formation or function of "cells" formally so called. A sixth will treat of chemical theories. A seventh of the now popular neuropathology.

#### SUBSECTION 1.—ANCIENT SURGERY.

We find Hippocrates (B.C. 460) in his Treatise on Ancient Medicine, rebuking those physicians who pretended that it was necessary first to form some philosophical conception of man in the abstract, *ὅτι ἐστὶν ἄνθρωπος*, and of his relation to the hypothetical elements of hot, cold, moist, and dry, and to deduce from this *à priori* the nature of disease and the method of treatment. On the contrary, he declared that the nature of man could be learned *à posteriori*, by the study of medicine; and that the physician should know man practically, in his relation with food and drink, and his entire mode of life. We find that he, like all true physicians down to our own times, treats of the great idiopathic inflammations, the pleurisies, pneumonias, phrenzies, quinsies, and erysipelas, not as so many local diseases, with constitutional symptoms, but as true fevers, true constitutional diseases from the first. He speaks of persons "fevered with ardent fevers, and pleuropneumonias,

and other grave diseases";—οἱ πυρεταίνοντες τοῖσι καύσοισι τε καὶ περιπλευμονίῃσι καὶ ἀλλοιοῖσιν ἰσχυροῖσιν νοσήμασιν. His leading doctrine was, that disease was produced by irritation of the humours (or of the blood, as we should say); that these humours underwent certain changes described as *coclion*; of which the most familiar examples and proofs were the deposit in the urine at the close of a feverish attack, and changes in the quality of the secretion of the nostrils in the course of a coryza. These changes when complete, are followed by the separation and excretion of the offending matters, whether by the urine and its sediments, by sweats, hæmorrhage, or abscess. Lastly, the idea of *time* enters largely into his doctrines; for, *ceteris paribus*, there is no doubt that every morbid process has its own period, equally with every natural one. All these doctrines are thoroughly consistent with general truth. His treatment of pleurisy may be taken as an example of his practice. At first, he says, it will be proper to attempt to dispel the pain by warm applications, such as hot water in a bottle or bladder, or in a vessel of brass or earth covered with some soft substance; or with a sponge wrung out of hot water, a poultice of barley or tares, or bran boiled in vinegar and water, and sewed up in a bag; or with a dry fomentation of heated millet seed or salt. If this do not relieve, blood must be drawn from the arm in considerable quantity, and until it flows of a lighter colour. Besides these, purgative medicines combined with aromatics, were administered; ptisans of farinaceous substances, honey and water or oxymel, with pure water; and warm baths, whose good effects, and the care necessary in using them, are described in terms that would suit the present day. (*On Regimen in Acute Disease, Works of Hippocrates, Sydenham Soc. Ed.*, vol. i. pp. 175, 289.)

When we speak of the surgery of the ancients, we must remember that we speak of the opinions and practice which prevailed from about B.C. 500 to the destruction of the Alexandrian library A.D. 640. This, in the form impressed on it by Galen, was handed down through the Arabian and early European schools to form the starting point of the opinions and practice of the present day. But during the earlier part of this ancient period doctrines had not become so crystallised and stereotyped as they were in the Middle Ages; on the contrary, it was a period remarkable for activity of thought and freedom of controversy. Rival schools and ambitious professors struggled at Athens, Alexandria and Rome, as they do now at Edinburgh or Paris. When we speak of "Hippocrates" we must recollect that, of the sixty treatises and more which are called by his name not all were written by one man. The passage I have selected from the "Ancient Medicine," is evidently the work of a rational empiric of the Sydenham type. But most of the Hippocratic treatises contain a body of doctrines or dogmatic systems, partly resting on experience, partly on the philosophy of the day—a kind of medical orthodox creed, the holders of which were commonly called *Dogmatists* or *Rationalists*. Amongst these doctrines was that of a *vital principle*, or *φύσις*; of *coclion*, of *time*, as evidenced by critical days and fixed periods for morbid phenomena; of the existence of four ele-

ments—earth, water, air, and fire—which, as M. Renouard suggests, represent the solid, liquid, and gaseous states of matter, and the existence of heat; that there were four conditions or temperaments—hot, cold, moist, and dry; and four humours in the animal body—blood, serum or phlegm, bile, and black bile; and that upon the quantity, mixture, and *temperies* of these, health and disease depended. These, as will be seen presently, form the basis of Galen's doctrines, and may be found in surgical treatises down to the middle of the eighteenth century.

But no established school or dogma was more safe in the free atmosphere of Greece and Alexandria than it would be now. Whoever reads that wonderfully interesting introduction to Celsus *De Medicina*, will see that amongst the dogmatic physicians there were men, such as Erasistratus, who differed as much from Galen as Todd did from Elliotson; and he will see further how the imperfections of the prevalent creed drove men to form new sects, in doing which they did but satisfy the necessities of the human mind. There was, as I have hinted, a sect "*qui se ab experientia ἐμπειρικοὺς nominabant*"—the Alexandrian sect of *empirics*, the most honourable and useful of all, whose name has in modern ears a baseness that it does not justly merit. The opinions of this school were almost identical with those of the Hippocrates who wrote the treatise on "Ancient Medicine" in abjuring *à priori* sophisms. Some time later, Aesclepiades, a man of brilliant genius, bred, like Boerhaave, as philosopher and rhetorician, established himself at Rome and began to practise as a physician. He, deriding the complexity of existing theories, proposed a short and easy way to medical knowledge—a short cut or *μέθοδος*, founded on a few common sense principles. He said, for instance, that in every disease there must be something too tight or too loose—too much discharge or too little—and that by attending to these simple indications any complex system of therapeutics was made superfluous. It will readily occur to the reader that no age of physic is without its *methodists*—the men who lay all diseases to the door, now of plethora, now of debility—or spinal irritation, or inaction of the liver, &c. With these introductory remarks we are prepared to study the position of Galen in the history of inflammation.

The opinions of Galen (*b. A.D. 131, d. circa 200*) on inflammation have to be collected from various parts of his most voluminous treatises. He frequently repeats himself, and gives numerous partial definitions of inflammation, though scarcely twice in the same words. The following are his formal definitions contained in his collection of "Medical Definitions" (*Ὅροι Ἱατρικοί, par. clxxxii. et seq. Ed. Kuhn, vol. xix. p. 441*):—

"Inflammation (φλεγμονή) is a swelling with redness, producing severe throbbing pain. And it is called inflammation, because the part, as it were, burns. Or, a painful resisting swelling, with redness, apart from fever. Or, inflammation is a painful swelling, hard, resisting, having its origin from an afflux of blood.

"Erysipelas is a redness with violent burning, sometimes producing fever and shivering. Otherwise, erysipelas is a painful swelling, having its origin from bilious blood.



"Abscess is a transition of bodies from inflammation into pus."

Galen treats of inflammation under the head of abnormal tumours or swellings: which he says, must be divided into inflammation (*φλεγμονή*), erysipelas, scirrhus, and œdema. He refers in many places to the opinions of former physicians, and the meanings which they attached to these terms: quoting particularly Hippocrates and Erasistratus. The former of these used the word *οἶδος* or *οἶδημα* to signify a swelling round a wound or ulcer: but if heat and throbbing were present, he called it an inflammation. Those who preceded him, however, differed in their use of the words, calling every kind of burning (*φλόγωσις*) an inflammation. (*Ad Glauconem, op. cit. vol. xi. p. 69.*) From the time of Erasistratus *φλεγμονή* was used to signify those tumours which had not merely a burning heat, but resistance and pulsation as well. The theory held by Erasistratus was that fever and inflammation were two possible effects of the same cause. "When some violent agency makes the blood contained in the veins pass over into the extremities of the arteries, the blood so effused meets the current of air coming from the heart, and, if strong enough, disturbs the action of the heart by forcing back the current, and so produces fever; if, however, the air is able to force the blood back to the extremities of the arteries, it becomes impacted there, and produces an inflammation." The passage of blood from the veins into the arteries (which, because empty after death, were supposed to contain merely air or "spirit" during life), was supposed to be caused by local flux or plethora in idiopathic inflammations, and in wounds, by the imbibition of blood by the arteries, after their canals had been laid open and the "spirits" allowed to escape.

Galen, in one of his manifold definitions and classifications of diseases, divides "tumours" or swellings into those which arise (1), from increase of the elements natural to a part, and (2), from the intrusion of matters not belonging to it. These latter constitute the *tumores præter naturam*, and may be created by afflux of blood, bile, phlegm, black bile (*melancholia*), or air. That inflammation is caused by infraction of blood, may be proved by incision of an inflamed part, when the blood with which it is stuffed like a sponge, flows out abundantly. (*De Tumoribus, Op. Ed. Kuhn, vol. vii. p. 707.*) Bile causes erysipelas, phlegm (i.e. serum) causes œdema, and black bile causes scirrhus. (In the ancient sense *scirrhus* signified a chronic inflammatory induration.) (*De Morborum Differentiis, op. cit. vol. vi. p. 837.*)

An afflux, or effusion of blood being stated by Galen, over and over again, in different forms of words, to be the cause of inflammation, he goes on to argue that corruption and disintegration of the part affected is the natural consequence. Food, badly digested and assimilated, and not changed into good blood, becomes corrupted; corrupted matters are hot; blood charged with these corrupted matters creates heat and unnatural swelling in the parts in which it putrefies, and this is inflammation. (*Comment. in lib. Hippoc. de Humoribus, Ed. Kuhn, vol. xvi. p. 131.*)

Heat, moisture, and stagnation are the things most favourable to putrefaction: and when blood has become impacted in a part in such

quantity as to exceed the natural powers of removal, these are the very conditions to which it is subject. Of necessity, therefore, its decay follows; and the pus formed is the result of the solution of the tissues. The connection between inflammation and fever is described by Galen as follows:—"The inflamed parts excite fever by the putrefactive process. For the substances effused into them, becoming impacted in them, and being by nature warm, putrefy by reason of the non-diffusion of air through them. When, therefore, the effused fluid is undoubtedly active bile, the part suffers from an erysipelatous burning: but when blood is effused, from an inflammation. When, however, the two are mixed, it is called an inflammatory (*φλεγμονώδες*) erysipelas, or an erysipelatous inflammation, according as one or the other predominates. But fever follows upon all these by reason of its identity of nature. For the neighbouring parts become inflamed in succession, until the influence reaches the heart." Just as a house may be burned down through too great a fire in the hearth. (*De Venæsect. ad Erasistratum, op. cit. xi. 189.*)

In another place, "Nature," we are told, "when she perceives anything noxious in the system,—under which all causes of pain are necessarily included,—strives to get rid of it by means of her excretive power, and thereby sometimes causes an inflammation: if her efforts at first fail, by increasing them greatly, she forces out blood and air into the tissues, and produces a swelling, the nature of which is different, according to the substances which find their way into it. Different tissues have different powers of resisting these effusions; that of glands being the weakest."

In the treatment recommended by Galen, blood-letting held a very high place, because consonant with both reason and experience. Nothing, he says, can be more reasonable than that a disease whose essence is afflux of blood, should be treated by evacuating that blood, on the established Hippocratic principle that diseases are to be treated by their opposites. (*Ad Glauconem, op. cit. xi. p. 16.*) *παναντία τῶν ἐναντιῶν ἰάματα* (*ib. p. 167.*) Nature, in her spontaneous hæmorrhages, sets the example, and the common instinct of humanity, and almost of brutes, bears witness to its reasonableness. The followers of Erasistratus objected entirely to blood-letting; yet they did not hesitate to use starvation, vomiting, and purgatives. Is it not better to take blood directly from a vein than to use those painful and roundabout modes of evacuation? As to experience. In his work addressed to the Roman followers of Erasistratus, he details how, when he first came to Rome, he saw patient after patient die, suffocated with pneumonia and angina, because the physicians refused to bleed; and by way of contrast triumphantly records (*De Venæsectione, ib. xi. 299.*) how he was called to see the steward of a rich man in the suburbs of Rome, who had been suffering under ophthalmia for twenty days and had been treated without benefit by the family physician, who was of the Erasistratean sect. "I found the patient," says Galen, "a plethoric young man, with intense inflammation, swelling, pain, and discharge. Knowing what the treatment had been, I said that it was impossible I could take charge of such a patient in the suburbs, and that I ought to see him very frequently for at least three days. Let

me take him home, I said, for three days. They assented gladly. The patient accordingly came about eleven o'clock, and I at once drew three pounds of blood, and at three o'clock one more. He was wonderfully relieved next day. A soothing collyrium, mixed with wine, was applied under the eyelids at daybreak, at nine, and three; and in the evening he was bathed. Next day the eyes were anointed twice with a collyrium containing more wine, and in the evening another bath. The day after he went to meet his master at the place where carriages put up in Rome, and saluted him with eyes open. People wondered at this cure, rapid as if by magic; and the master enquiring into it, and learning what had done it, nicknamed his Erasistratean physician *Αἱμαφόρος*, in literal English "Blood-funker."

Blood-letting is properly recommended by Galen for the young, robust, full blooded adult, and is forbidden, or sanctioned with limitations, in the case of the aged, the very young, the feeble, and persons of soft white flesh and complexion, amongst whom he reckons the Gauls! Early in an attack the blood is to be drawn from a part as far away as possible, in order to create revulsion; i.e. if the left pleura be inflamed, blood should be taken from the right leg. If an inflammation be of some duration, blood should be taken locally by leeches, or cupping, or by opening a neighbouring vein.

We must not linger longer on Galen, except to say that his ideas and his very words on inflammation were implicitly copied by succeeding writers down to the middle of the eighteenth century.

The Arabian school, founded on the Greek, held its ground long in Europe, and such was its reputation that Dante, in the beginning of the fourteenth century, in enumerating the chiefs of the faculty of physic whom he saw in the Elysian circle of Hell, mentions

"Ippocrate, Avicenna e Galieno,

Averrois, che il gran comento feo,"

putting the Arabians on the level of the Greeks. They treated the Greeks as authorities who were to be followed implicitly. So they give us but little in return for a search through their misty pages. We look for a theory, a sign of thought or research, or a good piece of argument, but find nothing. Volume after volume of worthless dissertation and diffuse commentary make us wonder that such works ever survived. Nothing approaching to a theory of inflammation is given us by these writers; it may be said of all of them, as a French writer says of their chief, Avicenna, "they seem to take pleasure in multiplying the signs of disease without any reason, and fix on the least important and most accidental signs as those on which to lay most stress." After the Arabians the torch of medical knowledge was kept alight by the school of Salerno in Italy, and by the newly-established universities of Paris, Montpellier, Bologna and elsewhere. Still, they were but followers of authority. In the books published in Europe before the revival of learning had yet reached medicine, we find the changes rung upon Hippocrates and Galen, Avicenna and Rhazes, and the others of their respective schools, with little acuteness or variety. None of these authors, as far as a moderately careful search shows, says anything about inflammation which had not been

said before by one or other of those from whom they extract the substance of their books. An aphorism given by one of them, Arnaldus de Villanova, or Arnald de Villeneuve, with reference to the treatment of inflammatory diseases, is perhaps worth recording:—"Modestus et sapiens medicus nunquam properabit ad pharmaciam, nisi urgente necessitate; cum etiam debilia, quibus corpus non indiget, sint nociva."

When we come to the sixteenth century we still find the illustrious Ambrose Paré (*b. circ. 1520, d. 1590*), treating of inflammation in the very words of Galen, in his fifth book, "*traitant des Tumeurs contre Nature.*" (*Œuvres complètes par Malgaigne, vol. i. p. 319 et seq.*)

The account given of inflammation by Wiseman, the greatest English surgeon of the seventeenth century, is evidently written with a desire to keep as close to Galen as possible. Phlegmon is treated of among tumours. The author commences his chapter on this subject as follows:—"Hitherto I have discoursed of tumours in general. I shall now descend to particulars, and begin with phlegmon, or inflammation; both because it is the first degeneration from good blood, and in its own nature nearest of kin to it; and also because it is the most frequent of tumours, happening in diseases, wounds, contusions, fractures, luxations, &c. It being also the usual forerunner of many mischiefs that happen in many of those cases, and consequently the most obvious occasion of exercising the surgeon's skill.

"I define it, a large tumour, hot, of a red colour, with pain, pulsation, tension, and a circumscribed hardness.

"It has different names according to its situation: \* \* \* or, lastly, from the matter; which, if simple, it is a simple phlegmon: if compound, it hath its denomination from the humour with which it is compounded, and so is called erysipelodes, phlegmatodes, œdematodes, scirrholes.

"The cause of phlegmon is generally a plethora, having some acrimonious mixture in the serum of the blood; which latter is the usual matter of a phlegmon, being cast out of the vessels, and lodged in the pores of the skin, or other part affected with it. This serum being accompanied by the thinner parts of the blood grows red and angry, and, wanting its due regress into the mass, first gathers into a hard swelling, and in few days (if it be not discussed) ripens into matter, and so dischargeth.

"The signs are" (as given above). "The tumour growing big and more collected, a suppuration succeeds, and then the symptoms abate. As the tumour riseth into a cone, so the matter may be felt to fluctuate, and the skin becomes thin and pale, viz., of the colour of the subjacent matter.

"The prognostic is good when the tumour insensibly exhales and resolves; in which case the ebullition abates, and the blood, being less violent in its motion, passeth gently by, and by degrees swalloweth up that humour into its channels again which it had in the time of its ebullition cast out; or, at least, having suffered the thinner parts to transpire, it receiveth the rest.

"Next to this way of terminating a phlegmon, suppuration is best, when the matter of the tumour ripens into a kindly pus.

"But it is of ill consequence if the tumour disappear without abatement of accidents, and the



fever still continue. In this case either a gangrene or some other grievous symptom succeeds; or, if it were the crisis of a fever, that increaseth, and the life of the patient is in great danger.

"It is also ill when the matter, instead of resolving, hardens, and the pain ceaseth. It foreshoweth a scirrhus tumour approaching."

Erysipelas, though included under the general division of tumours, is distinguished from inflammation in this manner:—"An erysipelas is generated of a hot serum in the blood, and affecteth the superficies of the skin with a shining, pale, red or citron colour, without pulsation or circumscribed tumour."

It must be borne in mind that in works of that age the words "tumour" and "swelling" are used interchangeably, and without any distinction of meaning such as we employ. Moreover, the habit of attributing a self-acting, almost volitional power to every force which exerts a real or supposed influence on the body or its tissues, renders the language in many cases obscure, and induces the author to give as explanation nothing but a fanciful personification of the agencies of which he is treating. As an example of this, we may quote Wiseman's description of chilblain. "Pernio," he says, "is a peculiar swelling, and belongeth to blood: it raiseth a thick red swelling with itching pains in the hands and feet."

The outward cause is the nipping of cold air in the winter season, which pierceth the skin, maketh painful swellings, and at the same time shutteth up the pores so as the humour cannot transpire, whereupon it corrupts, and raises little wheals or blisters, which ulcerate the cuticula, and corrode into the skin, and sometimes deeper, as in kibes (i.e., chilblains on the feet) is frequently seen." Here we have the simple fact that cold, under certain conditions, will produce these local inflammations dressed up in a web of theory in which four different agents, pernio, the cold air, the humours, and the little wheals, all appear to take parts of their own, quite independently of all other influences. And Wiseman is a far more than average specimen of the writers of his time. His style is clear and candid, and his language is such as no medical writer of the present day need disdain to study as a model of logical precision, terseness and force. Some of his descriptions of military surgery, at the battle of Worcester and other fields, now almost forgotten, may still be read with great interest.

If space permitted we should gladly give specimens of Wiseman's minute classification of remedies; one example amongst many of the disproportion which mental elaboration bore to the collection of facts, with the imperfect means of observation then existing. In treating inflammation, the morbid state of the blood, which is the "antecedent cause," is to be opposed by bleeding and purging, but the *causa continens* or "proximate cause," which is the depraved blood intruded into the inflamed part, must be dealt with by translating it to some other part of the body, or by evacuating it. It may be translated by *Revulsives*, such as cupping, blistering, and other means of "raising a tumour in the contrary part;" or by *Derivatives*, which are milder means of revulsion to a neighbouring part; or by *Repellants*, which drive away blood, such as astringent and cold applications in the form of "Liniments, Cerots, Cataplasms, or Emplasters."

The peccant humour may be evacuated by *Discussion* or *Resolution*, i.e., by a supposed insensible perspiration, promoted by emollients; or by *Suppuration*, which may be promoted by *Suppuratives*, of which the linseed poultice is the modern representative. If pus form it may be discharged by knife or caustic; and when we add that the empty abscess was to be *digested*, then *mundified* or *deterged*, next *incarned* (or made to granulate), and lastly *cicalrised*; and that for each of these natural processes there was a most copious apparatus of most complex applications—"digestives," "detergents," "epulotics," &c.—we shall give some idea of the meddlesomeness which was the great fault of ancient surgery, even in the best hands. (*Eight Chirurgical Treatises, by Richard Wiseman, Serjeant-Chirurgion to K. Charles II.*, 6th ed. 1734.)

We cannot help referring in passing to the doctrines of Sydenham (b. 1624, d. 1689) of the generation of humours in the blood, and how nature, conscious of danger, sets up fever, i.e., a fermentation, which should produce "a thorough despumation of the morbid matter." But we will conclude our account of the ancient humoral doctrines of inflammation, by referring to the works of Daniel Turner, a writer of immense popularity, whose *Art of Surgery* was the book in general use till long after the middle of the eighteenth century, and who reproduces Galen and Wiseman. The ancient humoral pathology was finally extinguished by Cullen's quotation from Hoffmann, that it were better to study the action of the solids, than the changes in the humours of which nothing certain was known. But it was useful in its day, and its main principle holds good for ever.

#### SUBSECTION 2.—FROM WISEMAN TO HUNTER.

We will now attempt the difficult task of enumerating the doctrines which came successively into light during the century between Wiseman and Hunter; in order to trace the lineal descent of the philosophic basis of Hunter's doctrines.

We may begin by remarking that they all suppose the existence in the body of some agent, more or less distinctly endowed with consciousness and reason, which takes cognisance of impressions upon the senses, and of injuries, poisons, and other causes of disease, and then sets up actions for the preservation and recovery of the individual. Such an agent was the "Nature" of ancients and moderns, the *Vis Medicatrix Naturæ*, Vital Spirits, Anima, or Archæus of different authors; and so far is the doctrine from being extinct, that it is set forth with the utmost vigour and ability by Dr. George William Balfour in his *Introduction to the Study of Medicine* (Edinburgh, 1865), who asserts the existence of "Life, the *Psyche*," a conscious, intelligent and voluntary agent in both plants and animals.

On this point we must say that no one knows the nature of matter or of the forces which are exhibited by it, save that both depend on the Will of God. As for "Vital Force," or "Vitality," we use the terms as convenient expressions for our conception of the peculiar kind of force which things living exhibit whilst they live, and by which the common physical forces are co-ordinated and controlled; but we are no more entitled to speak of Vital Force as existing apart from living things, and as an intelligent Being, than we have to speak of a "Spirit of Timekeeping" as inhabit-

ing a watch which is constructed with a compensation balance.

This, which I may call the spiritual theory, assumed the vital forces to be some entity inhabiting the living structures and acting on them, yet separable both in idea and fact. (*Renouard, Histoire de la Médecine*, t. 2, p. 191.) Thus Van Helmont, (b. 1577, d. 1644) speaking of the Archæus, or sentient principle, which he makes the ruler of the animal body, says that when offended by acidity, it sends the disordered blood to the pleura to cause a pleurisy; for, he says, the humour cannot go of itself, nor yet can the pleura fetch it. (*Ortus Medicinæ*, § *Pleura furens*, Amst., 1648.) Van Helmont was a great opponent of Galen, and opposed bleeding under all circumstances. He says, "*gas et blas nova quidem sunt nomina, à me introducta*," and describes these as secondary powers, acting in obedience to the Archæus.

Subsequent physicians taught that the initiative in inflammation was taken by the vital spirits. Thus the venerated *Thomas Willis*, the great expounder of the nervous system (b. 1622, d. 1675), affirms that there is a corporeal soul, of material existence, and equal extent with the body, common to man as to brutes, as well as a mind or rational soul. The *hypostasis* or substance of the soul is constituted by "Animal Spirits" of a fiery nature, which issue from the brain through the nerves, and when expended are distilled out of the blood in the brain as in an alembic. These spirits are contained in the blood with water, salts, sulphur, and earth; and if any heterogeneous thing be introduced it causes the blood to effervesce and boil with fermentation, evidenced by increased heat and motion. A Peripneumony, of which the symptoms are accurately given, is caused by blood "boiling feverishly," and "sticking within the narrow passages of the lungs, engenders there an obstruction causing inflammation." The reason of the "stickiness" of the blood is too much sulphur, and the retention of excrementitious matter. (*Works*, fol. Lond., 1684, *Pharmaceutice Rationalis*, Part ii., p. 59.)

Morton, in his *Pyretologia*, or Doctrine of Fevers (dated 1691; *Mortoni Opera*, Geneva, 1727), also describes what we call "nervous influence" as the *Animal Spirits*, or *Aura Animalis*, of a material aerial nature, everywhere intimately mixed with the blood, proceeding from the brain as rays from the sun; running along the nerves as channels, and inhabiting every fibrilla; the immediate Organ of the Soul, and matter of Life (*Vitæ subjectum*). These spirits are acted on by poisonous ferments, which cause them to expand and surge—hence the heat, and preternatural movement of the blood. Morbid blood may affect the "spirits," but virtually the "spirits" are the agents in all general diseases, and mediately in local diseases also.

Thus, as Stahl complained, the first effort of the "moderns" was only to substitute a new set of imaginary humours—salt, acid, and sulphureous—invented by their most imperfect chemistry, for the "humours" of the ancients. The hypothesis was held that the blood was moved by the animal spirits, whereas the humours seemed to establish themselves of their own accord.

There are four main facts which have influenced the modern theories of inflammation, viz., the dis-

covery of the circulation of the blood and the functions of the nervous system; the development of chemistry; the invention of the microscope; and, fourthly, one whose influence is just beginning to be felt, the doctrine of the conservation or correlation of force. In the seventeenth century experimental science began to flourish; the authority of "the ancients" began to decay, and their humoral doctrines to be derided. The importation in 1649 of the "Peruvian Cortex," as it was called *par excellence*, gave a heavy blow to these doctrines, because it showed that a fever might be suppressed absolutely, without any of the coction and evacuation of morbid matter, which were absolutely necessary under the old theory. It is an unfortunate fact that medical theorists, like children who will not wait till fruit is ripe, are always eager to seize upon new discoveries in physical science, and to construct out of them some premature and abortive scheme of pathology. So out of the premature use of the science of the seventeenth century grew various doctrines which flourished for a while. Out of the anatomy of the nervous system grew the notion of animal spirits, distilled from the brain, and effervescing with fever ferments in the blood, as held by Willis and Morton. Out of the chemistry were constructed the doctrines of the *iatro-chemical* sect, which we shall trace further in Subsection 6. Out of the new doctrine of the circulation of the blood, and the invention of the microscope by which Malpighi showed the globules passing through the capillaries, grew the *iatro-mechanical* or *mathematical* or *hydraulic* school, of which I shall take Borelli, Pitcairn, De Gorter, Belloste, Astruc, Mead, and Boerhaave as representatives. This school, as regards doctrines of inflammation, was *obstructionist*, holding that the minute vessels were stopped up by their contents. Afterwards, as the functions of the nerves and nature of living parts became better known, theories began to prevail of the action of the capillaries in causing inflammation by arresting the passage of blood.

We may first notice that vigorous offshoot from the pathology of the seventeenth and eighteenth centuries, the *mathematical* or *mechanical* sect, which, neglecting chemical and vital properties, endeavoured to deduce a theory of disease from the mechanical laws which the animal structure must obey, and the mathematical calculations by which they may be expressed. The founder was John Alphonse Borelli (b. 1608, d. 1679), the illustrious author of the work *De Motu Animalium*, in the latter part of which he endeavours to give, but very unsuccessfully, a mechanical account of fever which he makes depend on obstruction of the glands by a nervous ferment. (Ed. Novissima Lugd. Bat. 1710, Vol. II. p. 297.) We rather take as one of the foremost of this sect Archibald Pitcairn (b. 1652, d. 1723), who, in his *Elementa Medicinæ Physio-Mathematicæ* (Hagæ Comitum, 1718), laments the waste of time by physicians in vain hypotheses, and claims that medical doctrines ought to be as infallibly true as are the propositions of Euclid. Beginning with the last proposition of the tenth book of Euclid, that "every body is divisible," he proceeds to construct a series of definitions and propositions, rigidly argued, but based upon the imperfect physiology of the day. He places all life in the circulation of the blood. Animal heat is solely due to this. All diseases consist in changes



in the quality or in the velocity of the blood. If the velocity be altered the quality is altered. Changes in the fluids, whether for good or evil, whether constituting disease or produced by the physician, must obey mechanical laws. The blood is reduced to its natural state by the constant churning of the heart and lungs; by which the chyle is made blood, solely through change in the quality of its particles. One chief cause of disease is over-eating, whereby the blood is made too copious and too viscid. In inflammation this viscid blood stagnates in the part affected. In fevers there is too great tenuity of the blood, so that the heart's impulse causes it to move with unnatural velocity. *Crises* are nothing but changes in the dimensions of morbid particles in the blood caused by increased circulation, and fitting them for excretion through the proper vessels. Bleeding is the grand remedy.

The nature of the mathematical and mechanical doctrines may be illustrated further by the way in which they were applied to therapeutics, and especially to explain the good effects of mercury in inflammation. In 1694 M. Belloste, surgeon in the Sardinian army, published an account of mercury, which he describes as the greatest gift of Providence in the whole *Materia Medica*. The mercury should be in the metallic form, and subdivided into the minutest globules. In this state it is taken up with the chyle, circulates with the blood, strikes against the blood globules, breaks up coagulations and obstructions in the vessels, renders the blood more fluid, insinuates itself into every place, dispersing everything not naturally united, and as its particles are spherical, they cannot irritate, like the "pointed, hooked, and keen" particles of mercury in chemical combination. (*Hospital Surgeon*, by Augustin Belloste, Lond. 1733, vol. ii.)

So also the work of John Astruc (b. 1684, d. 1766), physician to the king of France, on venereal diseases, contains (edition of 1754, book ii., ch. 10) an account of the mode of action of mercury, which may serve as an excellent illustration of the theories of those who accounted for all the processes of life on mechanical grounds. This author undertakes to prove, by a long series of postulata, propositions, lemmata, and corollaries, that the greater specific gravity of mercury gives its globules a velocity fourteen times greater than that of the blood in which they circulate; and that consequently obstructions which prevent the passage of blood through the minute vessels will sometimes give way before the more powerful impetus of the globules of mercury. Moreover, that the blood and other fluids, if they are too viscid, will be broken up and rendered thinner by the velocity of the circulating globules; and that by the same agents "the venereal poison, whatever it be, or wheresoever it lies, by the repeated action of the mercurial globules, may be so divided, broken, and comminuted, as to be subdued at last, and discharged by some of the secretory outlets." By these means, he says, mercury when it acts properly, attenuates the fluids, scours the vessels, restores the oscillatory motion of the solids, removes the obstructions, dispels the venereal poison, and absolutely extirpates the disease.

We get further advance in the opinions of Hermann Boerhaave (b. 1668, d. 1738), which are

summed up in his "*Aphorisms*" (transl. 1742 from the last Latin ed. of 1728) where he states (No. 371) that inflammation is "an attrition of the red arterial blood stagnating in the smallest vessels, occasioned by the motion of the blood circulating with greater force in the larger vessels. Which therefore may take place either in the extremities of the smallest arteries, or in the arterial lymphatic vessels, they being incapable of transmitting the red globules received by their dilated orifices through their extremities. So that its seat is in every part of the body where there is a tissue, that is, abundance of arteries dispersed in the manner of a net, and wherever the lymphatic arteries have their beginning. This stagnation is caused in the smallest arteries by whatever makes the ends of the vessels in their cones and cylinders so narrow that the diameter of their orifice is made less than the diameter of the globule of the blood. In the lymphatic arterial vessels it is occasioned by all causes which stretch their mouths so wide as to give entrance to the coarse parts of the blood, which being drove in deeper, meet with narrow passages that give way: also, by all causes of inflammation in the blood-vessels. But as often as these causes have occasioned that stagnation, then doth the power of the blood, pushed on by the remaining vital strength, occasion some effects, which are at the same time signs of a present inflammation;" i. e., distension of vessels, pain, redness, heat, &c.

The chain of causes is given as follows: A too great flow of the "nervous juice" being directed to the heart and large vessels, and the motion of the blood being increased in the vessels, there results "a strong resistance of the vessels against the blood, a strong pressure of the blood upon the sides of the vessels, a violent rubbing of the vessels and the blood against each other, a strong rubbing of the several parts of the blood among each other; a greater heat of the whole, a drying up of the blood, and consequent viscosity," &c.

The account given of suppuration is that "the vessels let out their liquids, break and corrupt, and dissolve into pus."

The doctrine of fevers is summed up in these words: "So that the too quick contraction of the heart, with an increased resistance at the end of the capillary vessels, is sufficient to complete in us the idea of all acute fevers." (*Aphorismi de cognoscendis et curandis morbis*. Ed. 4to. Lug. Bat. 1728.)

In an eloquent academical address—"De usu ratiocinii mechanici in Medicina,"—delivered at Leyden in 1703, Boerhaave advocated the introduction of mechanical theories of disease in place of the prevailing vital and chemical theories. The enthusiasm with which he followed up this mode of argument, so as to lead himself into fresh errors while he exposed old ones, is strongly marked in this address. "I can scarcely restrain myself," he says in one place, "from declaring that the causes of the most complicated diseases are more simple and more mechanical than any single physician now imagines."

In the history of doctrine we may next refer to De Gorter, Professor at Leyden, who develops the ideas of "lensor" and "visciditv" of the blood, of obstruction of the arteries by it, and of local irritation as causing afflux. In his treatise

*De Secretione* (Lugd. Bat., 1735), he describes the process of secretion as consisting in the separation of the components of mixed liquids by pores and vessels of different shapes and sizes; and remarks that in health blood-globules are only found in blood-vessels, whereas in disease they may intrude into seriferous or lymphatic vessels.

He says (*De Motu Vitali*, Amstelodami, 1737) that if a part irritated be observed, there will be found greater heat and throbbing than in the rest of the body. But this cannot arise from mechanical laws, but from an increase of vital motion in the stimulated part. Any arteries may have their vital movement increased; so as even to cause their emissaries to exude blood as in the menses, or from a wound; and throbbing precedes both the menses and bleeding from a wound. Hence the lymphatic vessels going off from any artery may have the red globules thrust into them in inflammation. A part may be inflamed by a stimulus, without any precedent obstruction; nay the obstruction, if the red globules do not pass in the small seriferous vessels, is an effect of the increased vital motion of the arteries. Venesection does good in inflammation, not by withdrawing an *inflammationis materies*, but by lessening all vital motion, and particularly that of the part from whence it is drawn; for preternaturally rapid vital motion is the cause of inflammation. Neither does venesection act by educing thick and inflamed blood from the inflamed part, but it lessens the mass of the blood, and hence lessens that increased vital motion, whereby *all* the mass of the blood is rendered thicker. If it be alleged that the blood is not thickened in all acute diseases, this may be because the inflammation hath not lasted long enough to thicken it, or because the case is not *inflammation* but *erysipelas*, which hath many signs common with inflammation, but yet doth not cause thickening of the blood.

He also observes in his *Compendium Medicinæ*, 1731, that a thickened or condensed state of the blood, such as may be induced by its more powerful circulation, or by the evacuation of its lighter parts, or by want of drink, may cause it to pass with greater difficulty through the extreme parts of the arteries, and so may distend them and cause them to oscillate more strongly and more frequently. (*Tractatus xlvii. de Inflammatione*, p. 240.)

In the course of a short time theory advances to contemplate inflammation as caused, not by the blood being driven into vessels too small for it, but by "actions," or conditions of the vessels through which the blood passes. Amongst those who propounded this view was G. E. Stahl (*b. 1660, d. 1734*), who repudiated the doctrine of "vital spirits," and boldly assumed that the immortal soul is the chief agent in all the operations of the animal body, in health and disease. In fact, he attributes very much the same functions to the soul that Macartney does to the "organic consciousness." The description given of inflammation in his "Dogmatico-systematic Medicine: Theoretic part: Section II.—Pathology," published at Halle in 1707 (pp. 246-265), still contains much of Galen's. Stahl calls the blood the principal subject matter of inflammation, and says that a *stasis* or total stoppage of the blood is the essential cause of it. A *stagnatio* may produce heat and burning, but a complete *stasis* is required before inflammation can exist. "I do not, however, by any means agree," he says,

(p. 255) "with the opinion that the swelling of inflammation consists simply of impacted, sometimes grumous, blood: I rather consider it due to the active, constant, and rapid influx and progress of good and pure blood. The vivid redness of inflammation cannot be caused by any but bright blood."

The heat is attributed (p. 257) to the friction of the particles of the blood against the vessels and against conglobated particles which are formed in them. The contraction of the orifices which the blood has to pass produces part of this friction, and prevents equable and free distribution of the blood.

Pus is corrupted and stagnant blood in the focus of inflammation, washed by the afflux and reflux of good pure blood till nothing but earthy particles are left. The tonic contraction of the porous parts intermediate between the arteries and veins is a great agent in the circulation of the blood in health and in disease. It is motion of the blood, not composition of humours, which is concerned in disease. (*Diss. de Mechanismo motus sanguinis*, Halæ, 1710.)

Frederic Hoffmann (*b. 1660, d. 1742*), the contemporary of Stahl at Halle, held opinions in some respects entirely opposed to him. In his work on "*Rational Systematic Medicine*" (*Op.* vol. iii. ch. 4) he states that "spasm" is the agent which brings about diseased states of all kinds; but agrees with him in stating that pathology should be grounded on the defects of the "microcosmic motions" of the solids of the body; not on affections of the fluids. He grounds this opinion chiefly on the "nerveo-muscular" structure of the alimentary canal, the arteries, and ducts of all kinds, and on the fact that no pain, inflammation, fever, or spasms can occur without implicating some of these parts. He says also that the action of the most valuable medicines takes place not on the fluids of the body, but in changing and moderating the action of the solid and nervous parts. Hoffmann is quoted with marked approval by Cullen, of whose doctrine of spasm he is the parent. Hoffmann repudiates Stahl's doctrine of the agency of the immortal soul, and derides the ordinary fictions about "Nature." If Stahl's doctrine of the agency of the soul were true, it would be an infallible guide; every appetite should be indulged, and every morbid process promoted. But the efforts of nature are, according to Hoffmann, often mischievous, and, still more often, insufficient. Fevers are produced by whatever causes spasm of the periphery (as cold) and so interferes with the circulation and sends the blood back to the heart. Inflammation consists in a stasis of blood in the capillaries of some part, into which it is driven by spasm of arteries, which interferes with its equal circulation. When once stasis has occurred, copious torrents of blood are directed to the part. (*Opera Omnia*, Genève, 1740, tom. i. p. 302, *de genealogia morborum*.)

We may make a classification of the doctrines heretofore set forth, into those which take (1) the humours, or (2) the vital spirits, or (3) the chemical quality, or (4) the mechanical quality of the blood, or (5) the passively obstructed, or (6) the actively contractile state of the blood-vessels as the cause and seat of inflammation. Meanwhile the doctrine of *irritation* gradually grew into



prominence—that is, that an injured part has in itself the power to draw a flux of blood to itself, and to set up inflammation by virtue of its own vital power. This power—*irritability*—was expressed by Serjeant Wiseman, who asserts that a part exposed to heat, pain, or injury, “attracts humours” to itself. Wiseman says that some call it *attraction*, others *appulsion*, but that either word will do for a practical man. Yet in truth a mighty difference is involved in the two words, one making the part inflamed *active* by its own vital power, the other making it the *passive* recipient of influences from humours, vital spirits, soul, or nerves. Boissier de Sauvages, the great nosologist (*b.* 1706, *d.* 1767), in treating of the causes of local afflux, describes the simple experiment of pinching a kitten’s ear to show the vascularity resulting from local irritation. He denies this can be from loss of power in the capillaries, or inspissation of blood, or morbid humours, but declares it to be the work of Nature, that “*potentia nutritrix intelligens et sanitatis tutrix provida.*” (*Opera, Amstelodami*, 1768, vol. i., p. 366.) Bordeu (*b.* 1722, *d.* 1776), a charming and most sensible writer, is most definite as to the independent life of the various parts of the organism. In his *Recherches anatomiques sur les Glandes* (Paris, 1752, Sect. 129, or *Œuvres complètes*, Paris, 1818, t. i., p. 193), he says: “When a part inflames, it becomes a special organ, which has its own action, its circulation, and all its own functions, independently in a certain degree of what it receives from the general circulation.” He compares the body to a swarm of bees, moving as a whole, yet composed of independent vital units. In inflammation he says there is a kind of local erection, to which blood is brought in greater quantity through the irritation of the vascular nerves. Again, he uses the Hunterian words “disposition” and “action.” Inflammation, he says, results from a certain *disposition* of a part, whose nerves have a violent action. Moreover, the words *stimulus* and irritation had come thoroughly into use; still all “action” was commonly ascribed to a sentient principle acting through the nerves; and this was held by Mead, Whytt, and all the most eminent men, till Haller demonstrated the contraction of muscles by a *vis insita*, or innate power, which might be influenced by the nerves, but existed independently of their influence. Whytt (a physiologist of whom Scotland should be proud, who foresaw the law and fact of reflex action of the central nervous system), contended that the action of the small arteries in inflammation was produced through the nerves. (Whytt, *Physiological Essays*, 3rd ed., 1766; Seller, *On Life and Writings of Whytt*, *Transactions of R. Soc. of Edinburgh*, 1862; Haller, *Prinæ Lineæ*, dated 1747.)

William Cullen (*b.* 1712, *d.* 1790), whose Nosology was used till 1850 in the army and navy, though he repudiates Stahl’s *Anima* in words, is obliged to have recourse to a *Vis Mediatricis Naturæ* to fulfil the same purpose. He also repudiates all humoral pathology. In his “First Lines of the Practice of Physic” (dated 1783, ed. 1791) he states that a “spasm of the extreme arteries supporting an increased action in the course of them” (p. 259) is the circumstance which determines and commences inflammation. This idea is supported by his account of rheumatism, which is “often manifestly

produced by cold applied to over-distended vessels, or by causes of an increased impetus, and over-distension in vessels already constricted.” And the state of the whole arterial system, which permits an inflammation to be readily produced in other parts besides that first affected, is brought forward as an additional proof.

The treatment recommended by Cullen (p. 279) is directed to the removal of the remote causes, and of the general or local “phlogistic diathesis,” and to taking off the spasm of the particular part by remedies applied either to the whole system, or to the part itself. This list resolves itself into febrifuge medicines, leeches, poultices, and cooling lotions.

This doctrine of “actions,” “spasms,” and “stimuli,” runs through the whole of this work. The same thing is particularly insisted on in the preface, where we find (p. 33): “although it cannot be denied that the fluids of the human body suffer various morbid changes, and that upon these diseases may primarily depend, yet I must beg leave to maintain that the nature of these changes is seldom understood; that our reasonings concerning them have been for the most part purely hypothetical; and that in this, particularly, they have been hurtful—that they have withdrawn our attention from, and prevented our study of, the motions of the animal system, upon the state of which the phenomena of diseases do more certainly and generally depend.” And (p. 47): “the affections of the motions and moving powers of the animal economy must certainly be the leading inquiry in considering the diseases of the human body.”

Having brought our history of theory to the middle of the eighteenth century, and, referring to Subsection 6 for short notices of the chemistry of the blood, we must now go on to give an abstract of the doctrines of John Hunter (*b.* 1728, *d.* 1793), a task of no small difficulty. It is rendered necessary by the reputation of the man, by the position which he justly holds as a profound philosopher, and by the incessant appeals which the succeeding generation made to his authority. Yet, as we have before shown, some doctrines have been ascribed to Hunter which he not only never held, but directly combated; as, for example, the doctrine of the essentially inflammatory nature of *all* repair, which was taught by the quasi-Hunterians of the Borough Schools in Sir A. Cooper’s time. (See above, pp. 8, 9.) But the difficulty is this—that in reading Hunter’s works (and we refer now especially to his treatise on the *Blood, Inflammation, and Gunshot Wounds*, &c., dated 1793; Palmer’s ed. 1837) we are perplexed by meeting with two sets of incompatible opinions, which continually strive for the mastery. On the one hand, he is a great theorist, laying down laws of life, and deducing his views of the phenomena and treatment of disease from those laws. On the other, he is a practical man or empiric, who confesses that we have no *a priori* knowledge, nor anything certain which is not based upon experience, and who finds his laws no laws, so full is nature of cases which cannot be reduced under them.

On the one hand he urges a study of *principles*, and repudiates a “Chinese philosophy,” consisting in a mere accumulation of facts; on the other hand he says, most justly with respect

to therapeutics, that "it is most difficult to ascertain the connection of substance and virtue," and to apply this in practice; that this cannot be learned *à priori*; and that "the practice of medicine is reduced to experiment, and this not built upon well-determined data, but upon experience resulting from probable data."

His theoretical view of the nature of inflammation is, we conceive, this—making allowance for the circumstance, that it is not easy to find in Hunter's writings on this difficult subject any general proposition which is not elsewhere contradicted wholly or in part. He hated definitions, and declared that you might thereby bring together a thousand things that had no connection with the subject.

He believed that a "principle of life" exists both in the solids and fluids of the body, diffused over the whole of them, "making a necessary constituent part of them, and forming with them a perfect whole, giving to both the power of preservation and the susceptibility of impression." This matter he believed to be identical with that of the brain, and continuous with it, and serving as a mode of communication and bond of sympathy between all parts of body and blood, and enabling each to affect and be affected by the other. Life thus existing as an entity combined with the body, and yet distinct from it, is supposed by Hunter to be endowed with, as it were, intellectual and moral faculties; for it takes cognizance of impressions from without, and sets going various operations or "actions" for definite purposes for the good of the body in which it resides. It may "take alarm," "feel sympathy," "call up the powers of the constitution." It may have "an object" or purpose—in the situation of the blood, for example. By its means "the whole powers or materials of life may be called into the vital parts or citadel, whilst the outworks are left to themselves"—as in the signs of the beginning of fever. It has "a consciousness of imperfection," or feels "the stimulus of imperfection"—"which produces a new action—the action of restoration." It appears capable of comprehending "necessity;" for there is a "stimulus of necessity" which, according to Hunter, the blood obeys when it coagulates in the veins of a mortified limb—the necessity in this case being clearly that of doing an action for the purpose of hindering the patient from bleeding to death. Alteration in structure by injury or by disease supplies the stimulus of imperfection; the parts injured or diseased not being able to pursue their natural mode of action, are obliged to set to work at actions of restoration. "Strength and weakness of the constitution, or of parts, are synonymous terms with a greater or less quantity of animal life, or living principle joined with powers of action." Strength is always better than weakness. Yet "too much strength might act with too much power, becoming unmanageable under disease that excites action." On the other hand "strength lessens irritability." It is essential that "the powers and actions should be well proportioned." Simple injuries require simple modes of restoration, which are union by the first intention, &c., and are not inflammatory, and do not call up the powers of the constitution to assist in the recovery. Wounded parts in contact may "mutually agree not to inflame;" or "by being in contact,

there is a mutual harmony which prevents their being excited to inflammation." "Inflammation is not a disease, but a salutary operation, consequent on violence or some disease." Yet, though it is a "mode of cure by changing a diseased process into a salutary one," it may be occasionally "a cause of disease." "Inflammation is an action produced for the restoration of the most simple injury in sound parts, which goes beyond the power of union by the first intention." It is "a disturbed state of parts, which require a new but salutary mode of action to restore them to that state wherein a natural mode of action alone is necessary." "It is a sign of powers, and of necessary powers."

So much for the purposes, or, as Hunter calls them, "motives" of inflammation. Now for its nature.

It is "an increased action of that power which a part naturally possesses." In "healthy inflammation it is probably attended with increase of power." "The act of inflammation would appear to be an increased action of the vessels." This increase of action is evident, not only in the solids, but in the blood, where it produces the *sizy* coat. It may be doubtful "whether the disposition for inflammation and the change produced in the blood arise from a real increase of animal life, or whether it is only an increase of a disposition to act with the full powers which the machine is already possessed of." "It appears to be certain," says Hunter, "that it is either one or the other." In his text he "suspects" it to be the latter; but in a note says, "It is reasonable to suppose that there is really an increase of animal life;" and he supports the latter view by this argument. Breeding women have *sizy* blood. Breeding women require greater powers than usual. "It would appear necessary for an animal whenever put into a situation where greater powers are wanted, to have those powers increased." Therefore they are increased in breeding women. Therefore, the *sizy* blood of breeding women "should not be called inflammatory blood, but blood whose powers of life are increased." The coagulation of blood may show its strength or weakness. A firm clot with cupped surface shows strength, whereas when it is soft and "lies squat" in the dish it is weak.

Hunter repudiated all "humours;" and in his system "sympathy" played the part that contaminated blood does in more modern times. The blood is a living thing; coagulation is its action, as contraction is of muscle. The coagulable lymph (fibrine) is the most important element of the blood. Blood being alive, a thin layer of it can unite with the living surfaces of a wound, and unite them to each other. The arteries are the agents in "every internal operation in the machine respecting growth, natural repair, and secretion." Any cause which produces stoppage of blood in the capillaries may be a cause of inflammation, but it does not follow that stoppage of blood is the essence of inflammation. The capillaries in this process are enlarged, but this is more than a "common relaxation," it is "an action in the parts to produce an increase of size to answer particular purposes," "an action of dilatation."

The effects of inflammation are in their intrinsic nature salutary: as adhesion, which unites divided parts; suppuration, which is a



leading step towards healing by granulations ; and ulceration. "Any irritation which is so great as to destroy suddenly the natural operations of any one part, and the effect of which is so long continued as to oblige the parts to act for their own relief, produces in some parts, first the adhesive inflammation; and if the cause be increased, or continue still longer, the suppurative state takes place, and all other consequences, as ulceration; or, if in the other parts, as secreting surfaces, then the suppurative takes place immediately, and, if too violent, the adhesive will succeed; or if parts are very much weakened, the ulcerative will immediately succeed the adhesive, and then suppuration will be the consequence."

It will be obvious that Hunter took for his philosophical basis, like Van Helmont, Willis, Stahl, Mead, and De Sauvages, the assumption of a conscious and intelligent entity ruling the animal body. It will also be obvious that he ignores totally what is now known as the doctrine of "conservation of force," which teaches that no movement is self-generated, or can be produced save by the conversion of some pre-existing movement. Hence that no "increase of power" can be generated by mere necessity or expediency. If we wish to realise the enormous gap which separates modern thinkers from the past, we need only refer to this idea. Yet we may remember that the doctrine of a vital spirit is held to this day (see p. 56), and that the venerated Prout (*b.* 1786, *d.* 1850), not only believed in "independent vital principles or agents," but also in the power of the digestive organs to "form azote and carbon," on an emergency. (*On Stomach, &c.*, 3rd ed., 1840, p. xxix.) With such intelligent vital agents, and such creative powers, why, we may ask, do animals ever sicken and die?

The weakness of Hunter's philosophical basis was readily detected by his contemporaries. John Burns, "Surgeon in Glasgow" (who first described medullary cancer under the term "Spongoid Inflammation," in his *Dissertations on Inflammation*, Glasgow, 1800, p. 345), "holds that there is no supposition more directly contrary to true philosophy and reason than the opinion that certain events take place merely because they are useful." It may also fairly be asked what is the sense of acknowledging a *vis medicatrix*, if its actions are as destructive as any injury or disease can be? Hunter's writings also are full of the fault of taking a metaphysical amplification for a real explanation. For instance, if it be asked why some parts do not readily suppurate, the answer is, "the realness to accept of the adhesive most probably becomes a cause why the suppurative inflammation does not so readily take place." It is well known that gouty inflammation is very violent, and that violent inflammation normally produces adhesion and suppuration; but gout does neither. Hunter's explanation of this is a mere assumption of the existence of an intelligent vital principle, and that effects are produced because useful. "Adhesions" in the gout, he says, "do not seem to be the intention, because none are produced;" and, "the inflammation is the only thing necessary to produce the ultimate effect," therefore there is inflammation without suppuration. So that laws are no laws if it please "Nature" to set them aside for the benefit of the patient!

It must be remembered that although Hunter's great work was not fully published till after his death, yet that he had been for more than thirty years working at it, and during the greater part of his time lecturing, so that his views were well known and criticised long before his book was complete. For example, John Pearson (*Principles of Surgery*, Part i., Lond., 1788) objects to treating the adhesive as a separate or peculiar kind of inflammation. He more justly ridicules the doctrine of ulceration by the agency of "absorbent vessels," to which Hunterians adhere down to the present day. Any part of any bone, he said, might die, and be separated by ulceration. But if this is done by the mouths of the absorbents, these mouths must be everywhere; and if so, where are the trunks? Of course, Hunter was not popular in his lifetime, his temper was too violent and contemptuous; and his rivals denounced him as an innovator, and a mere physiologist. He was hated by Benjamin and John Bell almost as much as they hated each other. Benjamin Bell in his *System of Surgery* (6th ed., Edinburgh, 1796) describes increased action of the arteries, with spasm of the extreme vessels, as the proximate cause of inflammation; "a doctrine which," he says, "for several years has prevailed in this University." Suppuration is a fermentation of serum. Adhesion of wounds is the same process as adhesion of inflamed serous membranes; viz., by "exudation of the gelatinous parts of the blood from the extremities of the divided vessels." This is "Healing by the first Intention." John Bell, in his *Discourses on Wounds* (2nd ed., Edinburgh, 1800), sneers at Hunter's experiment of the tooth and cock's comb, which he would not believe till assured by his friend Astley Cooper that it was a fact. He is "at pains to represent the improvement" of procuring the adhesion of wounds, not as the work of Hunter, but "as gradual and silent; as having obtained general and common consent by a slow communication from friend to friend, till at last the practice was fairly established, and no man could fully claim an improvement in which every man had some little share." The doctrine of primary adhesion was not universally accepted when O'Halloran (*Treatise on Gangrene, Amputation, &c.*, Dublin, 1765) wrote, for he treated it as chimerical, and first dressed wounds with lint and flour till suppuration began, then applied the granulating surfaces to unite by the "second intention." This was a great improvement on the old plan of letting a stump heal with a large cicatrix, but the credit of procuring immediate union is due to Edward Alanson, of Liverpool (*On Amputation*, London, 1779), who at once united the wounds after amputation and extirpation of cancer. Hunter even denounced union in the latter case as dangerous.

It is easy to point out the errors of Hunter, which were those of his time; but they do but add more lustre to the grandeur of his character and of his life labour, which was all his own. He saw the necessity of making physic a branch of biology. Other great men had seen this, but Hunter began to do it. He saw that it was necessary, in order to understand disease, that healthy actions must be studied, and this not in man only but in the whole organic range, animal and vegetable. To acquire this knowledge he appealed to the whole animated world, and left his Museum as the record

of his work. He attempted to construct a theory of disease from a study of health, and his attempt has an air of grandeur, though *magnis excidit ausis* for want of the proper data. His permanent claims to respect as regards inflammation are founded, not on his philosophy nor his science, but on his great practical sagacity. He separated "repair" from inflammation; he taught that "immediate union" takes place without inflammation; he laid emphasis on the distinction between injuries with wounds and without, and the danger in the former "that the blood may lose its living principle;" he thus evidently foresaw the basis of the antiseptic treatment, and, further, anticipated Sir J. Y. Simpson in pointing out that needles and ligatures tend to promote suppuration in wounds. To Hunter's teaching is due the care of English surgeons to avoid suppuration and promote healing by the first intention, and the success of ovariectomy, in which this union is the cardinal point. His observations on scabbing point in the same direction. By his influence chiefly, the farrago of complex applications which disgraced the pages of the earlier surgeons was abandoned for simpler remedies.

But it was Hunter's general character as a philosopher and as the founder of the Museum which caused his memory to be venerated, and amongst his pupils were all the surgeons who attained eminence in London during the early generation of this century—Abernethy, Sir Astley Cooper, Sir E. Home, Cline, Lynn, Sir A. Carlisle, Wilson; from them, the *cultus* of Hunter passed to J. H. Green, Travers, Lawrence. Yet it is most certain that they abandoned one of their master's cardinal doctrines, the separation of repair from adhesive inflammation.

Little advance was made during the 40 years which succeeded Hunter's death, and in which his doctrines, in English schools, were held in unabated reverence.

We must, as matter of history, not omit to notice three *Methodist* systems, which appeared during the Hunterian period. One, that of John Brown, who instead of contemplating living man as made of flesh and blood, considered him as a compound of excitability and stimulus. His doctrines were taken up by Rasori, Tommasini, Giacomini, and the Italian contra-stimulant school, who divide diseases into two kinds, *sthenic* and *asthenic*. There was also the doctrine of Broussais, who ascribes all general disease to some local inflammation. Brown's practice was "incendiary;" his chief remedy brandy. The others were "vampyres."

#### SUBSECTION 3.—THE EARLY MICROSCOPIC SCHOOL.

Medical theories are always revolutionised by new means of physical investigation. This is made clear by the influence of the microscope on the doctrine of inflammation. The existence of the blood globules was made known by the early microscopists of the seventeenth century, and the circulation of the blood in the tails of fishes and in feet and mesentery of frogs were demonstrated by Malpighi, Hooke, Leuwenhook, Cheselden, and Haller; but a search into their pages gives us little that concerns our special subject. Fabre, in 1770, repudiated the doctrine that obstruction could be the essential condition of inflammation, by observing the freedom with which the circulation is carried on in the network

of capillaries, and how, if obstructed in one channel, the current oscillates and finds its way by another. In his excellent *Essais sur la Physiologie, Pathologie et Thérapeutique* (Paris 1770), he gives the axiom, 'l'action des nerfs attire le sang vers le lieu où ils sont stimulés,' as one result of a careful series of observations on the mesentery of the frog. Of Hewson and his labours on the blood we need not again speak, but may observe that microscopical observations were thoroughly discredited by Hunter, who believed that the imagination was called in to supply what the eye failed to see. (*On the Blood, &c.*, part i., cap. i., § 4.) Nor need this be wondered at when we think of Sir E. Home, and his observations on muscular fibres constructed out of a linear series of blood globules. (*Phil. Trans.* 1818, p. 129.) Early in the present century, however, pathologists again took up the task, amongst whom may be enumerated Wilson Philip, Sir C. Hastings, John Thomson (1809), author of the *Lectures on Inflammation*, Gendrin, and others, some account of whose labours may be found at p. 22 *supra*.

Hastings and Wilson Philip virtually clothe the doctrines of Boerhaave in the jargon of Cullen. They make inflammation to consist in a *debility* of the capillaries, followed by increased action of the larger arteries, and terminated so soon as the capillary vessels are so far excited, and the larger arteries so far weakened by the preternatural action excited in them, that the power of the capillaries is again in the proportion of *vis à tergo*. Again, Hastings declares that "congestion should stimulate, by its distension, the blood-vessels to frequent but ineffectual efforts to carry forward the excess of blood with which they are loaded." (*On Mucous Membranes, &c.*, Lond. 1820, p. 74.) It will be noticed that Hastings and Philip speak of action as if it were power, and as if debility of capillaries was cured by an excitement which weakened the arteries; whilst in their notions of obstruction they are far behind the knowledge of Fabre in the eighteenth century.

Mr. Dowler (*Med. Chir. Trans.*, vol. xii., for 1822) holds that serum, fibrin, pus, and red globules are poured out in inflammation successively as it becomes more acute; and as the diameters of the blood-vessels are enlarged. But that if the blood-vessels of a part, as of a mucous membrane, are naturally large, pus escapes the sooner. He does not prove that there are any open mouths of vessels, nor does he show why fibrin is not effused more frequently than it is by mucous membranes.

Dr. B. G. Babington (*Med. Chir. Trans.*, 1831, vol. xvi.) thinks that morbid effusions are of these sorts: 1. Mere water effused in the form of vapour; which he believes to be the condition of the serous membranes in health, and of the fluid effused in atonic hydrocephalus and other non-inflammatory cases. 2. Effusion of "liquor sanguinis"—a now familiar term introduced by Babington—with less water in proportion to the intensity of the inflammation. He believes that in the majority of cases, serum is not effused *per se*, but formed by a deposition of the fibrin from the liquor sanguinis; and that wherever serum is effused, fibrin will be found somewhere near, either as flakes in the serum, or as false membrane, or as gelatinous exudation, holding the serum in its meshes; and that the fibrin is not observed oftener, because its quantity is so small



when compared to that of the albumen. 3. That nevertheless, serum really albuminous may be secreted without fibrin. 4. As pus-serum in which very minute particles of fibrin are suspended—Hodgkin denying that the globules of pus resemble those of the blood, and affirming that they are altogether irregular.

Amongst writers of this period we find Herbert Mayo, in his *Outlines of Pathology*, 1836 (p. 431), stating his opinion that the chief change in inflammation is a stagnant condition of the blood in relaxed capillaries, the distinction of red particles from liquor sanguinis being lost. He says that Gendrin's observations on the effects of inflammation excited by a burning-glass in the frog's foot, "simplify the theory of inflammation, and satisfactorily explain the alliance of all its leading phenomena. The initiatory effusion," he goes on to say, "of serum and lymph, dependent upon the visible obstruction of the circulation—the lymph the same substance with attenuated inflammatory fibrin—the consequent occasional mixture of blood with lymph—the formation of pus secondary to and later than the secretion of serum and lymph"—(Gendrin believed he saw the conversion of blood corpuscles into pus, and their exudation as such, an interesting observation when compared with Cohnheim)—"the solid particles in pus, although larger, yet of the same remarkable figure with those of the blood, and doubtless the same enlarged—the occurrence of blood in pus—the organisation of lymph by extension of vessels, some at first containing pus, others a thick red liquid—and lastly, inflammatory gangrene, proceeding from the vessels being in certain cases irrecoverably obstructed—are phenomena, which may be declared to be now grouped under one law."

We have already mentioned Macartney (see p. 9 *supra*), as vindicating the Hunterian doctrine. In his "Treatise on Inflammation" (1838), he extends Celsus's definition by adding a fifth article, viz., "an alteration or suspension of the natural secretions of the part." He then accounts for each of the symptoms (p. 15), attributing the "heat" more to "the state of local or organic sensibility of the parts than to the condition of their arteries, as regards circulation or secretion." The "redness" is due, he says, to the dilatation of minute arteries which before contained only serum. The "pain" is connected with the increased sensibility which always accompanies an increased blood-supply (as in the case of erectile tissues). The cause of "swelling" is sufficiently obvious. "Secretion of every kind," he says (p. 21), "is stopped when parts, either internal or external, are excessively inflamed. Even the secretion of pus ceases when an abscess or ulcer, or an issue, is suffering a severe degree of inflammation." But, on the other hand, he says (p. 26), "I shall show that when all irritation is removed from an ulcer, seton, issue, or abscess, that the formation of pus either diminishes or ceases altogether."

But the distinctive opinion on which this author's theories are grounded (p. 130), is that the "organic consciousness," i.e., the sense which remains after the connections of a part with the individual consciousness have been cut off by dividing the spinal nerve—in other words the action of the sympathetic system—is the proximate or essential cause of inflammation. He

considers that an "organic sense of vacuity is the cause which produces inflammation of closed cavities which have been suddenly emptied; e.g., in the case of peritonitis following the evacuation of an ovarian sac, or cystitis following the removal of a stone. He proposes (p. 117) to call the effect of the working of the sympathetic system with regard to the non-muscular tissues of the minute arteries, *tone*, or *tonicity*. But he explains that this is to mean a state of dilatation quite as much, or more, than a state of contraction; and considers that these arteries have three states as regards size: (1) their middle or ordinary state; (2) their excited, or dilated (tonic) state; and (3) their passive or contracted (collapsed) state. In proof that contraction of the vessels is a passive, and not a tonic state, he refers to the condition in which arteries as well as muscles and other structures remain after death; it being difficult to force injection into the minute vessels until decomposition is about to commence. The opposite of this state he considers to be the dilatation and proportionate increase of strength which takes place in the arteries in phlegmonous inflammation. Nevertheless, though we are told that the "organic sense of injury or danger, modified according to the causes which produce it" (p. 130), is that which induces this tonic dilatation, and therefore the inflammation, yet that the local abstraction of blood (p. 152), is intended "to make such an impression on the sensibility of the part as will produce a contracted or diminished state of the arteries, by which less blood is permitted to circulate in the vessels immediately concerned." And this is said to be due to a law of tonic action: the abstraction of blood "creates that organic consciousness of vacuity which always produces a tendency to contraction."

The great share taken by the nervous system in inflammation is well illustrated (p. 6) by the fact that animals are liable to the active forms of the affection, and the constitutional disturbance caused by it, in proportion to the perfection of their nervous systems; man being the greatest sufferer.

The treatment recommended by this author is directed "to diminish the force of the heart, and give the disposition to the small arteries to go into the contracted state;" and to reduce sensibility, to restore secretions, and to induce pleasant or comfortable sensations. The use of opium, ice, irrigation, and water-dressings are especially advocated; the applications being usually modified according to the sensations of the patient.

In fact if we survey the period from J. Hunter's death down to 1838, we shall find the key-note of the prevalent doctrines in the following quotations. Thomson assumes it to be "knowledge acquired by experience," and the "truth of which is universally acknowledged," that "inflammation has its principal seat in the capillary vessels." And Caleb Hillier Parry declares that there is "one component or constituent part, which is primarily affected in that morbid change called inflammation." \* \* There can be no doubt that such a part exists, and that this is the Capillary System." (*Pathology and Therapeutics*, 2nd ed., p. 81, 1825.)

#### SUBSECTION 4.—THE "CELL" DOCTRINE PERIOD.

But there is no finality in medical theory, and the new biological doctrine, called the cell theory,

soon gave a new face to theories of inflammation. In 1838 Schleiden published his observations on the essential structure of plants, and was very soon followed by Schwann, who demonstrated that one and the same plan rules the original composition of animals. Both plants and animals are composed of myriads of units, or cells, each enjoying a life of its own (as Borden had shown) though all subordinated to the general life of the individual.

Schwann's cell theory takes for its starting-point the existence of a soft structureless, or granulous, substance, such as that of the early embryo in the ovum, or that nutritive material effused from the capillaries into the interstices of all tissues. This is called *blastema* or *cytoblastema*. In this, he says, there appear in due course *granules*;—granules by growth or by coalescence, form small bodies called *nuclei*;—on a nucleus there forms by precipitation a membrane, projecting from it like the glass of a watch, called the cell membrane;—and thus is formed a *nucleated cell*. Cells may continue isolated, as the blood lymph and pus corpuscles; they may cohere by their edges to form a *pavement* or superficial layer, as cuticle or epithelium; they may coalesce with the remaining *cytoblastema* into a solid mass, as bone or cartilage; they may elongate and split into fibres, as the areolar tissue; or they may elongate, and coalesce by their extremities to form tubes, such as those which contain the peculiar substance of muscle and nerve. "Thus," said Dr. J. Hughes Bennett, "nutrition in all organised beings consists in the formation of a cytoblastema, in which nucleated cells are formed, which are again developed into different textures, or made subservient to the process of secretion."

We must add that this aspect of the cell doctrine, which taught *free cell development* in a blastema, was soon called in question, though most ably applied to pathology by Hughes Bennett and Lebert; and the development of cell from cell, either by fissure or division, or budding or endogenous multiplication, was held the more orthodox view.

The cell theory soon attracted the attention of the zealous observers who were then at work with the new instruments made by Smith & Beck, Ross, and Powell, as Kiernan, Owen, Bowman, W. Addison, Tones, Quekett, the Goodsirs, Hughes Bennett, Rainey, Wharton Jones, Tynbee, and Paget, the last of whom published in 1842 an admirable *Report on the Results obtained by the use of the Microscope in the study of Human Anatomy and Physiology*, and distinguished himself as a lucid historian of the labours of others, before his own labours were made public in his Hunterian Lectures. One of the most eminent workers was Mr. Gulliver, the translator of *Gerber's General and Minute Anatomy*, Lond., 1842, and the editor of Hewson's works, whose name has honourable mention in any account of microscopic pathology. Dr. J. S. Goodfellow, too, deserves praise for his translation of David Gruby's *Observations Microscopiques sur Morphologie Pathologique*. (Vindobonæ, 1840, Trans. in *Microscopical Journal*, 1842.)

As a specimen of the application of the cell theory to the doctrine of inflammation, we may take the clearly-written work of the able and indefatigable pathologist, J. Hughes Bennett, whose *Treatise on Inflammation* (1842-4) is intended to demonstrate that the process is a modification of the functions

of nutrition, as explained by the doctrine of cytogenesis, i.e., cell development. Dr. Bennett (p. 74) compares the contraction and subsequent dilatation of the capillaries with which inflammation commences to spasms and paralysis of muscular tissue. The enlargement of the vessel permits a larger quantity of blood to enter it, while a corresponding increase of tenuity, together with "increased vital attraction" of the tissues, permits not merely of *effusion* of serum, but of "*exudation* of liquor sanguinis;" and this last—not any mere vascular or nervous disturbance—constitutes inflammation.

"The blood-plasma exuded, the textures imprisoned in it may die and pass into decomposition rapidly, constituting mortification; or more slowly, causing ulceration. On the other hand, it may assume an active power of growth, in which case different kinds of nucleated cells are formed, which either remain isolated or pass into organisation of tissue. Inflammatory softening is caused by the formation of exudation-cells; organisable lymph by the formation of primitive filaments, mixed with plastic corpuscles; and suppuration, by the formation of purulent matter corpuscles. When there has been loss of substance the exudation passes partly into purulent matter and partly into cellular tissue, and sometimes into other elementary textures. This, however, always by the process of cytogenesis. Occasionally the exudation is absorbed, either directly before its coagulation, or more commonly after this, by the disintegration of the isolated and temporary corpuscles which are formed, so that the coagulated blood-plasma is again rendered fluid and molecular, and capable of re-entering the vessels. These different results constitute the subsequent phenomena, or terminations of inflammation." (P. 72.)

There are three factors (says H. Bennett) which determine the fate of an exudation. 1st, the surrounding tissues. Thus the plasma effused into the neighbourhood of cellular tissue, bone, divided nerve, serous tissue, may be converted into similar tissues respectively. 2ndly, the vital power of the whole organism; thus, in scrofula and debility, the development may be feeble or abortive. 3rdly, rapidity of the exudation favours its transformation into one of the three kinds of isolated corpuscles—viz., exudation, plastic, or pus-cells. If the process is slow, the plasma exuded has an evident tendency to pass into a higher state of organisation; and in extreme cases, to produce hypertrophy by forming tissues identical with those existing in a normal state.

With regard to the proposed substitution of the term "anormal nutrition" for "inflammation," Dr. Bennett remarks (p. 78) that "the term, if correct, can only affect the results of inflammation, and not inflammation itself. But what is inflammation unconnected with exudation? Dr. Alison directly tells us that he can form no idea of inflammation unconnected with effusion. If we take away the results, we have only congestion or the early phenomena remaining, to which we can never apply the term. But it is evidently erroneous to split one process into two; and to call the first part the cause, and the other the result. Besides, where shall the division be made? Who has ever thought in healthy nutrition of making such distinctions? The whole is one process, consisting essentially in the exudation of blood-plasma,



and of its subsequent transformations, and so it is maintained in 'anormal' nutrition; the exudation and subsequent changes are one process also."

Not only do "cells" possess power of development, but, as was shown by the Brothers Goodsir in 1842 (*Anatomical and Pathological Observations*, Edinburgh, 1845), they have powers of destruction of neighbouring tissues, and are agents in the work of absorption. As they grow in the interstices of an inflamed tissue or on an ulcerating surface, "the subjacent tissues also disappear, either by previous solution and subsequent absorption by the properties and powers of the former, or under the peculiar circumstances of inflammatory action, by the more vigorous growth of the former monopolising the resources of the part, the latter dissolving and disappearing by the usual channels of the returning circulation more rapidly, but according to ordinary laws." The view here given of the destructive power of an actively growing cell-structure, on a part in contact whose vitality is impaired, was well shadowed forth by that able surgeon Aston Key in 1833 (*On Ulceration of Joints*, *Med. Chir. Trans.*, vol. xviii.), who described the ulceration of cartilages as effected by the vascular granulation layer which covers its surface in an advanced stage of white swelling. Miescher (*De Inflammatione ossium*, &c., Berol, 1836) well described the absorption of bone in contact with a sequestrum as the work of the reddish, slightly tenacious, gelatinous matter which grows in the medullary and Haversian canals of that part of the living bone which adjoins the dead. Tomes and De Morgan afterwards pointed out the absorption of the fangs of temporary teeth, as effected by a granulation layer beneath them, and of the constant hollowing out and renewal of living bone by the same means. (*Phil. Trans.* 1852.)

In 1841 Toynbee published his researches on the non-vascularity and mode of nutrition of cartilage and other structures (*Phil. Trans.* 1841), and in 1842 John Goodsir delivered his lecture on the structure and economy of bone (see *op. cit.* published in 1845), followed next year by Tomes's description of the structure of bone, in Todd and Bowman's *Physiological Anatomy*. H. Lebert in 1845 (*Physiologie Pathologique*, vol. i. p. 239) recognises the agency of the fibroplastic or granulation tissue developed in inflamed bone to absorb bone tissue. These developments of the cell theory laid the foundation for a revolution in pathology. Hitherto, as we have seen, the pathologists both of the pre-microscopic and of the early microscopic schools had concerned themselves with the "action of vessels;" and supposed the arteries and absorbents to be the agents in building up and determining the form and duration of the tissues. But the cell theory was the means of deposing the "action of vessels," and inducing pathologists to look to the "action of the tissues." It became clear, as stated in the words of Schwann (preface, *op. cit.*, dated 1839), re-echoed by Goodsir (*On Bone*, *loc. cit.*) that all tissues are really extra-vascular; tissues which have many vessels enjoy a more minute distribution of nourishment, and more power of imbibing fresh material and sending away old; but the difference is one of degree, not of kind. This seems simple now. But thirty years ago, so ingrained was the surgical mind with the doctrines of Hunter, which were conceived to be final, that even Brodie (*On Diseases*

*of Joints*, 1834) refused to admit the possibility of ulceration of cartilage by any other means than its own vessels, though, like an honest man, he afterwards acknowledged that such vessels might not exist. (*Life of Brodie*, by C. Hawkins, 1865, vol. ii. p. 218.)

Pursuing our sketch, we must next notice the remarkable researches of W. Addison, of Malvern, who (*Lond. Med. Gaz.*, Dec. 18, 1840, p. 447) demonstrated white corpuscles, known to Hewson and Senac (*leucocytes* or *sarcophytes*) in the buffy coat, and soon afterwards (*ibid.*, Jan., 1841, p. 639) their presence in the capillaries; their accumulation in the inflamed capillaries of the frog's foot; their sluggish adherence to the sides of the vessel, whilst the red globules move on in a rapid stream in the centre.

In the same year (*Med. Gaz.*, July 23), and more fully in his *Principles of Medicine*, 1843. Dr. C. J. B. Williams announced the full significance of that behaviour of the white corpuscles which is only just beginning to be understood after thirty years of neglect. The microscopical research which led to this discovery, which the time was not ripe to receive, was unusually careful; but Dr. Williams was not freed from by the pathology of Boerhaave and Hunter, and believed that the chief phenomena of inflammation were referable to obstruction of debilitated capillaries by blood rendered viscid by unusual abundance of white corpuscles, together with increased action of the arteries.

Mr. Gulliver (*Lectures, Med. Times and Gaz.*, 1862, vol. ii.), justly adverts to the embryonic character of the white corpuscles, and their importance in the work of development.

Just so, the eminent pathologist H. Lebert, in his *Physiologie pathologique* (Paris, 1845), describes all that Dr. Williams saw, but affirms that there is no escape of globules in the exudation of inflamed capillaries without rupture; that the cell elements found in inflamed tissues are formed in them, out of the exuded liquid which serves as blastema, and do not pre-exist as such in the vessels. Lebert, in speaking of the pathology of cells, describes their formation from the aggregation of granules, and gives descriptions of the white blood corpuscles, of pyoid granular globules, seen active in the vessels of an inflamed part, and of pus corpuscles, as so many entirely distinct entities, although the difference between them in his drawings is almost imperceptible. In his grand *Anatomie pathologique* (Paris, 1857) he still denies the influence of the white globules in inflammation, describes the formation of globules as free cells outside the vessels, and attributes exudation to increased pressure in the capillaries, combined with increased attraction between the blood, the capillaries, and the extravascular tissue, for which last item Virchow is quoted.

But to return. Hitherto the application of the cell doctrine to pathology had consisted in what we may call *interstitialism*—the notion that exudation of unhealthy liquor sanguinis took place into the interstices of tissue, where, instead of serving for nutrition, as in health, it set up a new interstitial cell growth, which constituted, as Lebert expressed it, the corner-stone of a new pathological edifice. All the writers on cancer, as Hughes Bennett, in his admirable *Treatise on Cancer* (Edinburgh, 1849), Walshe, *On Cancer*

(London, 1846), and Lebert, *Maladies cancéreuses* (Paris, 1851), held the same doctrine. Theory had advanced from the contemplation of action of vessels to the behaviour of exudation outside vessels; but there was yet a further step to be made, and that was the behaviour of the elementary constituents of the inflamed tissues themselves, and this, which had been slightly sketched by Goodsir, was fully demonstrated by Redfern in his paper on the *Anormal Nutrition of Cartilage*, and on the *Healing of Wounds of Cartilage* (*Edinburgh Monthly Journal Med. Sci.*, 1850 and 1851). Redfern showed that all the accidents of inflammation cannot be present in cartilage, because it has no nerves, no pain, no vessels, and no exudation; but that when exposed to injuries or conditions which excite inflammation elsewhere, it displays a constant series of changes in its intimate structure. These consist of rapid, irregular, and degenerate growth of the cells, ending in disintegration, and in degeneration of the intercellular structure.

We must next notice Paget's *Lectures on Surgical Pathology*, delivered between 1847 and 1852 at the Royal College of Surgeons, and published separately in 1853, a work which it is a pleasure to look back upon for the eloquence and the vigorous power exerted by the author in generalising, harmonising, and refining the existing mass of fact and theory. The author denies the propriety of looking to one condition only as essential to inflammation. As there must be in health a proper quantity of blood, of healthy quality, with due influence of nerves, and with integrity of structure—in inflammation all these conditions are altered. The quantity of blood is increased, as we have before quoted (*supra*, p. 25), and he denies that this increase can arise merely from the altered mechanical conditions of the blood-vessels, but must depend on some alteration in the mutual relations of the blood, the vessels, and the parts around. That the quality of blood is altered, he takes for granted; but cannot assent to the view which ascribes to the blood viscosity arising from excess of fibrine or of white corpuscles. That the nervous influence is disturbed he also assumes. And with regard to the inflamed tissue itself, he calls attention to a double source of change: one *interstitial*, from the intrusion of exuded fluid, and the changes it undergoes, and its effect in blighting the natural tissues; the other *textural*, consisting in the degeneration of the affected tissues themselves. Paget takes anything but a *high* view of inflammation, as if it were an exaltation of vital or formative force; on the contrary, he regards it as one of depression of the true nutritive forces, and degeneration of tissue; whilst whatever formative force is exerted is in the production of the lowest and most transitory kinds of tissue.

I must now hasten to consider the ideas of Virchow, whose vigour, audacity, and consistency soon gained for his *Cellular Pathology* (1858) as speedy an acceptance as was possible for anything so revolutionary and destructive of settled doctrine. His postulates are the existence of cells, as the living units out of which all structures are developed, each cell the centre (as Goodsir has shown) of a certain district, which it maintains in structural and functional activity, by its power of attracting nourishment;—every cell derived from

a pre-existing cell—no such thing as *free cell* development, or independent generation; *omnis cellula e cellula*. In inflammation the living cell is the part affected—its chemical and nutritive processes, and its attraction for the contents of the blood-vessels. The vessels are not in a state of increased action; on the contrary, they are dilated from paralysis. No corpuscles can pass through their walls without rupture. "Inflammation in all vascular parts begins with hyperæmia, but the hyperæmia is not the 'essential and determining cause.' If it were, the inflammatory changes should be greatest in the immediate vicinity of the blood-vessel; whereas, in injury of the cornea for example, the focus of inflammation, is not next the vessel, but at the spot where the injury is committed." There is no such process as inflammatory exudation, considered as an act beginning from the vessels. The vessels under pressure transude mere serum, but the so-called inflammatory exudation is a proliferation of the cells of the inflamed tissue—"material which has been generated in the inflamed part itself through the change of its condition." Neither is there such a thing as blastema as a result of exudation. It is the *connective tissue* that is the true seat of inflammation. It is this tissue whose cells in a state of active proliferation constitute the so-called exudation, and whose continued proliferation in a degraded form constitutes suppuration in the deep textures, whilst epithelium is the source of it on surfaces.

We must observe that the connective tissue plays a very important part in Virchow's doctrine. It includes the passive tissues of the body, i.e., common cellular or areolar tissue, fibrous tissue, ligament, tendon, bone, and cartilage. It is universally diffused, is composed of cells, and is pervaded with cavities and canaliculi like those of bone, for the universal diffusion of nutriment; and it constitutes the true blastema, the general source of new cells and growths for the whole body. It is very doubtful whether muscle, nerve, or vessel ever suppurate; more probably it is the elements of connective tissue everywhere penetrating them. The other great seat of inflammation and suppuration are the epithelial surfaces.

But perhaps the greatest amount of subversion of established notions is to be found in Virchow's doctrine of "fibrinous exudation" or "adhesive inflammation," and in his views of the source of the fibrine in "inflammatory blood."

If, for the sake of comparison, we turn to the *Pathological Anatomy* of Rokitsansky, the great light of the Vienna School (published 1842-46, *Trans. by the Sydenham Soc.* 1855), we find exudation of blood plasma looked upon as the climax and test of the inflammatory process. It is regarded as a consequence of the thinning and permeability of the walls of blood-vessels, produced by their distension. Why, it is asked, does the exudation in inflammation of membranes only take place on their surface and into their cavities, with slight serous infiltration of the inflamed structure itself? "This problem," says Rokitsansky, "like that of Johannes Muller, as to natural secretions affecting the free surfaces, is only to be solved upon the ground of less resistance being offered in this direction."

On the contrary, Virchow's doctrine is that the fibrinous matter found, in pleurisy for example, is



not a transudation from the liquor sanguinis, an overflowing plasma, but a creation of the inflamed part itself. In inflammations (catarrhs) of mucous membranes, the mucus is a product of the epithelial cells of the inflamed surface; and there are only special regions of mucous membrane where fibrinous flakes are commonly found in inflammation. Just so, fibrinous exudation is not a property common to all inflamed tissues, but to a limited number; the serous membranes especially; and certain mucous membranes (as the trachea) if the irritation be violent.

If we turn to the subject of inflammatory blood, we find Rokitsansky dilating on the diseased condition or *crases* (or *dyscrasies*) of that fluid. He teaches the "primitive anomaly of blastemata," that the blood may become diseased, and that different local diseases are expressions and consequences of the primary blood disorders (of course it is also taught that local diseases may be the starting-point of a general dyscrasy). Of these "crases," which include hyperinosis, hypinosis, the drunkard's dyscrasy, scurvy, anæmia, and the like, the "fibrine crases" are described first, as being those in which an increase in the quantity, and some alteration in the quality of the fibrine exist in the blood. These crases are distinguished by the proneness of the fibrine to coagulate within the vessels, and to be exuded locally in inflammations. They are divided into *pure fibrinous*, and *croupous*, in the latter of which there is greater tendency to softening and suppuration. It is taught that "ordinary pneumonia (with fibrinous product) is the localisation of a pre-existent crasis." Considering that fibrine is in a higher state of oxidation than common lymph, it is clear, according to Rokitsansky, that it must be developed before the inflammation, for it is paradoxical that it should be developed during a disease which disabes large portions of the lung.

Virchow, on the other hand, teaches that there is no dyscrasia, or permanent disordered condition of the blood, which is not dependent upon some local disease. That the "inflammatory crust" is a consequence, not a cause, of local inflammation. His opinions are already quoted (*supra*, p. 17). Hyperinosis is always accompanied with some degree of leucæmia, or excess of white corpuscles in the blood. Both are frequent during pregnancy, and are no evidence of increase of the "powers of life," but of the great development of the inguinal and lumbar lymphatic glands. Both conditions may be found in puerperal fever, but they constitute no sign of either inflammation or pyæmia.

It will be of interest if we subjoin Virchow's general conception of inflammation in his own words. (*Op. cit.* Lect. xvii.)

To begin with, we must sweep away everything implying entity (ontologisch) from the notion of inflammation. (See *supra*, p. 8.)

"The old physicians, as represented by Galen, made heat the chief of the four cardinal symptoms of inflammation (the others being redness, swelling, and pain). Afterwards heat was placed more in the background, and redness was brought forward. The opinions of Boerhaave, who derived inflammation from an obstruction of the blood-vessels and a stagnation of blood inseparable from such a condition, may be said to belong to this class: inflammation being connected by these mechanical theories with the condition of the

vessels. The Vienna school attempted a grand change, endeavouring to establish exudation as the essence of inflammation, and thereby putting the products in the place of the symptoms. This class of opinions, then, may be said to have put forward the swelling as the prominent feature of inflammation. The fourth symptom, pain, has been made the principal only in the more speculative views (*Anschauung*) of the neuro-pathologists. The anatomical theory of the Vienna school, would doubtless be the most correct, if it could be demonstrated that an exudation accompanies every inflammation, that the swelling consists of the exudation, and that the exudation ought to be regarded as constant and typical, and the fibrinous contents of the swelling as the criterion of its inflammatory nature.

"I have already shown how the notion of exudation must be contracted, and how really the active relations of the tissue-elements themselves enter into the question, when substances make their appearance which we must at all events treat as having come out from the vessels and been deposited in the parts. A great deal is, as we saw, not so much an *exudation* as, if I may so express myself, an *educt* from the vessels in consequence of the activity of the tissue-elements themselves.

"The point from which, as I think, we must set out, in treating of inflammation, the point in which I judge the propositions of Broussais and Andral to be justified, is the notion of *irritation*. We cannot imagine any inflammation without an *irritation*: and the question next arises, in what way are we to picture to ourselves this *irritation*? The form of irritation may be traced in three different directions, according as a *functional*, *nutritive*, or *formative* irritation has taken place. Now there can be no doubt at all that in inflammation we have not really to do with functional *irritations*; simply on the ground that (as all newer schools at least are agreed) to the four characteristic symptoms mentioned above, a fifth, namely damaged functions (*functio læsa*), must be added.

"The function being disturbed in inflammation, this presupposes that the *irritation* must be of such a kind as necessarily to imply certain changes in the composition of the part which have damaged function as their consequence. Nobody would expect a muscle, gland-cell, or ganglion-cell to discharge their respective functions properly when inflamed. The conclusion to be drawn from our commonest experience is, that changes have occurred in the composition of the cellular elements which alter their natural functional power. Such changes, when they follow stimuli which do not immediately destroy the tissues, must be the consequence of either nutritive or formative stimuli. This conclusion is confirmed by what occurs in inflammation, for now-a-days we find the view pretty generally spread, that in inflammation we have, in the main, to deal with a change in the act of nutrition; nutrition being regarded, indeed, as embracing the formative and nutritive processes.

"If therefore we speak of an inflammatory stimulus (*Entzündungsreiz*) (irritament), we cannot properly mean anything but that, in consequence of some cause or other external to the part which has fallen into a state of irritation (*welche in Reizung geräth*), and acting on it either directly from without or through the medium of the blood,

the composition and constitution of the part undergo changes which alter its relations to neighbouring parts, whether blood-vessels or other structures, and enable it to attract to itself, and to absorb from them, a larger quantity of matter than usual, and to affect the circulation.\* Every form of inflammation with which we are acquainted may be explained in this way. It begins as an inflammation from the moment when this absorption of matters takes place, and changes in the matters commence."

*Nutritive and formative* irritation differ in this respect. Under the first the "constituent elements of a tissue already existing take up a larger quantity of material." The cells are larger, fuller, clouded, and preternaturally distended with nutritive matter. Under formative irritation the cells alter in form, divide, and proliferate.

This short sketch of Virchow's doctrine will suffice to show its vigour and completeness; and the enormous progress which the microscope and cell doctrine enabled the pathologist to make, from the mere blood-vessels to the very penetralia of the tissues, in his task of unravelling the secrets of the inflammatory process.

#### SUBSECTION 5.—LATER VIEWS OF THE POWERS OF PROTOPLASM OR GERMINAL MATTER.

"E pur si muove." There is no rest for the student of medical theories. Not even Virchow's genius could save the doctrine of cells from the common fate of the doctrines that had gone before.

The first change we may notice is one in the conception of the cell itself, and in the notion of what are or are not its essential parts. The ideal "cell" was generally described as consisting of a boundary or *cell wall*, containing *cell contents* of various kinds, and a *nucleus*. It might further be imbedded (like cartilage cells) in an intercellular substance, supposed to be the remains of the blastema out of which the cell was developed. Huxley even, in 1853 (*Brit. and For. Med. Rev.*, Oct. 1853, p. 305), considered the cell wall or *periplast*, the most important element. He clearly saw that it was this part which becomes converted into tissue, but conceived that this conversion was "the result, not of any metabolic action of the *endoplast*" (i.e. the cell contents and nucleus, which this acute naturalist believed to be the less important element), "but of intimate molecular changes in its substance which take place under the guidance of the *vis essentialis*, or, to use a strictly positive phrase, which occur in a definite order we know not why."

But as time went on, it became clear that the same mistake had been made as if a shell had been defined to be the essential part of a mollusk, without considering that there are mollusks without shells. It was clear also that a cell might exist without nucleus, frequent and important though that part be. Attention was also called to the nature of the contents of the youngest cells, and to their similarity (pointed out by W. Addison

\* In Chance's translation, the translator (with the author's sanction) draws a distinction between "Reiz" and "Reizung," translating the latter by "irritation," and the former by "irritament." This word is meant to imply a kind of imaginary intermediate stage between the cause and effect, and to include the state of activity assumed by the tissues in consequence of the "irritation;" which state of activity becomes the cause of further changes.

in 1843, *Prov. Med. Trans.*, vol. xi.), to the *sarcodæ* of which the humblest members of the animal kingdom are composed. The name *protoplasm* was given to the cell contents; it was asserted that neither the vesicular form, nor the cell wall, nor the nucleus were necessary, and that the essential of a "cell" was a small mass of protoplasm endowed with independent life. It would be out of our province to distribute the credit due for the elaboration of this physiological problem to Max Schulze, Leydig, Remak, and other continental physiologists; but, in the meanwhile, Lionel Beale, the English microscopist, working with glasses of a power hitherto unreachd, had constructed a scheme of his own, which he made public in lectures at the College of Physicians in 1861. (See Reports in *Med. Times and Gazette*, 1861, vol. i.; also *supra*, p. 27. *History of the Cell Doctrine*, by James Tyson, M.D., Philadelphia, 1870.)

Beale taught that the animal body is composed of "elementary parts" (physiological units, or "cells"), and that each "part" consists of a small mass of living, active, "germinal matter" ("centre of nutrition" of Goodsir), derived by direct succession from the original germinal matter of the ovum. Around, dependent on this, may be more or less "formed material" which has been elaborated and produced by the germinal matter. For instance, in living cartilage the germinal matter is distributed in little masses at regular distances, each surrounded with more or less of hyaline matter, which it has assimilated from the blood, and elaborated by its own vital power. Most of the masses of germinal matter, found in every tissue, are called "nuclei;" but the nucleus really is a new centre of growth in germinal matter; it is like an ovum to provide for its maintenance and succession, but not essential to its existence. The germinal matter is composed of spherical particles so infinitely small as to defy the imagination. The purest specimens of germinal matter are the white blood corpuscles, and pus corpuscles. These have no cell wall, unless the exterior of the corpuscles is submitted to the action of something which kills and curdles it. Germinal matter has the power of movement like the *amœba*; when it grows beyond a certain size it gives off buds or offshoots, or divides into particles having the power of rapid growth and multiplication. Under inflammation, the germinal matter of the inflamed surface or tissue absorbs more nutriment, divides and subdivides, each portion grows rapidly, and the result is a mass of living, moving, multiform *amœbiform* particles, known as pus, which, when dead and inert, as they commonly are when examined, assume a spherical figure and outer membrane. (See SUPPURATION.)

So far, the differences between Beale and Virchow relate to the conception and morphology of the cell, whilst there is agreement as to its function in health and disease. But Beale attacks the *Cellular Pathology* in many points. He denies the importance of the connective tissue, which, according to Virchow, is the very seat of common inflammation, and declares that it is, for the most part, mere ill-formed or degenerate tissue, which has lost its proper structure marks—empty blood-vessels and the like; and that its so-called nuclei, which Virchow regarded as a universal *germ-stock*, belong to the capillaries. "The proper germinal matter of every tissue," says Beale (not



of epithelium and connective tissue alone, as Virchow taught), "is capable of inflaming and suppurating." Beale again denies those doctrines of irritation which lie at the root of Virchow's doctrine. "A particle of sand," he says, "falling upon the conjunctiva is followed by increased action, as shown by the more rapid growth of cells, and the increased vascularity. It is said the particle of sand has *excited* these changes; it is an *irritant*." But this and other irritants may alter the whole physical conditions of the part, and, "in consequence of these physical changes, *pabulum* may flow towards the living matter more readily than before. If this be so, the living matter is not *excited* to live faster, but, in consequence of more *pabulum* having access to it, more matter becomes living within the same period of time. The influence of the so-called *excitant* is after all of a passive character. It does not excite dormant energies or evoke vital actions, but by it some of the restrictions under which it lived before are removed." (*Lecture on Inflammation, Med. Times and Gaz.*, 1865, vol. ii. p. 593.) Beale further ridicules the doctrine of irritation, and the power of sympathy which uninjured cells are supposed to possess for an injured neighbour, and resolves the action of an irritant into some physical or chemical alteration, which "permits the *pabulum* to pass more freely to the germinal matter." Beale lays great stress upon restriction to the flow of nourishment, as tending to the permanence of the "elementary part." Nothing is more mischievous than to make "living too easy." He repudiates the idea that inflammation is a chemical process, or attended with increased oxydation. On the contrary, he affirms that "so far from inflammation depending upon increased oxydation, it would seem that the oxydising process is greatly diminished in intensity or altogether stopped. In a vascular tissue in a state of inflammation the circulation is very slow, or is actually suspended. How then can there be increased oxydation? If we could increase oxydation at the seat of inflammation, we should diminish the activity of the inflammatory process." "Combustion is an intense chemical action, inflammation an intense vital action. Oxydation is opposed to vital action." It must be noted that Beale is a staunch upholder of the doctrine of a Vital Force, and restricts the term vital to such actions in the animal economy as are not physical or chemical. Conversely, he regards as chemical and physical many changes which are usually regarded as vital. For instance, the action of oxygen on the red corpuscles. The growth of liver cells is vital, their conversion into bile by oxydation is chemical; the collection, conversion, and assimilation of nourishment, the growth, movements and functions of germinal matter, the cycle of life and generation which no chemistry can explain, are regarded as vital. Evolution of heat he believes to accompany the rapid development of germinal matter.

Beale is quite at one with Goodsir and Addison as to the destructive powers of active germinal matter. So soon as the germinal matter of an epithelial cell is set growing by a preternatural afflux of *pabulum*, it begins to devour the "formed material" which surrounds it, and hence acquires the power of growing and proliferating with less restriction. He finds a teleological import in the destructive power of living pus corpuscles, for they

feed upon, and render harmless dead and diseased matters in the focus of an inflammation which otherwise might decompose, and infect and kill the neighbouring parts, and pass into the circulation.

He states his belief (1865, *Lecture* quoted above) that when the capillaries are "fully distended with blood, particles of living germinal matter, probably derived from the white blood corpuscles, may make their way through the walls with some of the serum and grow and multiply in their new position. Thus an "exudation" will, in many instances, contain particles of living growing matter, and these particles absorb nutrient matter, and some become those spherical granular cells which are often seen external to the vessels in inflammation." Each particle grows by imbibition, not by aggregation or union as Hughes Bennett thinks, and then divides and subdivides.

Particles of germinal matter that have grown in a diseased rapid manner are capable of preserving their vitality for considerable periods, of being transplanted from one body to another, there settling on some mucous surface, growing, penetrating the blood-vessels, multiplying enormously, blocking up small capillaries, and producing the local congestions and inflammations which characterise contagious fevers. (*Beale, on Cattle Plague, 3rd Report of Commissioners, Blue Book No. 13,533, 1866.*)

"Contiguous sympathy" and "irritation" are, in Beale's system, not the mere reactions of tissue as such, but the effect of nerve force. "Pale nucleated nerve-fibres" are distributed to all the capillary vessels, and to the tissue between the vessels. "These fibres, close to the capillary vessels, and in tissues destitute of capillaries, are not concerned in special sensation, but are the afferent fibres to the nerve-centres in which the efferent fibres distributed to the small arteries take their rise. I believe that these fibres do exert an influence upon the process of nutrition, but only by their indirect influence upon the nerves which govern the calibre of the small arteries transmitting the nutrient fluid to the capillaries nearest to the tissues in which they ramify." Beale next goes on to describe what he calls a *self-adjusting* system, whereby the tissues of animals, subjected to varying external circumstances, are supplied with varying quantities of *pabulum*, according to their needs. "It is obvious that the afferent fibres above referred to must be affected by any alterations occurring in the flow of *pabulum* to the tissue in their immediate neighbourhood. Suppose, for example, the quantity of nutrient *pabulum* flowing to the cells of a tissue to which nerve-fibres of this class are distributed to be unusually great, these nerve-fibres would necessarily be compressed by the swelling of the surrounding elementary parts which absorb the *pabulum*. This pressure would, in the first instance, so affect the nervous centre as to cause a change in the condition of the efferent nerve-fibres, which would induce contraction of the small arteries transmitting the blood to the capillary vessels, and thus the quantity of *pabulum* sent to this locality would be immediately reduced. The nuclei of the nerve-fibres would also participate in the increased absorption of nutrient matter, but precisely in what manner I must not now discuss. If, however, the conditions which led in the first instance to the

increased nutrition persisted, the pressure upon the nerve-fibres might go to the extent of paralysing them, in which case the small arteries would become dilated; the capillaries must in consequence be fully distended with blood, and that congestion which constitutes one of the earlier stages of inflammation, as it occurs in man and the higher animals, would result." (*Proceedings of Royal Society, Croonian Lecture, May 11, 1865, p. 256.*)

The doctrines of Virchow had been generally accepted, alike as to inflammations and new growths, and the origin of pus corpuscles. The production of inflammation in the corpuscles of connective tissue, was the view considered orthodox on the Continent, when in 1867 Cohnheim, then assistant in the Pathological Institute in Berlin, in a paper (*Ueber Entzündung und Eiterung. Virchow's Archiv, vol. xl.*) drew attention to another mode in which leucocytes, identical with pus corpuscles, accumulate in inflamed tissues. Taking his stand on the generally recognised phenomena of traumatic keratitis, he asserted that in the inflamed cornea, "however numerous might be the pus corpuscles, so even that there was hardly room for them, yet there were the fixed corneal corpuscles, with their offsets in their normal disposition." Either, therefore, the pus corpuscles had originated in wandering elements already existing in the cornea, or they had wandered into it from without. Further experiments were made to clear up this doubt, and from these Cohnheim came to the conclusion that "simple traumatic keratitis invariably commenced at the border of the cornea, and spread thence towards its centre." First would appear around the margin of the cornea a slight greyish turbidity, which would gradually extend until the whole organ was involved. This turbidity was due to pus corpuscles, which, however, might be removed, when the fixed corpuscles would still be seen apparently unchanged. The whole of the phenomena of simple traumatic keratitis lent themselves, as he thought, to one interpretation, and one interpretation only—that the pus corpuscles, the products of the inflammation, originated in wandering bodies, which had made their way from without into the substance of the cornea. This he endeavoured to make more certain by the employment of colouring matters, as aniline blues, so as to be able in a fashion to identify certain bodies tinged with them. This colouring matter was introduced into the lymph sac of a frog, when portions of it would be devoured by the leucocytes therein contained, which henceforth by its means became recognisable. After a time keratitis was set up in the same animal, and the pus corpuscles in the cornea being examined by the microscope, certain of them were seen to contain the blue granules, thus proving, as he thought, that these at least had been formerly white blood or lymph corpuscles.

Thus far the researches had been carried on in a non-vascular tissue; but to settle definitely the origin of these wandering bodies, a vascular tissue had to be studied. The mesentery of the frog was chosen, and to keep the animal at absolute rest during the experiment, a solution of curara, as first practised by Stricker, was injected subcutaneously. The details of the mode in which this now celebrated experiment is performed are simple. The abdomen of a frog is exposed by an incision on the left side away from the liver. Any bleed-

ing is stopped by cold water. The animal is extended on a plate of glass prepared for the purpose by having a cork ring stuck to it; the mesentery is drawn out and spread over this, and the intestine fastened to the cork by small pins. The whole is then placed on the stage of the microscope, and the microscope adjusted. The mesentery should be kept moist with weak salt water during the examination.

The exposure of the mesentery is enough to excite inflammation, when all its phenomena may be watched with ease. A goodly portion of Cohnheim's paper is occupied with details of this experiment, and of the normal and abnormal phenomena it reveals. Of the latter, that is to say of the phenomena of the inflammatory process, the first is dilatation of the vessels, beginning with the arteries; afterwards, but more slowly, extending to the veins. Meanwhile the blood flow is retarded in velocity, and of the two layers in which the vascular contents arrange themselves, a peripheral clear lymph-space and a central mass of corpuscles, the former is gradually invaded by numerous colourless corpuscles; after a time a stray red one may be seen among them also. The white corpuscles tend to adhere more and more to the wall of the vein, sometimes being swept away by the current, to be brought up again at some sudden bend of the vessel, this time, it may be, to adhere permanently—permanently, that is to say, as far as the blood stream is concerned, for, if they be watched, they will be seen to gradually penetrate the wall of the vessel, until, as little buttons, they are next seen projecting from the outer surface of the vessel's wall. This process goes on until each leucocyte is next seen attached to the outside of the vessel by a fine thread, which, giving way, the leucocyte is once more free, but it is now what we call a pus corpuscle. This emigration may be observed in the case of corpuscles containing particles of aniline blue, which renders them easily recognisable without as well as within the vessel. The migration is effected by virtue of the amoeboid powers possessed by the colourless blood corpuscles. Nor is the emigration limited to the colourless corpuscles. In the capillaries the red corpuscles appear as if forced into and through the wall of the vessel, and to be constricted by it into the shape of an hourglass. But these bodies do not pierce the walls by virtue of their own spontaneous movements; the motive power in this instance is the increased blood pressure, necessitated by the retarded blood flow.

In this way the connective tissue of the mesentery becomes filled with colourless multiple nucleated corpuscles, which also enter or emigrate on to its surface, and constitute the so-called exudation or pus corpuscles. "What, therefore, was inferred from the experiments with colouring matter in the case of the inflamed cornea, namely, that a part at least of the pus corpuscles originated from the blood, has been proved by direct observation." Further, the author thought that in this way all the pus of an inflamed part might be produced, that is to say, partly by means of increased production of leucocytes, increased rate of blood flow, increased rapidity of emigration, and partly multiplication by subdivision of the extra vascular corpuscles.

But, so far back as 1841, the increase of white blood corpuscles in an inflamed part had been



observed by Dr. William Addison (*Med. Gazette*, Jan. 29, 1841); and not long after Dr. C. J. B. Williams noticed their extraordinary tendency to adhere to the walls of the irritated vessel and to each other. (*Ibid.* July 23, 1841.) These authors satisfied themselves of the presence of these bodies outside the vessel as well as within its walls, and concluded that they had escaped in the form of small nuclei, though the act of migration was not actually observed. Nevertheless, Dr. Williams in his *Principles of Medicine*, 1843, § 425, so far as regards the agency of leucocytes, their identity with pus, and the non-specific character of "tubercle," was a quarter of a century in advance of his time. W. Addison says (*Prov. Trans.* 1843, Vol. xi. p. 238), of the colourless corpuscles, that they abound in blood drawn from a boil, or from the skin in scarlatina, and in the discharge of irritated mucous membranes; that they are identical with pus; that "the central portion is alive, and by virtue of its vitality it exercises certain movements by which a division into parts ensues;" that mere effusion of liquor sanguinis is not inflammation; that "vital turgescence" coincides with accumulation of white corpuscles in a part; that if required for purposes of nutrition and nourishment, well;—but that if they accumulate uselessly they create fever and inflammation, and, "exercising their own inherent vitality, uncontrolled by the assimilative law of the tissue," they develop into pus or other morbid product. In his work on *Healthy and Diseased Structure*, Lond. 1849, he enunciates a law of irritation: that unusual conditions cause a preternatural accumulation of nutritive elements in a part, whether for good or evil; and there occur these remarkable words:—"During inflammation, using the word in the general sense, there is a more or less marked increase of colourless elements and plasma in the parts affected. At first—in the first stage—these elements adhere but slightly along the inner margin or boundary of the nutrient vessels, and are therefore still within the influence of the circulating current; belonging at this period as much, or rather more, to the blood than to the fixed solids. Secondly—in the second stage—they are more firmly fixed in the walls of the vessels, and are therefore now without the influence of the circulating current. Thirdly—in the third stage—the new elements appear at the outer border of the vessels, where they add to the texture, form a new product, or are liberated as an excretion." This seems clear enough, and if anything was necessary to add to its accuracy, that was supplied by Dr. Augustus Waller's researches on inflammation in the frog's tongue. (*Phil. Magazine*, 1846, p. 347.) But men's minds were not ready for the reception of these doctrines, or their importance was not then appreciated, and they gradually were forgotten by all save a few, till this research by Cohnheim, when their bearing on the phenomena of inflammation, and their true value, speedily became apparent to all; the more readily, inasmuch as the amoeboid characters of pus corpuscles and white blood corpuscles had by this time been generally recognised.

In the paper just alluded to, Cohnheim left the question as to the part taken by the fixed corneal corpuscles in inflammation an open one. The next researches of importance were those of A. Hoffman and Von Recklinghausen (*Med.*

*Centralblatt*, 1867, No. 31), and F. A. Hoffmann (*Virchow's Archiv*, Bd. xlii. s. 204), which really dealt with inflammation of the cornea and the behaviour of the corneal corpuscles alone. As the object of this section is to give an account of the history of doctrines relating to the inflammatory process generally, and not as seen in any particular part or organ, it may be as well to proceed at once to the experiments undertaken by Cohnheim to establish his views as to the considerable, if not sole share, taken in the process of inflammation by wandering corpuscles, to the exclusion of those that were "fixed." These are given in *Virchow's Archiv* (vol. xx. s. 333). After pointing out the fallacies in his critic's experiments and arguments, he proceeds to narrate certain experiments carried out by himself. One of the most striking of these was the gradual substitution of a solution of common salt for blood in the vessels of a frog, the animal being still alive. When no more blood corpuscles existed in the vessels, irritation of the cornea produced in it no turbidity: it remained clear till death. But, to change the subject of examination, the tongue of the frog was selected, as in Augustus Waller's experiment, the animal being however curarised. The mode of performing this experiment resembles that adopted for tracing the phenomena of inflammation in the mesentery; only, as the frog's tongue is extensible, no cutting is required. A small portion of the mucous membrane is removed with a pair of forceps; this causes little or no bleeding, and adds much to the transparency of the object. A variety of structures are thus brought to light—muscular fibres, nerves, and connective tissue, with well-defined connective tissue corpuscles. But beyond assuming more of the spherical form, these bodies, says Cohnheim, change not. Not so the vessels and their contents; immediately after the injury to the mucous membrane, the vessels widen, the blood flow for a moment increases in rapidity, only to become retarded. With this retardation the accumulation of white blood corpuscles in the clear peripheral spaces within the vessels promptly begins; presently the emigration commences and very soon assumes a character of importance, to be followed as the congestion increases by a more or less considerable emigration of the red corpuscles through the walls of the capillaries and smaller veins. From these experiments, which, on the whole, are negative as far as the fixed connective tissue corpuscles are concerned, the author concludes that all true pus corpuscles (leucocytes) originate from the vessels, at all events in the first stages of an acute inflammation; their mode of origin in the further stages he at that time considered undetermined, but afterwards he gave in his adherence to the view that at all times and under all circumstances pus corpuscles spring from the blood-vessels, and from the blood-vessels alone.

The enquiry into the nature of the inflammatory process, thus commenced by the Berlin school, were continued and, so to speak, brought to perfection in that of Vienna, chiefly by Stricker himself, or under his supervision. The results of these experiments were published in 1870 (*Studien aus dem Institute für experimentelle Pathologie in Wien aus dem Jahre 1869*), and constitute the next important contribution to the development of the subject. Other enquiries have been published

since under the same authority, in the *Medicinische Jahrbücher*, but as these mainly refer to inflammation of special organs and tissues, they hardly come within the scope of the present article.

Briefly, the results obtained at Vienna were these:—Examining into inflammation of the cornea, the authors (Norris and Stricker) as in previous researches, produced irritation of the cornea of the frog, by applying nitrate of silver. After a time the cornea was removed and examined, either fresh in the serum of the animal or after treatment with a half per cent. solution of chloride of gold. A few hours after the irritation the fixed corneal corpuscles exhibited signs of change; they were swollen and granular, and their nuclei increased in number. Yet again, when the cornea was examined from five to twelve hours after irritation, there was found in the neighbourhood of the slough produced by the irritant a larger number of these corneal masses, with a few thick and short projections from their surface, and a number of irregular multiple nucleated masses, without any projections. Many of these were vacuolated, but this seemed to have no necessary connection with the irritation.

From fifteen to twenty hours after the application of the irritant, the corpuscles showed more numerous nuclei (eight to ten), these nuclei not being the product of several amalgamated cells, but the outcome of a single corpuscle, the product of an excessive cell growth. These cells further exhibited the characteristic movements of wandering cells. Thus it was proved that the fixed corpuscles of the cornea undoubtedly do partake in the changes implied by the inflammatory process, even in its earliest stages.

When inflammation of the cornea is indirectly induced by section of the bulb, the process begins at its periphery, and these wandering cells, multiple nucleated masses, and unchanged corneal corpuscles accumulate, but the nearer the centre of the cornea examination is made, the more the two former varieties shrink in numerical importance, whereas, if inflammation is produced by direct application of an irritant, it is from the irritated spot that the inflammation, with its wandering cells, &c., spreads in an ever-widening zone.

These results it will be seen are quite at variance with those obtained by Cohnheim. The fixed corpuscles of the cornea, according to Stricker, alter; they increase in size, and their nuclei multiply; above all this, they assume the power of spontaneous movement. Furthermore, the changes in traumatic keratitis do not invariably begin at the corneal margin, as stated by Cohnheim, but at the source of the irritation, be that where it may. Cohnheim erred in taking turbidity as his guide, for by the time turbidity is set up, important changes have taken place, these being in reality the causes of the turbidity. To Cohnheim's two best experiments of the "salted frog" and the coloured leucocytes, the Vienna investigators reply that the former experiment implies a complete alteration in the nutrition of every part; the conditions are no longer normal, and inflammation can no longer take place normally. To the latter they also reply, that they as well as Von Recklinghausen (*Ueber Eiter- und Bindegewebs-Körperchen*. *Virchow's Archiv*, vol. xxviii.) had seen wandering cells transfer coloured particles from one to the other, so that the pre-

sence of coloured particles in a few corpuscles proves nothing as to their origin.

The second paper in the *Studien*, also by Stricker, treats of *cell-division in inflamed tissues*. The frog's tongue was made the subject of experiment, as in Cohnheim's second research. Stricker fixed his attention on the colourless corpuscles lying outside a small vein, and watched the further changes which they underwent. By prolonged attention to single elements, it was seen that they gradually divided into two rounded masses, which spontaneously separated the one from the other, each becoming a wandering element, and probably in its turn undergoing self-division. Turning his attention next to the original tissue elements of the frog's tongue, he was able to recognise the connective tissue corpuscles described by Cohnheim. These he observed first took on a certain degree of mobility, then assumed a jointed appearance, but true cell-division could not be satisfactorily made out, owing to the crowded state of the field. Next he tried to make out the specific influence exercised by the conditions of inflammation, viz., increased supply of nourishment, and elevation of temperature, on a healthy structure. To this end he cut out the cornea of one eye in a frog, and introduced it into the pouch formed by the nictitating membrane of the other side, which had been prepared for the purpose, by having violent inflammation set up. In twenty-four hours the transplanted cornea was examined, and found exactly in the same condition as if it had remained in its place and been itself the subject of irritation, only these changes were not quite so far advanced as those would have been under normal circumstances. The presence of wandering bodies in the transplanted cornea was, however, of doubtful interpretation; they might have penetrated it by virtue of their own motive power from the fluids of the inflamed eye, or they might have been developed in the transplanted corneal tissue itself. To settle this as far as possible, a cornea was cut out and divided into two portions before being introduced into the inflamed conjunctiva. One of these portions was introduced into the inflamed eye living, so to speak, the other was killed by washing with distilled water. Twenty-four hours after, when the two were examined, the difference was marked. The portion introduced living presented all the marks of inflammation, that introduced dead contained but few migrated cells, and these mostly near the surface. The conclusion arrived at from this and similar experiments was that, under such circumstances, though a portion of the wandering cells found in the transplanted cornea had undoubtedly made their way from the fluid without the cornea into its interior, the great bulk of them had been produced within its substance—the product of its own corpuscular elements, no other stimulus to their production being required than an excessive supply of fluid nourishment. The other papers in the *Studien* are mainly taken up with special forms of inflammation without any very particular bearing on the process generally, but some were published about the same time in Rollett's *Untersuchungen aus dem Institute für Physiologie und Histologie in Graz*, which deserve notice. The writer, Dr. Ryneck, deals entirely with the phenomena of blood-stasis in inflamed parts. It had already been proved by Prof. Lister (*Phil. Trans.* 1858) that blood



corpuscles in an inflamed part exhibit no greater tendency to adhere together than in blood of uninflamed parts, and when withdrawn from the body the corpuscles of the former behave themselves exactly as in ordinary blood. This would point to the inference that stasis is due not so much to the corpuscles themselves becoming more adhesive, but rather to some change in the walls of the capillary vessels containing the corpuscles, or in the tissues outside them. Ryneck's researches favour that conclusion. He first repeated a well-known experiment by H. Weber (*Müller's Archiv*, 1852) which is as follows:—The thigh of a frog is tightly ligatured and the web of the corresponding foot placed under the microscope. To this a drop of ammonia is applied, whereupon the irritation set up is manifested by a rush of blood corpuscles from all parts to the irritated or inflamed spot; and, although the circulation has been stopped, the accumulation of corpuscles characteristic of stasis speedily results. If now the ligature be removed the circulation is again set up, and stasis remains only at the irritated spot. During the process of the experiment inflammation may be set up in the other and unligatured web in the same way, and by comparing the two the phenomena of stasis in either will seem identical. It is plain from this that circulation of the blood is not necessary for the production of stasis. Ryneck next sought to get rid of the living corpuscles altogether, and to substitute for the natural blood a fluid containing visible yet dead corpuscles, bland and un-irritating. Such he found in the fat globules of fresh milk, which he tried to inject, but when it reached the heart the heart stood still. This he found was due to the milk turning acid. He mixed some soda with the milk, but still the heart stood still before all the blood was removed from the body. So he tried an artificial circulation. He inserted a glass tube into the bulbus aorticus, and this, by means of an india-rubber tube he connected with a receptacle filled with warm and fresh cow's milk. At the same time he opened the sinus venosus, whereupon, by elevating the vessel containing the milk, an artificial circulation could be set up. If now, as before, the web was irritated with ammonia, the phenomena of stasis were promptly produced, and the oil globules of the milk gathered together at the spot and formed greyish cords similar to those produced by blood, although, of course, the milk globules were devoid of life. When, instead of milk, the defibrinated blood of pigs or oxen was used, the same phenomena were observed, only the lines or cords were red instead of greyish. Thus it was shown that the corpuscles natural to the animal were not necessary for the production of the phenomena of inflammation, or at all events, of stasis.

Next, the author tried to change the walls of the vessels by some chemical agent, which would kill them without altering them. First, he prepared an apparatus, whereby he was able to send into the vessels *seriatim*, three different fluids, the one succeeding the other without interval, the animal being arranged and curarized as before. First, then, he thoroughly washed out the blood-vessels with a solution of common salt (1 grain to 100 c. centimetres), till in the web under the microscope, no corpuscles—red or white—could be seen, and the salt fluid ran clear from the sinus venosus. Next he turned a stop-cock, stopped the salt solu-

tion, and turned on a solution of the same strength as before of chromic acid, of tannin, of sulphate of copper, or of gold chloride as the case might be, varying the substance with each experiment. This he allowed to flow but a moment—however it was enough to provoke convulsive movements of the voluntary muscles in the animal. The stop-cock was again turned, and again salt solution was allowed to flow, so as to wash away the irritant substance out of the vessels. Finally a third fluid was admitted, and defibrinated mammalian blood made its way into the vessels. If, now, ammonia was applied to the top of the frog's foot, no result followed; the vascular walls were dead—yea, ammonia might be applied so freely as to affect the red corpuscles in the vessels in the same fashion it does outside the body, causing them to swell up, and yet stasis did not follow. But if, while the salt solution was yet flowing, and before the vascular walls were killed, an irritant was applied, even with this an outward current of fluid was produced sufficient to produce swelling betwixt the frog's phalanges. The results of these researches seem to indicate as clearly as may be that stasis does not arise from changes in the blood corpuscles, but either from changes in the vascular walls, or in the tissues beyond; and it is difficult to reconcile the results of the last-mentioned experiment with the idea that the change occurs in the surrounding tissues, for it would be difficult to account for the accumulation of a salt solution in the tissues, except it were due to an unnatural permeability of the vascular walls. One result follows from these researches which is very emphatically expressed by Stricker (quoted in *Med. Times* July 2, 1870). The doctrines, which I have called *interstitialism*, may be combined with *texturalism*. The teachings of Rokitsansky, Hughes Bennett, Lebert, C. J. B. Williams and Addison, respecting exudations, are not incompatible with those of Virchow.

Besides this harmonious reconciliation, so unusual amongst physiologists, there is but little to add to this aspect of the history of the inflammatory process, and the only other authority we need appeal to is Dr. Burdon Sanderson's exceedingly able article on the process of inflammation contained in the fifth volume of *Holmes's System of Surgery*, 1871, and *Lectures on Practical Physiology* (*Med. Times and Gaz.*, vol. i., 1871). His "conclusions" which give as clear an idea of the subject as can be communicated in a few words, tend to rehabilitate *vascular action*, along with *interstitialism*, and *texturalism*. They are as follows:—

"1. In every inflammation which attains its full development, the changes which manifest themselves on the inflamed part are of three kinds, distinguished from each other according to the organs which are concerned in their production. They are (1) effects of disorder of the vascular nerves and centre; (2) effects of alteration of the properties of the living walls of the capillaries; or (3) effects of the stimulation of the living cells by transudation of liquor sanguinis.

"2. Of these three orders of phenomena, the second only can be regarded as absolutely essential to the existence of inflammation, which may therefore in the strictest sense be said to have its seat in and about the veins and capillaries, it being there that the earliest and most constant effects of irritation or injury manifest themselves.

"3. The nervous and vascular effects of local irritation cannot be directly described as successive stages of one process, for the determination of blood to the seat of injury, which is the sole result, and, if I may so speak, purpose of the vaso-motor disturbance, has no relation to the local vascular changes, excepting in so far as it tends to make the exudation more abundant. Exudation of liquor sanguinis, although favoured by increased arterial afflux, may occur without it, and as a rule, continues after the afflux has ceased. The vascular and textural changes, on the contrary, may be regarded as successive stages of one process, for they are connected by a causal relation—the exudation of liquor sanguinis in which the former end being the determining cause of the latter.

"4. The mode in which an injury changes the living substance of the vascular walls so as to make them permeable to the blood is unknown. The nature of the change itself is also unknown, the only clue which we have to its character being those afforded by the structural alterations to which it tends in certain organs, and particularly by those which are observed when the process of reparation, attended with the formation of new capillaries, is commencing. From these appearances we are led to infer that the primary change consists in the transition of the material from the formed to the plastic condition—from a state in which it is resistant, because inactive, to one in which it is more living, and therefore more labile.

"5. In all living tissues the effect of inflammation manifests itself in a modification of the action and properties of individual cells. In cells which form part of permanent structures the protoplasm increases in quantity, and becomes more or less contractile. Subsequently it is converted entirely or partly into young cells, either by cleavage or by endogenous germination." (Holmes, vol. v.)

#### SUBSECTION 6.—CHEMICAL THEORIES OF INFLAMMATION.

We have noticed the successive theories by which inflammation was regarded as a stagnation of humours, or as the effervescence of some vital agent, corporeal or spiritual; or as a consequence of perverted action of the various powers that move the blood, or of change of the fluidity of the blood, or of the nutritive action of the tissues outside the vessels. We must next notice the theories based upon changes not merely in the mechanical condition, but in the chemical composition of the blood and tissues. That there is a change in the blood was palpable from its buffed or "sizey" appearance; and, to explain this, philosophers in every age used the chemical lights at their disposal. But chemistry, as an exact science, is of very late growth, and the earlier experimenters were most imperfectly acquainted with the nature of the objects they had to deal with. In the 17th century the four ancient elements, earth, air, fire, and water, were discarded, and spirit, sulphur, salt, water, and earth were assumed to be elements existing more or less in all created things. (Willis on Fermentation, &c., op. cit.) Soon afterwards a hypothetical acidity was conceived to be the secret of *cacoehymy*, or disordered humours. Acids curdle milk, therefore acids were supposed to cause other coagulations. Etmuller, for example (*Medicus Instructus*, part ii. cap. ii. S. 24, 1685), declared that pleurisy

arose from "peccant" acid, which curdled the serum of the blood and "vellicated" the pleura. Amongst the causes cold air is reckoned the first. "But," asked Pitcairn (*Op. cit.* p. 146), "what is there acid in cold air?" F. Sylvius (b. 1614, d. 1672), who is usually considered the chief promoter of *iatrochemistry*, uttered the valuable maxim that nothing should be held true in medicine that is not attested by the senses, and that clinical observation, anatomy, and chemistry were the foundations of the science. Good words, truly. But in his *Praxeos Medicæ Idea Nova* (lib. i. cap. 40, *Opera*, Amsterdam, 1680) he treats of inflammation under the head of obstructed return of venous blood to the heart. "Blood, or perhaps phlegm—or chyle absorbed from the small intestines"—he says, "stagnates in the small vessels and interstices of a part, heats and corrupts. Its volatile and spirituous parts are lost which were wont to mitigate the acid and saline elements; these effervesce with each other and with the oily parts." Bleeding was prescribed in the early stages; in the later the volatile alkaline salts distilled from animal matters, hartshorn, &c., forasmuch as, he says, they have egregious power of dissolving all things coagulated and conglutinated in the animal body. Books of the date 1670-1750 treat of "sharp acrimonious juices," "hot raging salts," "sulphureous particles in the blood," and the like. About 1732 the real nature of the blood-clot, and the existence of coagulable lymph, was made known by Petit; this knowledge was extended by Quesnay, Senac, and Dr. Richard Davies, of Bath, whose *Essay on the Experimental Analysis of the Human Blood*, Bath, 1760, is as good a description as can be given of the division into serum, gluten, fibrine, and globules. (*Gulliver, Preface to Hewson, op. cit.*)

We find ammonia recommended in order to hold the fibrin of inflamed blood in solution by Dr. Hugh Smith, physician to the Middlesex Hospital, who published in 1761 some "*Essays, Physiological and Practical, on the Nature and Circulation of the Blood, and the Effects and Uses of Blood-Letting.*" Dr. Whytt, of Edinburgh, is right, he says, when he attributes to an increased oscillatory motion of the smaller vessels the cause of inflammation; but Haller's idea is better—that an effusion of blood into the cellular membranes from the ends of the arteries which exhale into their cavities is brought about by unusual irritation. The heat is due to the increased and quickened contraction of the vessels, and the consequent accelerated motion and friction of the fluids. Blood-letting, antimony, and volatile alkaline salts—the purpose of which last is to dissolve the "inflammatory gluten" and to render the blood more fluid—are the modes of treatment recommended. "It may appear contradictory," the author says (p. 110), "to prescribe the volatile alkaline salts in a disease where the circulation is already too rapid, and the vis vitæ much too excited;" but after the pulse has been lowered they will tend to resolve the inflammation. He agrees with Dr. Huxham in supposing that even the most sizey blood out of the body is prevented from coagulating, and the tone of the fibres and power of the vessels in the body is diminished by these salts, and that the dissolution of the blood may be hastened, and the momentum of the circulation reduced, by the same means.



Meanwhile the nature of the blood and its clot were further developed by Hewson. The effect of air on the blood had long been known, and what we now call oxygen had been called "nitrous spirit" by Mayow; but Priestly (1777) discovered "dephlogitiscated air" (oxygen) and its power of acting on the blood through membranes, and, with Lavoisier, founded the modern theory of respiration. Nevertheless, animal chemistry at the end of the eighteenth century was in the rudest state; substances to be analysed were only exposed to destructive distillation by fire, and the ammonia and pitchy products resulting were classed under the head of spirits, salts, and stinking oil. From *Rees's Ed. of Chambers's Cyclopædia*, 1786, it is clear that the state of the blood in inflammation and fever was conceived to be thickened by heat arising from errors in diet and excited circulation.

It was not till 1835-40 that Mulder, Simon, and Liebig directed attention to the evidences of increased oxydation in inflammatory blood. The animal body is an oxydating machine. Oxygen is needed, not only to cause "force" as heat and motion, but whether tissue is to be formed from the blood, in nutrition, or to be taken back into the blood when effete. "All the tissues of the body contain, for the same amount of carbon, more oxygen than the constituents of blood. During their formation oxygen has been added to the elements of proteine." (*Liebig, Animal Chemistry*, by W. Gregory, Lond. 1842, p. 127.) The buffy coat was believed to contain a tritoxide of protein, equivalent in composition to pyin, a principle found in pus. The illustrious Liebig taught that weakened vital power in any part of the body is equivalent to deficient resistance to the action of oxygen; this is equivalent to increased change of matter, and increased change of matter is followed by increase of all movement. Diseased transformation of living tissues, abnormal generation of force, acceleration of the involuntary motions of the heart, and higher temperature are the phenomena of fever. In consequence of the accelerated circulation, a greater amount of arterial blood, and consequently of oxygen, is conveyed to the diseased part. Health is restored when the equilibrium between the action of oxygen and the resistance of the implicated tissue is restored. These being the cardinal principles of disease, the philosopher goes on to describe the rationale of treatment, and his observations on the empirical nature of the ancient traditional treatment deserve to be written in letters of gold. "These methods employed by the physician," he says, "the result of ages of experience, are such that the most perfect theory could hardly have pointed them out more acutely and more justly than has been done by the observations of the sagacious practitioner. He diminishes, by blood-letting, the number of the carriers of oxygen (red globules), and by this means the conditions of change of matter; he excludes from the food all such matters as are capable of conversion into blood; he gives chiefly and entirely non-azotised food, which supports the respiratory process, as well as fruits and vegetables, which contain the alkali necessary for the secretions." (*Op. cit.* p. 258.) The uses of counter-irritation and of cold are explained by Liebig on chemical principles, but it must be added that he condemns the too lavish abstraction of blood, because it contains the store of nutrition and vital

resistance, as well as of the oxygen which is necessary for the destruction of diseased and effete products.

Twenty years later we find the chemical nature of inflammation vindicated and unfolded by one of Liebig's most distinguished followers—Dr. Bence Jones—in his ingenious *Lectures on the Application of Chemistry and Mechanics to Pathology and Therapeutics* (Lond. 1867). Inflammation, he teaches, is a "state of oxydation beyond that which occurs in health." Neither vascular nor nervous disorder lie so near the root of inflammation as chemical disorder. This last is independent of and anterior to the others. This is shown by tracing the beginnings of inflammation in such a texture as the cornea, where neither vessels nor nerves exist. Inflammation begins as an exaggeration of a natural process. Inflammatory heat proceeds from an excess of the process which causes healthy heat. The diseased oxydation and heat production begin in the tissue outside the capillaries; the increased action soon reaches the capillaries; the oxygen-bearing red globules are attracted in excess by the demand for oxygen; hence follow increased circulation and stasis, pain and sensitiveness, and exudation of serum and fibrin. Fever may follow. "When the increase of chemical action is excessive, the whole blood participates in it." So said Galen. "Peroxydation not only causes an excess of fibrin, but it produces a higher state of oxydation of fibrin than exists in health." The blood globules become more adhesive, so that they roll together and sink more rapidly when blood is drawn, "whilst the altered fibrin contracts more firmly than ordinary fibrin usually does." (*Op. cit.* p. 85.)

It is of great interest to study the way in which chemical theory harmonises with ancient doctrine, according to which inflammation was regarded not so much as a disease as a means of removing disease. We may take Dr. Bence Jones's description of a fit of the gout for an example. An attack of gout, he says, is a process of oxydation set up in parts where the urates (the presence of which in the blood is, *per hypothesin*, the gouty diathesis) accumulate. By oxydation the urates are converted into urea, which can be more readily absorbed from the tissues and eliminated by the kidneys. It will be remembered that Hunter spoke of the gout as a process in which something was to be done in the part, and that Garrod had affirmed that the gouty paroxysm destroys the urate of soda. The effect of a feverish or inflammatory attack in clearing the blood of elements which may have caused ill health for years is explicable on this hypothesis.

We have already mentioned B. W. Richardson's chemical theories of the coagulation of the blood and of the buffy coat. (*On the Coagulation of the Blood*, Lond. 1853.) In a note with which he favoured me in 1861 his theory of the fever accompanying inflammation was that it was due to a process of superoxygenation extending throughout the system at large, and that local inflammation is secondary, as are also the increased temperature of the body and the quickened respiration and circulation. The conditions which give rise to the process of superoxygenation are such as lead to arrest of the circulation in one or other of the vascular organs, and to a suspension in the process of excretion in such organs. Whenever the circu-

lation is temporarily arrested in one portion of the body (as, for example, when the function of the skin is suppressed by exposure or cold) the circulation of the blood is shortened, according to the extent of the arrest in function, and the burden of the circulation has to be borne by the parts in which the circulation remains free. Additional labour is thus thrown on the heart, a quickened pulmonary circulation and a quickened respiration are established, and, as a sequence, there is a super-oxidation of the blood and inflammatory fever. Meanwhile secretions of the decayed organ accumulate in the blood, and upon their presence in excess the local manifestation of inflammatory action depends, the character of the inflammation varying with the character of the arrested secretion.

According to the same author, the great increase of fibrine in cases of acute inflammatory fever has more to do with the fatal result in many instances than the local inflammatory mischief. There is, he contends, a limitation as to the amount of fibrine that can make the round of the circulation. If the blood is surcharged with fibrine, a portion is left undissolved in the liquor sanguinis. The heart *churns* out the fibrine. The fibrinous deposit embarrasses the heart, and sinking symptoms succeed as the result of the obstruction to the course of the blood stream; these concretions, when present, being diagnosable by certain distinct symptoms.

By submitting animals to the influence of oxygen, Dr. Richardson has produced all the symptoms of inflammatory fever, the hyperinosis, the local manifestation of pneumonia, and fibrinous deposits, which latter he has removed from the hearts of animals while the hearts were yet contracting.

Taking this view as to the general phenomena of an inflammatory disorder, and contrasting this with the phenomena of arrested oxidation as induced by the influence of narcotics, Dr. Richardson considers that opium, but above all the volatile narcotics, are the grand remedies in the cure of acute inflammatory affections. In cases of acute inflammatory croup, he has thus administered chloroform by continuous but cautious inhalation with marked success. Under the influence of this agent the circulation and respiration are at once reduced in force, the temperature of the body is lowered, the skin begins to act freely, and all the increased vascular action is brought down promptly by an agent, the effects of which pass off as soon as its administration is withdrawn.

Dr. Richardson has shown that in dogs and cats inflammation of the fibrous structures, as of the endocardium, pericardium, and sclerotic, can be artificially produced by the free introduction of lactic acid into the circulation through the peritoneal surface. This is one experiment amongst many on the synthesis of disease, which, perhaps, explains the genesis of rheumatic fever. In a very valuable lecture *On Increment of Heat* (*Med. Times and Gaz.*, 1869, vol. i. p. 486), Dr. Richardson points to the augmentation of fibrine, and its deposit in the heart as effects of pyrexia.

The increasing application of the cosmical theory of conversion of force, and the measurement of effects by the thermometer, well deserve further consideration.

Dr. Julius Robert Mayer, of Heilbronn, in 1842, and about the same time James Prescott Joule, of

Manchester, first propounded in a comprehensive form the doctrine that force lives for ever; that it may change its form, or remain for a time in abeyance, but cannot be annihilated. (See *Tyndall, On Heat*, Lond. 1863.)

In a healthy man, the bodily temperature varying little, implies a balance between the production of heat and the loss of it. Let this be disturbed, let the production of heat be increased, or its loss diminished, elevation of bodily temperature or pyrexia follows.

The sources of heat within the body are not entirely understood, and do not readily admit of estimation. Liebig (*Animal Chemistry*, p. 38) alludes not only to *direct* but to *indirect oxidation*, such as occurs in the transformation of starch into fat, or of sugar into alcohol, or in the heating of a haystack. In the formation of fat a portion of the oxygen of the starch is given up, and is converted into carbonic acid with a portion of the carbon, but the combustion of the starch is incomplete; for, instead of carbonic acid alone being produced, fat and carbonic acid are the products of this imperfect form of oxidation. In fermentation of starch or sugar again, water, alcohol, and carbonic acid are formed. This is no combustion at the expense of the atmospheric oxygen, but a rearrangement of elements; yet, as certain as carbonic acid is formed heat is set free.

There are yet other sources of heat; for example, *hydration*, such as occurs when oil of vitriol is mixed with water. Here there is rearrangement of elements, but not such as occurs when carbon is burnt. Again, in the pulmonary and systemic circulation, changes are constantly going on which account for the evolution and abstraction of heat, but which are in no respect of the nature of oxidation. It is well known that wherever gases are being condensed, as oxygen is in the lung by the red corpuscles, there heat must be given out. The evolution of the carbonic acid gas would to some extent neutralise this, but how far is not known. Finally, the so-called catalytic process may have something to do with the production of animal heat.

Briefly, it may be said that the heat of the body depends on chemical change, and this chemical change is essentially oxidation; that air and food are burnt up within us, and expelled in the shape of consumed material, whilst force in the shape of heat or mechanical work is liberated. In estimating the exact measure of these changes we encounter considerable difficulties. Thus our food does not consist of simple carbon; to render that substance available for our wants, it must be combined in certain fashions, and the heat produced by the combustion of the combined matters is not the same as the heat produced by the combustion of each element separately. Then again our nitrogenous food is only very imperfectly consumed; it reappears mainly as urea, but urea itself is capable of giving out considerable combustion heat, so that this also must be taken into consideration.

Increased activity of function implies increased nutrition and oxidation, and thus increased production of heat. Thus a gland actively engaged in the process of secreting increases in temperature, contraction of muscle gives rise to increased temperature in the blood issuing from it, and as one of the phenomena of inflammation is increased



though perverted, nutrition, this also invariably finds expression in elevation of temperature.

The bodily temperature is normally about  $98.5^{\circ}$  F. in the axilla, and a degree higher in the mouth and rectum. If it rises above  $99.5^{\circ}$  the condition is described as febrile. Even in disease temperature rarely falls below  $91^{\circ}$ . The highest temperature which has been noted in a living man is  $112.5^{\circ}$  F. This Wunderlich encountered in a man dying of tetanus. In tubercular meningitis of children the bodily heat may sink very low ( $79^{\circ}$ ); in a case of mania it has been rated at  $77^{\circ}$ . A gradual accumulation of heat in the body, such as occurs in individuals working in a heated atmosphere, proves fatal. This is the rationale of heat-stroke or sun-stroke. The ordinary means for keeping down the temperature—viz., evaporation from the surface—fails in these cases, or proves insufficient to keep down the heat, and so death ensues. The temperature in these cases usually goes on increasing after death.

When, again, the surface has been cooled by a cold bath or cold water, two things take place to keep up the bodily temperature. The first of these is increased oxidative change; the second is more mechanical, for by the cold the blood is driven from the surface, and so a layer of badly conducting bodily tissue is made to intervene between the warm circulating blood and the cold medium external to the surface. These facts have an important bearing on practice.

It has been contended that increased heat of a part of the body, as in inflammation, by no means implies a general elevation of temperature. Brown Séquard in his *Experimental Researches* (New York, 1853) declares that the temperature of the rectum is  $101^{\circ}$ , of the urine  $102^{\circ}$ , and of the heart  $103^{\circ}$ , in health. Claude Bernard pointed out that internal organs, like the liver, normally have a temperature of above  $100^{\circ}$ . His idea, therefore, was that in an inflamed part, just as in a part whose sympathetic nerve-fibres have been divided, there is vascular relaxation and increased rapidity of circulation, thus tending to equalise the external and internal degrees of bodily heat. Marey has adopted the same view. He believes that inflammatory heat of surface is due rather to the levelling up of its heat as compared with the internal organs than to any increase in the rate of the production of bodily heat. But it is plain that such a theory would account for nothing beyond the normal level of internal heat, and it is a matter of experience that this is frequently exceeded. So that although the theory helps us to explain the rapid increase of superficial temperature in inflamed parts, it only suffices up to a certain point.

Originating as it does in tissue-waste, the increased bodily temperature in fever may be roughly compared with the increase of waste. This has been made the subject of experimental investigation, and the results obtained are that in pyrexia we have increased evolution of carbonic acid, and of urea: indicating increased oxidation of both the carbonaceous and nitrogenous elements of the body. There is of course loss of bodily weight.

Hippocrates pointed it out as a bad sign that some patients do not waste in disease. The fact is confirmed by Parkes when he says that some febrile cases are attended with diminished excretion. The tissues are oxidised, hence the heat; but not thoroughly oxidised into matters ripe for excretion.

Thus the blood is loaded with unwholesome matters, which perhaps cause delirium or local inflammation. When they have at last attained to what Hippocrates called *coction* they are discharged, to the great relief of the patient, and constitute what the Fathers of Physic called *Critical Evacuations*. (Aitken, *Sc. and Pr. of Med.*, vol. i.)

The local elevation of temperature has important bearings on the phenomena of inflammation. It favours chemical change, and the movement of living bodies. Now this chemical change, as we have said, is probably only half complete. Blood containing these half-consumed matters is capable of setting up pyrexia in a healthy animal, or even pyæmia, and cannot, therefore, fail to have a similar effect on the individual in whom they are produced. For if capable of producing pyrexia *de novo*, *à fortiori* they increase it in intensity when already set up.

Again, with regard to the effects of elevated temperature on motion, it is matter of experience that elevation of temperature, within certain limits favours the motion of leucocytes. Outside the body they move most readily with a temperature of  $102^{\circ}$ —which represents fairly enough, that common in local inflammation. (J. Burdon Sanderson, *Lectures* quoted above.)

But, as has already been pointed out, these two processes are two of the most important in inflammation. The increased quantity of blood plasma soaking the tissues, and the increased number of leucocytes, even in those parts where normally they abound, are essential parts of the inflammatory process. And so we see they act and react on each other.

The thermometer was used in practice by Boerhaave, by Boissier de Sauvages, who records a rise in one case from  $95^{\circ}$  to  $106.5^{\circ}$  F. ( $28^{\circ}$  to  $33^{\circ}$  R.); De Haen, who established the fact of increased heat during cold shivers, and of possible rise of heat after death; by John Hunter, Bateman, Christison, and other practitioners of the earlier part of this century. Later by Zimmerman, Traube, Aitken, Parkes, Jenner, Sydney Ringer, Edward Long Fox, W. Squire, and Spencer Wells; but Wunderlich and Billroth, the former in relation to medicine, the latter to surgery, have written on it most largely. Wunderlich's work has been translated for the New Sydenham Society, and though Billroth's papers have not been translated, the main facts contained in them are embodied in his *Surgical Pathology* (Amer. ed. pp. 81 and 328). Perhaps the best and purest examples of inflammatory fever are to be found in persons on whom wounds have been inflicted, or on whom surgical operations have been performed. After such injuries two sets of feverish symptoms may occur, the first being called traumatic fever (*Wundfieber*, Billroth), the other secondary fever (*Nachfieber*, Billroth). With regard to the former of these, Billroth says (*op. cit.* page 82), "Traumatic fever occasionally begins immediately after an injury, more frequently not till the second, third, or fourth day. The highest temperature attained, although rarely, is  $104.5^{\circ}$  F.— $105.5^{\circ}$  F.; as a rule it does not rise much above  $102^{\circ}$ — $103^{\circ}$ . Simple traumatic fever does not usually last over a week; in most cases it only continues from two to five days; in many cases it is entirely absent, as in most small superficial incised wounds. Traumatic fever depends entirely on the state of the

wound; it is generally of a remitting type; the decline may take place rapidly or slowly. . . . The cause of the difference in the occurrence of traumatic fever depends partly on whether the wound heals with more or less inflammatory symptoms, partly on unknown influences." Again (p. 329) the same author says, "Fever appearing in wounded patients is partly due to the blood taking up materials resulting from decomposition of mortified tissue on the substance of the wound, partly to the absorption of materials formed by the traumatic or accidental inflammation." He gives a temperature chart, showing how, after amputation of an arm, the pyrexia did not occur till the third day. On the fourth day the temperature was 102.2° F.; on the fifth 103°; after that it sank; on the eighth day the patient was free from fever.

Billroth gives illustrations of another form of traumatic fever, commencing immediately after operation; when, for instance, unhealthy tissues are cut, blood is left and decomposes, or when the discharge early decomposes. As an example he cites a case of excision of a carious wrist, where the soft parts were greatly infiltrated. Here the fever began at once; the same evening it rose to 102.2° F.; the second day the temperature was 103°; on the third this was somewhat exceeded, after which defervescence followed.

When the inflammation assumes an unhealthy type the pyrexia may be more severe and prolonged. Billroth gives a chart of the temperature in a case of erysipelas of the face following extirpation of a cancer of the lip. The attack began with a temperature of 98.6°; in the evening of the same day it was 103° F. This was its acme. On the morning of the fourth day it had sunk to 101.2° F.; by the ninth day the temperature was at the same level as at the time of operation, and the patient recovered.

In the foregoing groups of constitutional symptoms we recognise only usual *traumatic* phenomena; but when the temperature rises higher we think of septicaemia or pyæmia. Thus in acute osteo-myelitis, which almost invariably ends in pyæmia, the temperature rises to a considerably greater height. In one case observed by Wunderlich (*Syl. Soc. Trans.* p. 403) the patient died with a temperature of 105.26° F., rising after death to 105.98° F. In others 104.9° F. was never exceeded. This he considers the bounds of pretty high fever. In these cases the course of the temperature was irregular, but the fluctuations were trifling, and in all there was a marked contrast between the temperature and the pulse, which was excessively quick, in one case amounting to 188 beats per minute twelve hours before death. With regard to *erysipelas*, Wunderlich says (*op. cit.* p. 351) that when it affects the face it presents many various types, varying greatly with its causation, the only thing in common being the inflammation of the skin.

In *pycemia* (*op. cit.* p. 361) the pyrexia generally begins abruptly with rigors and an elevation of two or three degrees up to midnight; after that the temperature rises more rapidly, and in the morning it may be four or five degrees above that of the preceding day. The rise is ordinarily completed within a day or a day and a half. The temperature then almost always exceeds 104°; generally it approaches 106°, and commonly enough it comes near 107°. This point being reached, it

begins to fall, and may fall rapidly, but only to a certain point, when it begins to rise again, and so fluctuates from day to day. The second rise does not extend so far as does the first. The fever lasts about a week, and if it proves fatal death is not certainly pre-indicated by the thermometer.

Wunderlich has given the name *hyperpyrexia* to the very high temperatures above 107.6° F., which occur at the close of rheumatic and scarlet fever, pyæmia, acute tuberculosis, and which, as they are often met with in the case of injuries of the brain and apoplexy, seem produced by abolition of the functions of the nervous system.

It may be taken as a general rule, that when fever is truly *symptomatic* temperature rarely exceeds 39°—40° C. (102°—104° F.) The higher temperatures prevail in blood-complications, primary or secondary. (Ladé, *Sur la Température*, &c., Genève, 1866.)

I must refer in conclusion to the very valuable series of papers on Medical Thermometry, by Dr. E. Long Fox, of Clifton (*Med. Times and Gaz.*, 1870), and to the series of Tables by Mr. Spencer Wells (*ibid.*), containing summaries of the results of his marvellous series of ovariectomies. By these it clearly appears that local injury or inflammation may be fatal, even though the heat does not rise above 100°—102°; but that a further rise is of very bad augury.

Very low temperatures, 95°—96°, if persistent, and attended with symptoms of collapse, are very unfavourable.

#### SUBSECTION 7.—NEUROPATHOLOGICAL THEORIES OF INFLAMMATION.

We have already given (at pp. 31, 32, 35) a short practical summary of the doctrine of the influence of nerves in causing inflammation. We then spoke of (1) the classical cases, in which injury of a nerve trunk causes disease of the parts to which it is distributed; (2) the effects of the sympathetic, when either divided or irritated, directly or reflectedly; (3) the effects of *trophic* nerves, which directly increase the afflux of blood. At the present day, the attention of pathologists seems diverted from changes in the blood to the action of the nerves, through which the processes of disease are set going; so that neuropathology is more in favour than humoralism; though, in truth, both doctrines are necessary for a complete pathology of inflammation. We shall here then enlarge on some of the most recent attempts to ascertain the share of the nerves in inflammation; fully believing that we are yet far from availing ourselves fully of the nerve-element, whether in the prevention or cure of disease.

We may begin with the action of glands, which is the true physiological analogue of inflammation; and will show (1) that glands may be engaged by direct irritation of their efferent nerves.

About 1840. Stilling observed that certain nervous irritants produced an engorgement of glandular organs, which he ascribed to vascular dilatation. The explanation was suggested that the irritation caused contraction of the efferent ducts, and so, the blood-pressure remaining the same, the gland became engorged with its secretion. Ludwig conceived the idea of directly irritating a nerve trunk going to a gland and watching the results. He exposed Wharton's duct in a dog, introduced a cannula within it, exposed also the branch of the



lingual going to the gland, and irritated the nerve thus exposed. Promptly a profuse flow of saliva took place, inasmuch that in a very short space of time the quantity excreted exceeded the entire bulk of the gland, so that it was plain that the irritation gave rise to something more than the expulsion of a pent-up secretion, it evidently affected the secretion itself.

Nor would increased blood-pressure account for this extra secretion; for the pressure of the secreted fluid in the duct exceeded the blood-pressure in the nutrient vessel as measured by the manometer. Moreover increase of pressure in the veins issuing from the gland had no effect in augmenting the secretion.

2. *No reflex irritation of the submaxillary gland produced if the efferent nerve be cut.*—In 1851 Moritz Schiff studied the salivary secretion before and after section of the chorda tympani, and noted that when it was divided there promptly followed a very abundant flow of saliva for a short period, which, however, speedily came to a standstill. After which acids and bitters, ether and galvanism, applied to the mouth failed to produce the salivary flow they are wont to do. The salivary flow ordinarily thus brought about is a reflex act induced through the glosso-pharyngeal as incident nerve, and the facial and chorda tympani as efferent, and, the circle being cut, stimulation fails to reach the gland.

3. *Effect on the salivary gland of irritating the sympathetic.*—But suppose the sympathetic irritated, as it may be, by galvanisation in the neck, the flow of saliva is momentarily increased, but speedily diminished. Moreover, as observed by Eckhard, instead of being limpid as when the chorda tympani and lingual are irritated, it is dense and very viscous, so as to hang from the canula in strings. Moreover, when the lingual and chorda tympani are excited, the veins issuing from the gland are filled with bright florid blood, they even sometimes pulsate synchronously with the heart during the excitation. In short the vessels are dilated. But with Faradisation of the sympathetic, the gland becomes smaller and paler, the vessels cease to be visible, the veins carry away a black blood, the secretion momentarily increased promptly diminishes and by-and-by ceases.

From such experiments it is clear that by stimulating certain nerves the flow of saliva is increased, by stimulating others it is diminished and altered in character. It is tolerably clear, also, that there are certain changes in the blood-flow coincident with these.

4. *Effect of dividing the sympathetic in the neck.*—In 1727 Pourfour du Petit published (*Mémoires de l'Académie des Sciences*) certain remarkable observations relating to section of the sympathetic nerve, but the matter lay dormant till revived by Claude Bernard some time before 1851. (Claude Bernard, *Système nerveux*, tom. ii., p. 474 et seq.) This author says: "I have observed that when in a mammal we cut or tie in the middle of the neck the cord which joins the inferior and superior ganglion of the neck, one immediately observes that the temperature increases in the whole corresponding side of the animal's head. This increase in temperature commences instantaneously, and develops so speedily that in a few minutes, under certain circumstances, one finds between the two sides of the head a difference amounting to, in some cases, 4°

or 5° Cent. Removal of the superior cervical ganglion is followed by the same calorific results as section of the nerve-cord, but invariably these effects are more speedy, more intense, and more lasting. . . . All the phenomena of elevated temperature and sensitiveness due to their removal were still very intense a year and a half after extirpation of the ganglion, when the animal was slain for other purposes.

"This difference of 4° or 5° is remarkable as the difference between the two sides of the face; but if the temperature of these parts be compared with the temperature of the rectum, thorax, or the abdomen, one sees they are nearly the same. At all events I have ascertained often enough that extirpation of the sympathetic raised the temperature of the corresponding ears to 40° (104° F.), the normal temperature in the rectum of the same animal not exceeding 38° or 39° C. (100·4° or 102·2° F.)

"Some days later, and sometimes even on the morrow, this vascularity has frequently considerably diminished, even though the heat of the face on that side continues to be much developed. This elevation is not confined to the surface, but extends also even into the cranial cavity and brain substance, as shown by the thermometer, and the blood returning from those parts is of unwontedly high temperature. . . . If the animals remained well, I have never seen after this experiment, even in the warmest parts, any subsequent œdema, or any morbid condition which one could attribute to what they call inflammation. I say when they remained well, for, in point of fact, when they became sick, whether spontaneously or after other operations they have undergone, one sees the mucous membranes of the eyes and nose, but only on the side on which the nerve has been cut, become very red and swollen, and produce much pus. The eyelids remain habitually glued together by purulent mucus, and the nostril is frequently obstructed by it. If the animal gets well these morbid phenomena disappear with the return of health." (See p. 34.)

5. *The effects of irritating the sympathetic in the neck* were probably first investigated by Brown-Séquard (*Central Nervous System*, p. 140). He enumerates the following conditions as resulting from it:—dilatation of the pupil, the eyelids are wide open, and the eyeball protrudes, the blood-vessels contract, and the quantity of blood in the part diminishes, the temperature is lowered and sensibility diminished.

The view he adopts is that the increase in the quantity of blood on the one hand, and its diminution on the other, with the corresponding variations of temperature, are due to paralysis and contraction respectively as affecting the minute arteries of the part. However, says he (*op. cit.*, p. 143), "we are ready to acknowledge that there are other causes of active circulation in the head, after the section of the cervical sympathetic, beside paralysis of the blood-vessels. The very fact that there is more blood, producing an increase in nutrition and secretion—a fact which, we have said, depends upon the paralysis of blood-vessels—produces an increase in the normal suction-power of the capillaries. In other words the greater afflux of arterial blood is itself, through the increased chemical changes of nutrition and secretion, a cause of attraction of arterial blood. To this another argument of the same kind ought to be added; it is that as there is more blood, the temperature is increased, and as the

temperature is augmented the chemical changes which are a cause of attraction of blood are also augmented. From this statement it may be concluded that the primitive and, I may say, by far the principal cause of augmentation in the afflux of blood is the absence of contraction of the blood-vessels, which allows the liquid to pass easier there than elsewhere."

In short, neuro paralysis gives rise to certain phenomena closely corresponding to, and often actually ending in inflammation. In the same chapter, Brown Sequard admits that a good deal more may actually take place than mere stimulation and paralysis of the vaso-motor nerves, but this part of the question has been more fully worked out by others.

6. *Doctrine of active dilatation of arteries.*—Of those who have adopted the doctrine of an active dilatation of vessels through a nerve stimulus, Moritz Schiff appears to have been one of the earliest. In his *Leçons sur la Physiologie de la Digestion* (vol. i. p. 287), this clever experimenter says:—"It was the attentive observation of the normal ear of the rabbit which led me, for my part, to formulate for the first time in a more positive fashion, the hypothesis of the active dilatation of vessels. If the ear of a rabbit be held out against the light and its principal artery watched, it will speedily be seen that the diameter of the vessel does not remain constant, but that the trunk shows throughout its entire length alternate contractions and dilatations, succeeding each other slowly and not isochronous with the beats of the heart. These rhythmical changes in the state of fulness of the artery, constitute a true systole and diastole, independent, I repeat, of the beats of the heart, and much slower than they. Supposing the heart of the rabbit contracts on an average 220 times per minute, the systole in the ear has only taken place from two to eight times in the same period, as I have ascertained from a great number of individuals. The hare and rabbit are the only mammals which present this kind of heart in the ear as far as I have hitherto seen (1868). It is also to be noted that the diastole of the artery coincides with no contraction of the vein; on the contrary, at the moment of arterial expansion, all the vessels visible in the organ are more strongly injected with blood than during the period of contraction. The only explanations possible are that the dilatation is *passive*, i.e., due to a return to the normal state after active contraction, or both are alike the result of nerve action, that is to say, *active*, and produced by the activity of an antagonistic set of nerves to those which cause contraction.

*Effect of nerve section on active dilatation.*—That these phenomena are due to nerve action is shown by the fact that if the vascular nerves supplying the ears are cut, the rhythmic movements of the vessels cease—irregular movements may take place, but regular movements no more. It is plain, were the movements due to relaxation of the muscular fibres surrounding the vessels, section of the nerves ought to increase their condition of dilatation; and this is true of them for a day or two, but after that the diameter begins to diminish, the other effects of the nerve section still remaining, in point of fact the vessels become less than do those on the sound side, and in this state they may remain for months. Paralysis from section of these nerves, then, is an obstacle to the actual diastole spoken of.

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*Vascular dilatation as a reflex phenomenon.*—The principal auricular nerves are the sympathetic, the effects of which have been duly considered; the auricular branch of the cervical plexus, commonly dividing into an external and an internal branch, and branches of the facial and trigeminal. Of these the cervical auricular acts much like the sympathetic, but the effects of its section speedily cease, the congestion of the ear speedily passing away. But if now, when this has come about, the *central* extremity of the cut nerve be irritated, vascular dilatation again promptly follows. That is to say, irritation of a sensory nerve induces vascular dilatation in the ear of the rabbit. Of course this causes pain and the pain may affect the heart, and so for an instant causes blanching of the rabbit's ear, but this is merely momentary, and after it comes the hyperæmia.

*Arterial dilatation active, not passive.*—On this phenomenon Donders founded the hypothesis that the sensory nerve conveyed the impulse to the brain, whence it passed to the vaso-motor nerves, which caused the momentary blanching, but speedily becoming tired out they gave way, and dilatation followed. But this, certain facts observed with regard to rabbits exposed to a high temperature after section of the sympathetic tend to disprove. Perhaps even more conclusive are other experiments, such as inducing artificial fever or inflammation in dogs whose sympathetic was divided on one side. At the beginning of the experiment the temperature on the affected side was 2° to 4° C. higher than on the other, but they speedily became equal, and by-and-bye the temperature on the sound side exceeded that with vaso-motor paralysis. The general law is, therefore, a portion of the body affected with vaso-motor paralysis does not, under conditions of fever affecting all the body alike, become so much heated as do the parts where the vaso-motor nerves are unimpaired. A weighty conclusion truly. It will be noted that all these experiments were undertaken on the trunks of nerves and not on nerve centres.

A reference to glandular physiology will make this matter clearer. (Schiff, *op. cit.*, p. 271.) Taking the submaxillary gland as the type—excitation of the chorda tympani, and submaxillary branch of the lingual induces the flow of saliva—probably because they contain fibres which cause active dilatation of the glandular vessels. Irritation of the sympathetic decreases the blood flow and the secretion. A good number of experiments show, however, that when the sympathetic is stimulated for a second or two the flow is increased (though, as pointed out by Eckhard, the saliva is so dense that it does not flow readily from the cavicular, and so the increase may fail to be observed). The initial flow might be due to the influence of the dilator fibres which probably exist in the sympathetic.

7. *Action of nerve on tissue. Trophic nerves?*—Here we may refer to certain researches on the salivary glands by Pflüger. (See *passim*, Stricker's *Histology*, Syd. Soc. Trans., vol. i. p. 423 *et seq.*) The secreting portion of the submaxillary gland consists of an epithelium, and into the protoplasm of each of these cells Pflüger has traced nerve fibres of the non-medullated kind. It is right to say that many microscopists of repute have not been able to follow his observations, but that does not prove that they are delusive. But it is

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plain that such nerves, if they are nerves, can have nothing to do with blood pressure, nor with the excretory pressure of Ludwig; they must be concerned with the functions of each individual cell, and lead us to the conception of *trophic nerves*. Pflüger says that if the chorda tympani be irritated, the first drop or two of saliva is cloudy, but after that clear. That is to say, the saliva contains neither leucocytes passing through the walls of the capillaries as is commonly observed in congestion, nor the products of increased nutrition in the glandular epithelium, beyond the fluid secretion.

According to the same author similar nerve filaments may be traced into the secreting cells of the liver, but that too remains unconfirmed.

8. *Effect of section of the fifth nerve on the eye.* *Quære, a trophic element in that nerve?*—Let us now go back to experiments bearing on the direct production of inflammation by nerve influence. Magendie showed (*Journal de Physiologie expériment.*, 1824), and whether or not it was shown before does not greatly concern us, that section of the fifth nerve began to give rise, after twenty-four hours, to opacity of the cornea, suppuration of the conjunctiva, and inflammation of the iris, with false membranes. By the eighth day the cornea was sloughing, and presently the eye-ball became totally disorganised. Other parts on the same side, when the nerve was only divided on one side, were affected, in such a manner as to indicate severe nutritive changes. Valentin made similar experiments on rabbits, and on the whole confirmed Magendie's experiments.

In his *Physiology* (see *Brinton's Trans.*, p. 538), he says that when the fifth nerve of a rabbit is cut through within the cranial cavity, the pupil of the corresponding eye immediately diminishes in size, the blood-vessels soon become greatly distended, and the mucous secretion of the conjunctiva is increased. Then follows a profuse suppuration like the Egyptian or gonorrhoeal ophthalmia. The iris next becomes distended with blood, the anterior chamber of the eye fills with exudation, and a funnel-shaped ulcer eats into the middle of the opaque cornea. After this the destructive process may cease, and the suppuration gradually diminish. But the opacity, exudation and obstruction of the pupil remain, so that the sight is lost. Section of the fifth nerve in dogs or cats, or disease of this trunk in the human subject often cause the eye to burst in consequence of such suppuration and ulceration.

Many experimenters state that these disturbances are only produced by cutting through the nerve at the Gasserian ganglion. They therefore conclude that they depend on the influence of that ganglion, or of those sympathetic fibres which may be supposed to arise from it. But in the Albino rabbit, when the injury lies between the Gasserian ganglion and the brain, and does not influence the whole of the nervous trunk, it is quickly followed by this vascular distension.

The same phenomena have been investigated by Von Graefe (*Archiv für Ophthalmologie*, 1854), who particularly noted the drying up of the secretion of tears as having an important bearing on the intensity of the subsequent inflammatory changes.

Moritz Schiff, who first began to investigate the matter in 1844, in his *Untersuchungen zur Physiologie des Nervensystems*, gives an admirable account of the subject down to 1855. It

was by-and-bye seen that the necessary division might be limited to the ophthalmic division of the fifth, to cause subsequent inflammatory change. Snellen, however, in *Virchow's Archiv*, vol. i., 1858, endeavoured to show that the section of this nerve merely destroyed sensibility (see p. 34); so that irritants were neither recognised nor removed. To him replied Meissner (*Henle & Pfeuffer's Zeitschrift* (3), xxix. 96), who showed that if all the ophthalmic was divided, save its inner fibres (median branch), no inflammation followed; but were these divided, it invariably did. He made it appear that the other portions of the nerve had to do with sensibility—this with nutrition; that it was a trophic portion of the nerve. (Later, Schiff confirmed these experiments. *Henle & Pfeuffer's Zt.* (3), xxxix.) Were this so, a powerful argument would be advanced in favour of the existence of such nerves, as contra-distinguished from vaso-motor nerves only; but even now this is by no means clear, later experimenters having shown that section of the sympathetic in the neck interferes with section of the ophthalmic of the fifth (*Senitzin Centralblatt*, 1871), and so the existence or non-existence of trophic nerves remains as yet unsettled by experiment.

9. *Nerve influence on the heart's action.*—The heart is presided over by two sets of nerves, the one coming from the pneumogastric, the other from the sympathetic. This portion of the subject has been carefully investigated by Von Bezold (*Centralblatt*, 1864–1867); Ludwig and Thiry (*Wiener Sitzungsbericht*, Band 49, 1864); Goltz; Cyon and Ludwig (*Ludwig's Arbeiten*, Bd. 1, 1867); and others. The discovery of a nervous twig extending from the ganglion stellatum or its branches to the pneumogastric (or superior laryngeal) in the rabbit, which acts so powerfully on the heart in reflex fashion, that it has been called the depressor nerve of the heart, has been one of the most important outcome of these researches. It may be supposed to extend between the pneumogastric and this ganglion, or rather vice versa. When it is divided and the peripheral extremity irritated, no result follows, as far as the pulse and blood-pressure are concerned; but the moment the central end is irritated, the blood-pressure begins to fall and the power and frequency of the heart's beat to diminish, and the blood-vessels to dilate. (*Ludwig's Arbeiten*, 1867, p. 131 *et seq.*) This is apparently effected through the spinal cord and (mainly but not entirely) the splanchnic nerve.

Researches of some of the authors cited above show that when the spinal cord is divided high up in the neck, and irritated in the lower cut surfaces, increased frequency and power of the heart's beat follows. These facts go to show that the regulating power has its seat in the medulla oblongata, but acts through various sets of nerves, including cerebro-spinal and ganglionic.

*Reflex action on blood-vessels, through medulla oblongata.*—The same volume of *Ludwig's Arbeiten* (1867), contains a valuable paper by Lovén on the effects of irritating a sensory nerve on the blood-vessels of the parts supplied by both. The difficulty in dealing with sensory nerves is, that their irritation produces so much pain, that the result cannot be depended on. Lovén, therefore, curarised the animals on which he experimented. The vessels examined were those of the ear, the saphena, and the arteria dorsalis penis. The re-

vessels were, in all cases, dilatation of the vessels, but in a good number contraction preceded it; nevertheless, dilatation was the ultimate result. It appeared to be brought about in reflex fashion, the motor centre being, as before, the medulla oblongata.

Later researches have shown more clearly that the heart's beat can be accelerated without increase of blood pressure, as by irritation of the first or third root of the ganglion stellatum. Except there be at the same time contraction of the vessel no increase of pressure is noted. (*Bever and Von Bezold, Centralblatt, 1867, p. 355.*)

In the same year (1867), Salkowski, investigating the origin of the sympathetic fibres of the neck, made out that they originated higher in the spinal cord than Budge had thought, viz., above the third vertebra, thus confirming the results of Ludwig and Thiry, who refer the vaso-motor influence (indirectly) to the medulla oblongata. (*Centralblatt, 1867, p. 487.*)

This fruitful field of inquiry—viz., the point of origin and the mode of action of the vaso-motor nerve system—has been worked by the Brothers Cyon (*Reichert and Du Bois' Archiv, 1867, p. 398*), and by Von Bezold (*Würzburg Untersuchungen, 1867*), with good results, showing especially that the pulse can be quickened through a particular system of ganglionic nerves. These nerve fibres originate in the spinal cord, pass out in the neck, form the lower cervical and the upper thoracic ganglia, whence they proceed to the cardiac plexus. These influence the heart—not the vascular system, which is mainly affected from the same central source, through the splanchnics. These last have the power to regulate blood-pressure.

10. *Combined effect of ligature of vessels and section of nerves.*—Samuel of Königsberg (*Centralblatt, 1869, No. 25*) relates some interesting experiments on this subject. He found that the signs of true acute inflammation were not induced by croton oil in the anæmic parts after a main arterial stem had been tied, until the collateral circulation had been fully established. Thus, after tying the carotid, the collateral circulation is set up in 36 to 40 hours; and not till then can the marks of acute inflammation be made to appear say in the ear of that side. But if at the same time that the carotid is tied the sympathetic is divided, inflammation may be produced in 24 to 30 hours. But if only sensory nerves are divided when the carotid is tied, the case is altered, inasmuch that if the auricularis major, minor, and temporalis are thus divided, no result is obtained in the ear for six times 24 hours. If other sources of blood-supply than the carotid are cut off from the ear, 14 days may elapse; but when the sympathetic is cut at the same time as the other nerves, the collateral circulation is finished by the second day, and acute inflammation may then readily be induced. This shows that section of the sensory nerves only acts through the sympathetic by causing a reflex paralysis of the ganglionic nerve-fibres, and so hindering the setting up of the collateral circulation. Some observations on the same subject, but in a different direction, were made by Tschaussow (*vide Centralblatt, 1869, No. 51*).

11. The most important papers connected with this subject, to be yet referred to, are one by Saviotti (*Virchow's Archiv, Bd. 50*), and one in *Stricker's Medizinische Jahrbücher, Heft i.*, by F. Riegel; as the lines of inquiry were parallel,

the results of Riegel's experiments may be taken. The question to be solved was this: *are the changes in blood-vessels in an inflamed part the direct result of local irritation, or are they the consequence of this irritation reflected through the nerves?* As to the local changes—these are usually two in number—alteration in the size of the lumen of the vessel, and alterations in the rapidity of the blood-flow: these had to be examined separately. Brücke's ocular micrometer was tried for the purpose of ascertaining if any dilatation or contraction took place, but did not succeed well. No one had attempted the latter problem—viz., ascertaining exactly any alteration in the rate of the blood flow. Riegel tried it by comparing the blood-current with an artificial one made to pass through the eye-piece of his microscope parallel to the course of the blood. This stream could be regulated, and it was rendered visible by introducing into it small particles of chalk. Thus arranged, it was brought carefully into the same focus as the object examined (the frog's web), and the current, by elevating or depressing the exit tube, could easily be made to correspond exactly with that of the blood. The animals were curarised very carefully, so as to be under the influence of the drug and no more. Moreover, the animal was so arranged that both hinder webs could be examined and compared. Next, the great sciatic was divided, and the effect noticed. According to Saviotti, this gives rise to dilatation of the vessels and retardation of the blood flow on the corresponding side; but this Riegel observed only in a few instances and to a slight extent, the frogs he used being strong spring frogs. Next, he applied to the cut nerve a pair of electrodes, so disposed as to readily send a current through the nerve. First he studied the effects of this form of irritation as applied to the peripheral extremity of the nerve, but each time he touched it, he found such violent effects—viz., excessive retardation and speedy arrest of flow—that he gave up this form of experimentation. He found, in point of fact, that with a wet thread he could produce the same effects, his galvanic current being very strong, and being thus conducted to the frog's web as easily as by the nerve. When a very weak current was employed, no result followed.

In Saviotti's experiments mechanical irritation was used, but Riegel strove to avoid the difficulties connected with it (pulling the nerve, giving rise to flowing of the blood-current) by laying the nerve on the electrodes. When through the nerve, by its central extremity, a moderate current was passed on the injured side, an acceleration of the blood-stream was noted, coming on in two minutes and gradually increasing, and accompanied by a moderate contraction of the arteries. The irritation continuing, the acceleration and contraction increased up to a certain point, the vessel diminishing by one-sixth or one-fifth of its diameter and reaching a maximum intensity in about an hour. When the current ceased the former condition gradually returned, the effects of the current lasting some time after it had been stopped.

To moderate the rapid flow of blood in strong frogs, the author exposed the heart and lowered the temperature by ice. In this way he reduced the circulation; nevertheless, central irritation of the nerve in these too gave similar results to those just recorded.



The conclusions drawn from these experiments are—1st, that there are nerve-fibres other than those contained in the peripheral end of the cut sciatic, whereby the arteries in the lower extremities can be influenced; 2nd, that the arteries can be made to contract through these by reflex action. After the irritation has lasted for a time, the circulation through arteries, capillaries, and veins becomes so quick that it cannot be followed by the eye with a magnifying power of 50. Saviozzi, on the other hand, found with narrowing of the vessels a retardation of the blood flow, and in some of Stricker's experiments irritation of the medulla oblongata produced contraction almost to a line, and complete stasis.

After prolonged irritation, Riegel found contracted arteries suddenly dilate, and after a few seconds or minutes return to their former dimensions. After very prolonged irritation, dilatation to even more than the original size of the vessel ensued, probably as the result of exhaustion.

Examination of the web of the opposite foot gave no very satisfactory results. At all events, weak central currents had no effect; strong currents gave rise to accelerated flow. This would tend to show that the irritant acted not through the system at large, or even on the heart, otherwise both sides should have been affected alike, but rather through the spinal cord as a centre.

11. *Inferences.*—From all this it is manifest that the so-called vaso-motor nerves have much to do with the phenomena of inflammation, especially as regards the alterations in the size of vessels and the blood pressure within them. Moreover, the same system of nerves command the heart, the central organ of the circulation. Direct irritation of certain of them accelerate its action, whilst if others be at the same time irritated, the blood-pressure in the vessels is at the same time increased. These nerves all belong to the so-called ganglionic or sympathetic system, but filaments of these undoubtedly exist in mixed nerves like the sciatic, or even like the ophthalmic, and so the vascular system may be acted upon through these also, not alone by paralyzing the heart from pain, but more directly and immediately.

Perhaps, however, the most interesting point of all thus made out is, that these so-called ganglionic fibres have a central origin. They are motor fibres originating in the medulla oblongata, and making their way out of the spinal cord at various points. They pass outwards, first to the various cervical, dorsal and abdominal ganglia, thence to the vessels and other organs. This much seems clear, and though as yet the subject is surrounded with difficulty, there are good hopes for the future, and we may hereafter attain to a more intimate acquaintance with vaso-motor pathology.

Hitherto we have described a neuro-pathology chiefly based on vivisection; but Professor Laycock has deduced a system from the teachings of physiology and the observation of disease. His main principles are that tissue is antecedent to nerve and vessel; that nerve-force of a motor order regulates nutrition; and he gives the name *trophesy* to the results of disorder of this force; that the trophic nerves (motor spinal) act on the tissues, conveying to them force from the special nervous centres; that the sympathetic or vaso-motor act on the hollow contractile tubes, arteries, veins, capillaries, and (as

Professor Laycock specially indicates) on the *lymphatics*; that the trophic system is anterior to the vaso-motor, just as the action of the tissues is anterior to both; that the blood, like the tissues, has a growth and nutrition of its own, yet regulated and interfered with by the nerves; that the trophic system may sanction or may inhibit the setting-up of local disease, and presides over its distribution and metastasis.

We shall see how well Professor Laycock's views are borne out when we come to speak of the prevention of disease, the use of opium and of neurotic counter-irritants. (*Lectures on Influence of Nervous System in Disease, Med. Times and Gaz., 1871, vol. i.*)

Section 9.—*Treatment.*—The treatment of inflammation resolves itself into three kinds: preventive, expectant, and curative.

1. *Preventive Treatment.*—If inflammation be threatened, whether after injury or in consequence of conditions affecting the health generally, "the first and great requisite," says Hunter, "is rest"—rest both mechanically, so that there may be no movement, and rest physiologically, so that the threatened organ may be relieved as far as possible from its duties. Thus the delicate material employed in the work of repair will be allowed to develop itself, whereas if disturbed it may perish, and inflammatory changes follow. On this point we may refer to Hunter (*On Inflammation*, p. 2, c. 6), and to the excellent Lectures of Hilton (*On Rest and Pain*, Lond. 1863). Hilton justly traces most of the disastrous after-consequences of concussion (i. e. bruises) of the brain, spinal cord, and joints to want of entire and timely rest. In threatened inflammation of any part of the respiratory apparatus rest in bed is essential. When there is risk of inflammation of the bowels, their action should be suspended by opiates. Entire rest includes of course confinement to bed—a simple and despised but most valuable remedy. It lessens the movements of the heart and lungs; by keeping up warmth it renders less food necessary; by keeping up the action of the skin it lessens the stress on the lungs and kidneys; it renders occupation irksome, and so keeps the brain and senses at rest. In fact, after a shake, fall, bruise, excessive fatigue, chill, operation, wound, or other injury the surgeon must be negligent indeed who hesitates to enforce absolute rest.

As a second preventive measure, auxiliary to rest, we must mention *narcotics*. They diminish, as John Hunter and Dr. Macartney (quoted, p. 64) well showed, the sense of injury and the danger of constitutional sympathy. Under opium an injury to an irritable anxious man becomes like one inflicted on a negro or an animal; the attention ceases to be directed to the spot, mental apprehensions vanish, sleep is ensured, and the vegetative actions of repair go on without disturbance from over-action of heart or brain.

What the narcotic shall be the surgeon must decide in each individual case. For children, and many delicate adults, conium in full doses answers well; but for most persons opium (and especially the solution of the watery extract—*Liquor Opii Sedativus*, or *Dover's Powder*) is the sheet anchor. The plan adopted by the most sagacious practitioners is to give it regularly in sufficient doses to keep down restlessness and the first beginnings of

pain. If the patient is not told what he is taking, he will seldom be found to complain that it disagrees with him. "Surgeons," says Dr Armstrong (*On Typhus*, Lond. 1819, 3rd ed.), "know the use of opium much better than physicians; for, by freely using it after operations causing excessive pain, they often succeed in warding off serious inflammation."

We need not speak of the splints, bandages, or other appliances that may be requisite to ensure rest after various injuries; nor need we add that, at the surgeon's discretion, some patients may require a purgative, some brandy or soup, some alkalis, some quinine, according to their respective conditions. Purgatives should not be given if they interfere with the rest of the part injured, as the bowels. Everything must in cases admitting of it be done to soothe pain by local applications, and especially by moist warmth. The *brân poultice*, with Dover's powder, may ward off the first threatenings of peritonitis after delivery. Cotton wool, finely carded, is an excellent application to parts that have been bruised or chilled. Of course all mechanical conditions contrary to comfort must be amended, foreign bodies removed. The threatened part should be elevated.

What we have said refers to all cases, but wounds in which the skin is divided require special precautions against the decomposition of the fluids on their surface, which would be a sure cause of inflammation. This was pointed out by Garengot (*Chirurgical Operations*, Lond., 1723), and the older surgeons, and by John Hunter. The strict parallelism between a wound and the condition of the womb after delivery, and the common dangers of both, first from ordinary putrefaction of fluids, and, secondly, from contamination by special septic agents such as the poisons of erysipelas, gangrene, and the like, were specified by Robert Ferguson after Cruveilhier. It was by an obstetric physician (the late lamented Sir J. Y. Simpson) that the greatest impulse was given to the study of the causes of that "surgical fever," which makes greater havoc after operations than puerperal fever does after delivery. (*Clinical Lectures on Diseases of Women*, Edinburgh, 1872, p. 296.) Sir James called attention not only to the necessity of removing clots of blood, but of adopting materials for obstructing arteries and closing wounds that shall not be like setons and provoke suppuration. He is emphatic in his condemnation of those surgeons who calmly lose patients after great operations, without taking the precautions against septicaemia which are now universal amongst obstetricians. Sir James Simpson was followed by another Edinburgh professor, Mr. Lister, who applied to the prevention of inflammation in wounds the principles which Pasteur proposed for the prevention of unhealthy fermentation in wine. (*Études sur le Vin, ses Maladies, etc.*, Paris, 1866.)

Some of the fine particles which are seen floating in the sunbeams are the spores of minute organisms, which, when developing in the fluids of the body, give rise to changes resembling the fermentation caused in sugar by the presence of the growing yeast plant. That this is so, and that the destructive changes are not due merely to the presence of oxygen, as Liebig taught, is shown by the simple experiment of guarding a quantity of blood or pus with a thick layer of cotton wool impregnated with some volatile vapour inimical to

life. The effect of this vapour passes off within the first twenty-four hours, but the blood will remain quite sweet under the cotton wool for weeks—clearly showing that the putrefactive agent is not the oxygen, which of course has free access through the interstices of the cotton, but rather the organic germs which become entangled in the wool and so are mechanically hindered from reaching the fluid below.

Guided by these observations, Prof. Lister introduced the treatment of wounds by such antiseptic applications as prevent the access of living germs. The material first employed, and still preferred by him, was carbolic acid. This has the valuable properties of being highly volatile, of hindering putrefaction indefinitely by the presence of its vapour, and of combining with different substances in varying degrees of affinity. Thus water takes up but little and parts with it very readily; resin holds the acid with great tenacity, and so forms a convenient storehouse, giving it off slowly during a considerable period, whilst the fixed oils occupy an intermediate position. Hence, where a temporary but brisk action is required, watery solutions are useful; where slow and prolonged disinfection is needed, a plaster of shell-lac saturated with carbolic acid may be employed; and when, as frequently happens, a free evolution of the vapour during many hours is desired, the oily solutions form valuable dressings. Remembering the points which demand attention in all cases, viz. (1) to prevent the ingress of living organisms, and (2) to destroy any such organisms as have already entered, the surgeon will see the necessity for varying the mode of application according to the exigencies of the case.

Thus, if a simple abscess is to be opened, the part being covered with a slip of muslin soaked in carbolic oil (1 in 5), the knife—dipped in the same—is to enter the skin through the muslin, another fold of which is to be at once dropped over the incision, so as to allow the pus to escape beneath the veil. A piece of carbolic-lac plaster is now laid over the wound (to protect the part from the too stimulating effect of the acid, which is now needed merely to disinfect any air which may approach the incision), and covered with oily dressings, which extend widely round it, and may be changed as often as necessary. Under such treatment, the granulating walls of the abscess are not stimulated to fresh production of pus by the presence of putrefying matter, a little serum only escapes for a few days, and the cavity quickly closes with cicatricial tissue.

In the case of an amputation more elaborate measures are necessary. Throughout the whole operation, from the first entrance of the knife until the insertion of the last stitch, a cloud of carbolised vapour should be made to envelope the part, by means of a large stream of watery solution from a spray-producer. The fingers of the surgeon and assistants and all sponges should be dipped into a like solution, and the knife and other instruments anointed with carbolic oil. An important element in the system is the use of the carbolised catgut, which forms a convenient ligature, with the property of being after a short time absorbed, and so leaving no foreign body in the wound. For sutures silken thread soaked in a combination of carbolic acid and bees-wax are more convenient, as these are not absorbed like the catgut. The



stump is then to be wrapped round with several layers of thin cotton cloth, impregnated with a mixture of carbolic acid, resin, and paraffin, a sheet of thin Mackintosh cloth being interposed between the last two layers of the gauze, so as to force the discharge (which is often considerable) to permeate all the length of the antiseptic wrapping before reaching the outer air. Two more points need attention. One is to allow a free vent for the discharge which the stimulating acid renders so abundant, by means of a strip of oiled lint laid in an angle of the wound as a drain and carried along underneath the gauze; and the other is to protect the wound itself from the continued irritation of the acid. This is best effected by laying over the line of incision a "protective" of common oiled silk smeared with carbolic oil, or a bit of specially-prepared silk dipped freshly into the watery solution. In the after-treatment of such cases the same precautions must be sedulously observed, the part never being exposed save under a cloud of carbolised spray, and the oily and other dressings changed with great care and regularity. After the first day or two these dressings will seldom need to be changed, but the method in all its minuteness of detail must be practised until the lesion is converted into a mere superficial granulating surface.

Where the injury is a contused and lacerated wound, inflicted some hours before the surgeon sees it, it becomes necessary to sponge into the wound, very thoroughly, a strong watery solution of carbolic acid, before proceeding with the measures above described.

Although carbolic acid is for many reasons the most convenient disinfecting agent for the majority of cases, it is not the only one. Any agent which combines volatility with hostility to low forms of life may be used in the same way. Chlorine, sulphurous acid, benzine, and creosote have all been so employed.

Nearly two years before the publication of Prof. Lister's first observations, Mr. Campbell de Morgan introduced the custom of sponging recent wounds with strong solutions of chloride of zinc. This he originally proposed with the view of destroying living cancer-cells scattered on the surface of an operation wound inflicted for the removal of malignant tumours; but the effect upon the healthy tissues was so remarkable, large wounds healing in forty-eight hours with hardly any suppuration or trace of animal smell in the discharges, that he was induced to recommend it in all cutting operations. And the practice is attended generally by the best results, whilst it has the great merit of being infinitely less complicated than the use of carbolic acid after Lister's method. (See BIBLIOGRAPHY.)

2. *Expectant Treatment.*—There are some cases in which it suffices for the surgeon to put the patient under favourable conditions of warmth, rest, food, and comfort, and to watch him meanwhile, lest anything should demand more active treatment. That expectant treatment is often reasonable in itself is shown by observations of the natural course of diseases when not interfered with, many of which are known, after a period of violence, to subside regularly of their own accord. It was observed by Baglivi (*d.* 1694, *Practice of Physic*, &c., translated from the Latin, Lond. 1704) that "all diseases, especially those of an acute form,"

i.e. fevers, "have a certain standard of increase and declension, and that a physician cannot change this course and stated period by exhibiting medicines" without doing mischief; and that the "motions" which diseased parts "put forth to retrieve their primitive state will be such as are regulated by Nature." Mr. Hilton (*op. cit.* p. 54) gives, as the "first professional thought" for the practitioner, "that Nature has a constant tendency to repair the injuries to which she may have been subjected, whether those injuries be the result of fatigue or exhaustion, inflammation or accident." These sentiments are doubtless the expression of a fact; and if any inflammation is to be dealt with which experience shows to decline speedily of itself, common sense forbids interference under ordinary circumstances. Thus there are few cases of mumps, erythema nodosum, or inflammation after injuries, in which the surgeon would dream of using special antiphlogistic measures.

We may observe, by the way, that the term "expectation" has been used in several senses. By Gideon Harvey—a coarse, shrewd medical satirist of the seventeenth century—it was used to signify the impositions practised by the faculty, who deluded their patients with useless remedies, and waited till time should send a cure. (*Art of curing Diseases by Expectation*, Lond. 1689.) By Stahl (*Sileni, &c. Ars Sanandi cum Expectatione*, Paris, 1730) it is treated as the study of the natural history of disease, and the plan of using remedies when really useful, not from mere routine. In the same sense it is used by Citizen Vitet in his *Médecine Expectante*, published at Lyons, and dated 1st of Messidor, in the tenth year of the French Republic one and indivisible, a work remarkable for general good sense, except in the profusion of leeches ordered.

But there is a good deal to be said on the abuse of "expectation," a fault of which the late Sir John Forbes cannot be acquitted in his *Nature and Art in the Cure of Disease*, Lond. 1857. There is a great deal of cant uttered about Nature, as if Nature never let patients go on from bad to worse, and as if "Nature" in the mind of a reasonable being meant any more than "matter of fact," or "what is." In the admirable words of Porzio, *Natura rei est Res ipsa*. (*Erasistratus*, Romæ, 1682.) Neither can it be denied that the "Efforts of Nature" are often insufficient, as Hoffmann well showed, and sometimes as fatal as the worst achievements of meddling physio. What effort of art can be more mischievous than that "effort of Nature" which sets up spasm of the eyelids in ophthalmia, spasmodic cough, the spasms of dysentery, the exhausting drain of cholera, the profuse suppuration in osteitis? all of which are to be suppressed, not as benevolent efforts of an intelligent agent, but as so many mischievous aberrations of the animal machine. Much is made of a saying of Hippocrates (*Epidem.* vi. ed. Kuhn, iii. 636), *Νούσων φύσις ἰητροί*, as if *φύσις* was *φύσις*, and as if it meant Nature was the physician of diseases, whereas *φύσις* signifies "temperaments." That celebrated expression of Lord Bacon is recited *ad nauseam*, "Man, the minister and interpreter of Nature," &c. &c.; whereas, in the noble words of Torti, the physician had need be not the *minister*, but the *magister*, and ought to control the natural actions if experience shows them to be mischievous.

Again, if there be practitioners who play the quack by using a multitude of useless or mischievous remedies, there are others who play the quack by an affected purism, by pretending to use "natural" means only, and to reject "drugs;" as if it were not "natural" for a civilised man to use drugs, or as if leeches, opium, iron, quinine, mercury, and iodide of potass in appropriate cases could not remove diseased conditions which go on unchecked even under rest and the best devised diet. The young practitioner should look upon this Nature-worship as a kind of quackish foppery, and will, after experience, agree with the Son of Sirach that "the Lord hath created medicines, and he that is wise will not despise them." (*Ecclesiasticus*, chap. xxxviii. v. 4.)

3. *Curative Treatment.*—Before entering on this we must warn the young practitioner to avoid that tendency which the common structure of language promotes, to consider inflammation, or other disease, as something apart from the individual patient in whom it occurs, and to allow himself to use violent remedies against a supposed sthenic "condition," whilst after all these remedies have to be borne by a human being, and perhaps a very feeble one. I, who caution others, cannot avoid the conventional practice of speaking of inflammation as a separate entity—for instance, when I say that "chronic inflammation causes induration," &c. The proper correction for these infirmities of thought and speech is found in the determination to think of the patient—the living soul and body—as the thing to be treated, and not the disease.

It will be readily seen that it would be impossible here to give the details of the treatment of the numerous varieties of inflammation. We can only describe the remedies generally, and leave their special application to the Articles which treat of the several varieties, although their proper combinations can only be learned thoroughly at the bedside.

The remedies for inflammation generally are divided into those which (1) diminish the quantity or the velocity of the blood or its heat; (2) purify it by acting on the excretory organs; (3) allay nervous irritation; (4) support the strength; (5) act specifically in a way we cannot explain; (6) counter-irritants and neurotics.

Amongst the first order we must first mention that most venerable remedy *blood-letting*, which the saintly Willis conceived to be taught by Nature and sanctioned by the divine law. We have already shown how Hippocrates bled in pleurisy moderately, and how Galen, 650 years later, bled in ophthalmia freely. Celsus (*circa* A. C. 18) recommends bleeding in violent fevers and acute painful diseases generally; he sanctions it even in some doubtful cases, on the plea "*anceps remedium melius quam nullum.*" (*De Medicinâ*, lib. ii.) Yet he rebukes a tendency which seems to have existed in that day to bleed in all diseases, and even to bleed patients who had no blood to spare. The modern practice of bleeding was introduced by Botalli, who visited England in Queen Elizabeth's reign; and whose practice was closely followed by Sydenham in the next century. Sydenham bled in acute fevers, "to relieve the patient from the

distress occasioned by violent commotion of the blood." He bled also in the plague. In his treatment of pleurisy (except that which might come on during a malignant fever) bleeding, twice or thrice repeated, is his sheet anchor, and he observes "that a confirmed pleurisy in an adult subject is rarely cured with the loss of less than forty ounces of blood." His object is "to repress the inflammation of the blood, and divert its inflamed particles from the lining membrane of the ribs." (*Syd. Soc.* ed. vol. i. p. 247.) He bled in confluent small-pox, rheumatism (because of the buffy coat), bronchitis, quinsy, hysteria, gonorrhœa, ophthalmia, and, in fact, bled *moderately* at the onset of most diseases, especially if of a feverish or inflammatory kind. Willis speaks of the custom of Rusticks and persons of full habit to be bled in the spring and fall, although he says that some are so obstinate against it that they refuse to be bled except under the greatest necessity. Bleeding, he says, lessens the quantity and alters the quality of the blood, by depriving it of excess of sulphur and fixed salt (*sulphur* in Willis's nomenclature = carbon, and is that part which combines with the "nitrous spirit" of the air to create heat). But bleeding is not proper in malignant fevers, when the texture of the blood is loosened. It is good generally in a hot and dry, bad in a cold and moist temperament. It is good in almost all fevers and inflammations. In pleurisy blood should be drawn freely, in order "to rescind the nourishments of the disease, and drink up the matter" which is the cause of it. A full bleeding once, he says, is better than small bleedings repeated. (*Pharm. Rat.* pt. ii.)

Pitcairn bled freely to lessen the heat of the blood and its viscosity, whether arising from acid or any other cause of coagulation. He prescribes such method of bleeding on mathematical principles as shall cause revulsion; that is, he directed it on the left arm for an inflammation on the right side, and so on. He shows how, on mathematical principles, and in words which clearly foreshadowed the doctrine of the conversion of motion into heat, bleeding must lessen the attrition of the blood, and the heat caused by the heart's impulse on blood which cannot move freely. He orders immediate and full bleeding in pleurisy. Pitcairn was a scholar, poet, cavalier, and man of honour; his reasoning is irresistible, though the assumptions on which it is founded have been abolished by the progress of physiology. But it is distressing to find a man of such clear intellect ordering horse-dung and pigs-dung as remedies for sick men; and this nasty custom, which was prevalent at that day, makes us doubt whether he was capable of accurate clinical observation.

We need not go through the list of the hydraulic practitioners of the eighteenth century, who saw in the animal economy not a living whole, but a collection of pipes liable to obstruction, and who, as Bordeu observed, thought every disease must be cured, if the circulation were freed and the vessels unloaded by depletion. "On a saigné sans mesure, on a purgé sans règles," says F. Quesnay (*Traité des Fièvres*, Paris, 1753), through the neglect of the study of natural processes and the prevalence of a dry, hard, mathematico-mechanical pathology.

Frederick Hoffmann was more conservative; he clearly and fully enumerates the diseases in which bleeding is pernicious, and shows how it promotes



some inflammatory maladies, yet he greatly approves the periodic bleeding of plethoric persons in health. (*Opera Omnia Geneva*, 1740, tom. v. and vi.)

Perhaps the great teachers whom I have quoted were led by the necessities of their theories to recommend in the lecture-room what they would shrink from at the bedside. This is rendered probable by an account with which I have been favoured by Professor Laycock of the teaching and practice of Dr. John Rutherford, the maternal grandfather of Sir Walter Scott, who occupied the already distinguished chair of medicine in the University of Edinburgh about 1750. Dr. Rutherford bled in febrile disease, if at its commencement, and the patient young, of full habit, and with a *hard*, quick, full pulse; but not if the pulse were not hard. In everything like pleurisy he at once bled to eight ounces, and in true pleurisy taught that a large quantity—as much as thirty ounces—should be taken once at the beginning, till the pulse turned soft and weak. In rheumatic fever he bled once at the beginning, and opposed the repeated bleedings of Sydenham. At the beginning of fevers he took eight ounces, not to remove the fever, but to prepare the way for other remedies. He neither bled nor used reducing remedies in mucous catarrh or bronchitis. He was emphatic in his warnings against excessive bleeding. From records of his cases, still extant, he seems not to have bled in cases of debility.

Hunter bled freely as a “means of producing absolute weakness,” and in order to diminish the “increase of life”—the action with power—in the inflamed part; but if the inflammation were one of much action with little power, he bled sparingly—no more than enough to “lessen the violence of the motion of the blood,” induce contraction of the vessels, and “remove the sensation in the part inflamed of having too much to do.” (*Op. cit.* vol. iii. p. 375.) Cullen employed bleeding as a part of that most severe regimen which he prescribed in fevers and inflammations, in order “to take off the phlogistic diathesis” and “diminish the activity of the sanguiferous system.” In pleurisy he bled as largely as the patient’s vigour would allow. John Burns, of Glasgow, considered bleeding the most powerful and useful remedy, but was averse to bleeding to faintness. So was Pearson. (*Op. cit.*) Benjamin Bell, in his *System of Surgery*, 1796, follows Cullen in theory and practice. Caleb Hillier Parry (1815) bled to diminish the general momentum of the circulation. John Thomson (1813) bled to diminish the quantity of blood, to reduce the force and frequency of the circulation. Wilson Philip (1820) bled because the capillaries were too debilitated to withstand the force of the circulation. Dr. John Armstrong (*On Typhus*; also *Lectures in Lancet*, 1825) bled in simple fevers as well as in inflammations, and accuses practitioners in general of bleeding too often in one case, but “without sufficient decision at first.” “In the beginning of my practice,” he says, “I used to order about fifteen ounces of blood to be drawn on the accession of any common acute inflammatory affection of the viscera, and the same quantity two, three, and even four times afterwards, at intervals of six or eight hours each, if the symptoms continued urgent and the strength unsubdued.” (P. 346.) “These repeated venesections, together with active purgatives, blisters, and the anti-

phlogistic regimen, constituted the means on which all my hopes of success were founded.” Many cases, he continues, certainly did well; several proved fatal, and post-mortem examinations showed that “such repeated bleedings sometimes made little or no impression on visceral inflammation, and I had previously observed that venesection in general only succeeded when it had been carried to faintness.” This practice was afterwards adopted, with greater success and even economy of blood. He regrets that the abstraction of 160 ounces in six hours did not stop the progress of a laryngitis. (P. 392.) Sir A. Cooper (*b.* 1768, *d.* 1841) considered a hard pulse the surest indication, and bled to “produce a diminution of nervous power and lessen the momentum of the circulation.” The blood, he says, should be abstracted as quickly as possible. Abernethy (*b.* 1764, *d.* 1831) believed that “the fevers produced by local disease are the very identical fevers which physicians meet with when there is no external injury.” (*Lectures*, 12mo. Lond. 1831.) With regard to the “sympathetic inflammatory fever” following injuries, he says there is no treatment required. “What must you do to mitigate the affection of the sanguiferous system, which is called fever? It is evident there is too much action; you must try to lessen it, then. How? why by taking away blood. Blood is the natural excitement of the heart and arteries, and if you diminish the blood you diminish the excitement. But in taking away blood you rob the patient of a vital fluid; consider what you are about; recollect that you cannot cure the disease. I put the case of a compound fracture. \* \* \* Do not take away his blood, which is his life, for you will find after a certain time that he will stand in need of every degree of vital energy to recover from the injury. I have seen a patient bled and bled, and two or three days after the medical man has been glad to throw in the bark, and try every means when it was too late” to restore the wasted strength. The only warrant for bleeding is, that the action of fever wears out strength, and that by lessening action we may save more strength than the bleeding wastes. But, says Abernethy, “if a vital organ is injured, and inflammation comes on,” the patient can only be saved by most “resolute conduct” on the part of the surgeon, which would otherwise seem “most outrageous.” *You must subdue all vascular action.* You must either let the inflammation kill, or run the risk of killing the patient yourself. “I have lived in London all my life, and am very chary of taking blood, but still it some were to see how I would bleed a patient in inflammation of a vital organ, they would wonder.”

Passing over the next ten years, during which Cooper and Abernethy were the leading lights of surgery, we find David Craigie (*Practice of Physic*, Edinburgh. 1836) considering fever as a distension of the capillaries from relaxation, with the circulation impeded and heart irritated by this mechanical obstacle. Inflammation is the same state locally. He thought bleeding “suggested by physiological considerations” and “therapeutically beneficial.” It should be early and decided (p. 286), “should make a great and evident impression.” John Mackintosh, in his *Pathology and Practice of Physic* (Lond. 1836), objects to the term *debility* as a description of the state of the capillaries in inflammation. They are strong enough, he says,

for their natural work, but are overloaded with an unnatural weight. He throws overboard Cullen's theory that spasm of the extreme vessels is the cause of the oppression and weakness in fever, and asserts that it is due to congestion of the internal organs, and supports this view by numerous records of post-mortem appearances of persons who had died of fever. Hence he advocates bleeding even in the cold stage of ague. He bled in scarlet fever, and "never had occasion to regret it," and of course his bleeding in inflammation was vigorous enough. John Elliotson, in his inaugural thesis at Edinburgh in 1810, *De Inflammatione Communi*, chiefly recited the doctrines of John Burns, and declares that "so long as a white crust continues we may bleed fearlessly." He was a great bleeder. He tells us in his *Lectures* (edited by Rogers, Lond. 1839) that he bled in scarlet fever "if inflammatory symptoms ran high," and goes so far as to say that the absence of the usual inflammatory characters of the pulse may not always forbid bleeding. In this decade (1830-40) bleeding attained its climax, and in the next there were symptoms of a decline.

So early as 1836 G. Macilwain (*Medicine and Surgery*, &c., Lond. 1838, p. 264) attacked the antiphlogistic regimen generally. "We bleed," he says, "we stop the supplies of food, we induce action of various secretions, we give rest and remedies to abate the action of the heart and arteries." But of these, and especially of bleeding, he asserts (p. 270) that it is sometimes unable to stop an acute inflammation, that sometimes the acutest inflammations do well without it; and that sometimes, when used, the recovery is due not to bleeding, but to other means. He mentions a very successful and experienced surgeon, who never bled. He renews his protest in his *Lectures on Fever*. (*Med. Times*, 1849.)

In the year 1836 also appeared the admirable *Elements of Medicine* by Robert Williams, which greatly promoted the study of the natural course of fevers and erysipelas, declared the impossibility of shortening the effects of morbid poisons, and hence the uselessness and mischief of violent remedies. He denounced bleeding in erysipelas, and gave wine freely. Magendie (1837) denounced it in rheumatism.

We find in 1843 W. P. Alison still recommending bleeding in the old terms. He employs it to weaken the heart's action by the abstraction of the stimulus by which, as Haller taught, its motion is habitually excited and maintained, and to cause derivation or revulsion from the diseased part. "No proposition," he says, "in medical science is more certain, and certainly no one is more practically important, than that which regards the power of large and repeated blood-letting to arrest the progress of inflammation in its early stage." But there are in Alison's work signs of a coming change. He complains that some "practitioners and teachers of medicine express themselves doubtfully as to its usefulness." This he accounts for by supposing that these eminent teachers and practitioners are not called in till diseases have got past the stage when bleeding is permissible; but, "as a farther and more satisfactory answer," he alleges "the frequent deflection of inflammatory disease from the simple and healthy type, on which blood-letting exerts its most beneficial effect." Thus we see the earliest signs of a

change which has gone on till bleeding is as rare amongst the subjects of Queen Victoria as it was at Rome amongst the disciples of Erasistratus during the reigns of Antoninus Pius and his successors.

In 1820 Marshall Hall began to publish on the effects of loss of blood. In 1829 he communicated a paper on the same subject to the Med. Chir. Soc. (*Transactions*, vol. xiv.), and in 1830 issued his volume *On the Morbid and Curative Effects of Loss of Blood*. In 1825 he had published a short essay on a condition of infants resembling hydrocephalus, and arising from exhaustion, in which the leeching, then supposed to be the remedy for congestion of the brain, would be perilous. About the same time Kellie drew attention to the little effect of even fatal hæmorrhage in draining the brain of blood (*Edinburgh Med. Chir. Trans.* 1828); and Abercrombie, in his *Researches on the Brain* (ed. 1828), described a state of children similar to that which M. Hall had spoken of. Gooch, in his *Diseases of Women*, 1829, in describing the same state, protests against indiscriminate leeching of children. Travers, in his *Constitutional Irritation*, 1826, had marked plainly enough the existence of cases simulating acute inflammation, but really caused by want of blood.

Marshall Hall, in describing the "morbid and curative" effects of loss of blood, takes for his principal thesis the fact that in some morbid conditions—especially "irritation," shock, and exhaustion—the abstraction of a very small quantity of blood will induce syncope; that inflammation and fever have the effect of a stimulus on the organs of circulation, which enables them to resist syncope, even when large quantities are taken, insomuch that the author believed that a patient sinking from exhaustion and failure of the heart's action might be saved by setting up an inflammation. In health the average loss which a man can bear without syncope is 15 oz.; bleeding, therefore, is a means of diagnosis as well as of cure, because if a larger bleeding than 15 oz. be borne, it shows the presence of some inflammation. Hall did service in 1830 by treating of the morbid effects, but his ideas of the curative effects of bleeding are shocking for their extravagance. Parodying the proverb about the wind that is tempered to the shorn lamb, he believed that when bleeding was well borne it was necessary.

This clever writer has the merit of marking off certain affections as utterly unfit for depletory treatment—such as "irritation," neuralgia, puerperal delirium, delirium tremens, "hysteria, dyspepsia, chlorosis, and cholera morbus," and the conditions following severe injuries. He also described a scale of tolerance representing the power of the system to resist syncope, and the quantity of blood which may be drawn in various affections. At the top of the scale is placed congestion of the head and tendency to apoplexy, and it is said that in "arachnitis" forty ounces should flow; inflammation of the serous membranes and parenchyma of organs follows, and it is said that 30 to 35 ounces should be taken in pleurisy or pneumonia; next comes acute anasarca, and then inflammation of mucous membranes, and it is said that 15 oz. is the quantity for bronchitis. This is the quantity which also causes faintness in health. Below this come fever and the asthenic conditions reckoned above, in which faintness ensues from smaller losses of blood.



Here we may pause for a moment to express our wonder at the glimpses we get of the bleeding practised in the last generation. The reign of the lancet was terribly absolute, and it was used under conditions which now seem preposterous. It was so common as to leave its trace in history and literature. Goethe, in his *Sorrows of Werter* (published 1774), after his hero had shot himself through the head, describes the surgeon bleeding the dying man. The Queen Amélie, widow of Louis-Philippe, describes the surgeon as attempting to bleed her son the Duc d'Orléans whilst dying from the effects of a fall from his carriage in 1842. Sir Walter Scott tells how, in 1785, he was bled almost to inanition for spitting of blood. The late Bishop Bagot, of Bath and Wells, told me that when a young man he was thrown from his horse in Hyde Park, and carried insensible into the barracks close by. Sir Everard Home was sent for, who immediately bled him, but was too drunk to stop the blood. The patient's mother-in-law, Lady Jersey, who was in the room, was expressing great uneasiness at this state of things, and the first thing the patient noticed, on coming to his senses, was Sir Everard muttering, "Who's that ——— woman in blue?" Coarse habits at table, coarse language, and coarse modes of practice went together. Lord Byron's end was certainly not averted by furious bleeding in 1824. A year or two earlier the late Mr. Wakley, in setting up a weekly paper for the medical profession, named it "The Lancet," as the most fitting symbol and chief weapon of the craft. The worst of it was that the bleeding was not confined to cases conventionally called "sthenic," in which a reason could be given for it, but was practised in maladies utterly unfit to be so treated—as, for instance, in diffuse inflammation from blood-poisoning. (See art. Erysipelas.) Patients were furiously bled immediately after injuries, ere they could have recovered from "shock," and before inflammation could have been established. Marshall Hall quotes the case of a man brought to St. Bartholomew's Hospital with three ribs broken by a fall from a scaffold. He was bled to 18 oz.; soon afterward 20 more were taken; second day, twice bled to 13 oz.; third day, because the pulse was jerky, he was bled again, but the dresser would only take a few ounces. Mr. Lloyd, a fearful bleeder, and Mr. Lawrence ordered 20 oz. to be taken, after which "the pulse became a mere flutter," and the man died. Equally shocking was the case of a surgeon who was bled to death at Dr. Marshall Hall's own house at Nottingham in 1821, after a fall from his horse and broken ribs. This poor man twice bled himself in the night into a wash-hand basin! and his advisers, after bleeding, leeches, and ptyalism, were proposing to cup him, when he became insensible, and soon died. The effects of loss of blood, the jerking pulse, and undue excitement were often mistaken for "action" requiring further depletion; and, strange as it may seem, there is no doubt that fresh blood-letting was often employed to relieve these ill effects, and often with temporary benefit. The idea, too, of using blood-letting as a means of diagnosis—that is to say, to bleed patients who ought not to be bled in order to prove that bleeding was wrong—seems terrible. Perhaps the most humiliating part of Marshall Hall's book is his statement of

the absoluteness of bleeding as "the remedy and the only remedy for inflammation." Well does he describe himself, as well as his medical brethren, when he says they "think only of the disease and forget the patient."

Let us look at some of the causes (or concomitants) of this love of bleeding which inspired our forefathers. In the first place there is no doubt that it is a positive remedy; it relieves (though, peradventure, for a time only) the dreadful pain of an acute inflammation; it makes the breathing freer, and is followed by a delicious sense of languor and inclination to sleep. As we have just said, there is no doubt that a few leeches will quiet for a time the throbbing caused even by previous loss of blood. Secondly, it was sanctioned by the preponderance of medical authority, and adopted by popular prejudice, so that most surgeons would not have dared not to bleed even if they thought it improper. A man, about 1835, fell from a balloon at a great height and was smashed to pieces; yet the surgeon who first saw him tried to bleed his mangled remains, and it was observed at the time that no surgeon dared face a coroner's jury who had not bled in any case of accident, injury, or sudden death.

It was an ancient and inveterate custom with many people to be bled spring and fall, and to be bled on any change. For instance, a man jilted in love was bled to mitigate grief; a man who came in for a fortune was bled to check exuberant joy. Schoolboys were physicked before bathing, and before going home for the holidays; many people were bled before a journey. The Prince Regent was bled to make him look interesting in the eyes of a woman. Singularly enough, the illustrious Stahl, who denounced bleeding *in fever or other disease*, yet recommended it in health to "ventilate the blood" and prevent disease. He prescribes it for both men and women of full habit and middle life, and especially for women at the cessation of the menses; and, as for himself, he thanks God that he has been able to preserve his health by this means during 43 years of practice. He began to be bled at 17, and says that in November 1727 he entered his sixty-ninth year, and was bled for the 102nd time, to the increase of his alacrity and vigour. I have already quoted Hoffmann. (P. 55.)

Thirdly, all the medical theories which succeeded each other in the way we have described, opposite as they might be in their premises, came to bleeding as their conclusion. Whether the capillaries were in too great force and action, or whether they were debilitated, whether there were too much or too little oxydation, the good effects of bleeding were equally demonstrable. The dominant theory of Hunter that inflammation consisted in excess of life and action was taken by his pupils without the checks and corrections which his own sagacious mind dictated. Broussais, Cluttbuck, and others, held the doctrine that most diseases depend on some latent inflammation. The prevalent medical notion was threefold, viz. (1) "excited and increased action," as Abernethy called it; next (2) the doctrine of Haller that the action of the heart depends on the stimulus of the blood; and (3) the doctrine of Cullen, in the words of Elliotson, that it was necessary "to exclude external and remove internal stimuli." This threefold chain of error was the strength of the bleeding system.

Fourthly, the medical theorists had discarded "humoral pathology" as something absurd or unattainable. All was "action" and "sympathy," in the Hunterian language, where we now think of blood-poisoning. The term "constitutional irritation" was also used for symptoms of blood-poisoning, and others which would not bear bleeding. But diseases of "irritation" and "action" are cold abstractions; the surgeon can conceive of those apart from the patient in a way he never could if he thought of such a tangible concrete thing as blood mixed with putrid sanies.

Fifthly, the doctrine of conservation of force was unknown, and the idea of *quantity* never seemed to be considered. The loss of pounds of blood was looked upon as the withdrawal of a stimulus (an abstract term) from a system to which inflammation (another abstract idea) had given apparently unlimited powers of tolerance, without the notion that the blood was a fluid of limited amount. What idea of quantity could have been entertained by the respectable practitioner who took 20 oz. of blood at once for peritonitis from a child nine years of age just recovering from measles? (*M. Hall, op. cit.* p. 191.)

Sixthly, bleeding and the antiphlogistic regimen were supposed to counteract a "general phlogistic diathesis;" an abstract idea which survived the doctrines of Brown, and still flourishes in full vigour in Italy.

Seventhly, the whole ideas of the time favoured severe measures towards feverish and inflammatory patients. Women in childbed and patients after injuries and operations were denied adequate nourishment, in order to "ward off inflammation," to avert which bugbear Ramsbotham did not allow even a "weak solution of animal matter" till the third day after delivery. As a sign of the times Dr. Caleb Hillier Parry (father of Sir Edward and grandfather of the suffragan Bishop of Dover) declared that indulgence and insufficient chastisement of children, horse exercise instead of walking, good food, and fermented liquor led to want of self-control and inflammation. All things nasty and disagreeable were considered medical.

The divine Hippocrates hath an aphorism to the effect that forasmuch as all things human are unstable, so when the height of excellence is reached there must be a fall. The converse of this aphorism is the homely English proverb that when things come to the worst they must mend. Nothing could be worse than the state depicted by the last-quoted author, and a change came by degrees. It began by the recognition of the conditions unfit for bleeding, which had been detailed by Gooch, Travers, Kellie, Abercrombie, and Marshall Hall before 1830. Then came the influenza of 1833 and 1837, which gave instances of fever attended with smart chest inflammation, in which depletion was pernicious or fatal. Copland (*Dictionary*, art. *Influenza*) blames the practitioners who talked of inflammatory action and attempted depletion, as if this action were primary and uncomplicated, whereas it was truly adynamic or asthenic. I must not let pass the opportunity of saying how much the profession owes to Copland, a descendant of Norwegian Vikings and every inch a man, for warning the practitioner of depressed vital power in acute disease, and for recommending a tonic treatment in many cases where the lancet was too much the routine. The burly Copland

held his hand when even the prudent Watson bled. The third influence was the revival of a humoral pathology—a thing which Armstrong craved in 1815—not disquisitions on imaginary humours, but the result of observations and experiments on the blood. "A rational humoral pathology," says Robert Ferguson (in his *Pre-fatory Essay to Gooch's Works*, New Syd. Soc. ed. 1859), "was unknown in our schools when Gooch wrote" (1829). Gaspard, Dance, Tonellé, Magendie, and Cruveilhier showed by experiment soon afterwards, the effects of the introduction of septic matters into the veins. Guided by their researches, R. Ferguson (*Essay on Puerperal Fever*, Lond. 1839) showed that "the phenomena of puerperal fever originate in a vitiation of the fluids," and thus gave to a true humoral pathology its proper place in English medicine. It is impossible for two persons to hold the same views of treatment of a disease in which one sees violent "action," the result of an ideal phlogistic diathesis, and the other a physical condition depending on the admixture of poisonous matters with the blood. I well remember, during my apprenticeship, seeing case after case of puerperal fever, no doubt conveyed by the hands of pupils who had been attending septic cases in the hospital. The poor women were actively treated, according to the views of the time, by bleeding and scruple doses of calomel. What struck me as odd was, that when peritonitis ceased in one instance plenury began, spite of the previous anti-phlogistics. Now, about this time, Dr. Robert Lee was endeavouring to construct a solidistic hypothesis of puerperal fever, by showing it to be "essentially dependent on inflammation of the womb and its appendages," its symptoms varying according as the serous, muscular, or venous tissue was implicated. (*Med. Chir. Trans.* vol. xvi. 1831; also *R. Lee, Lectures on Midwifery*, Lond. 1844.) Anyone who compares Lee's treatment, in which, following Craigie, he gives copious bleeding the chief place, with Ferguson's poultices and Dover's powder (not that Ferguson never bled), may see the influence of a humoral pathology on practice. Ferguson was much in advance of his time. His book is full of hints on the benefit of subduing the nervous disturbances in inflammation, and not looking entirely to the vascular. It is amusing to notice how timidly English pathologists of that day seemed to feel it necessary to touch on a humoral pathology. W. Addison, for instance, in 1842, said, with a tone of apology, that we were approaching a "modified humoral pathology;" and the tone of Todd, in his *Lectures on Gout*, 1843, is the same.

Fourthly, the natural history of disease was a thing longed for by all true physicians; Baglivi, especially, and Stahl craved to know of diseases, as Stahl said, "*quales in se ipsis sunt et quomodo observantur se gerere.*" (*Sileni, &c.* 1730, p. 98.) But this history was unexpectedly developed in the decade 30-40 by the spread of homoeopathy—a doctrine which repudiates "Nature," busies itself in combating every symptom, and yet employs remedies so ludicrously impotent that they cannot effect the slightest alteration in the animal system. (*Hahnemann's Organon*, by Devrient, 1833, p. 25.) It is one mode of curing by "expectation," such as was satirised by Gideon Harvey (*Art of Curing by Expect.* 1689), as "the applying of remedies that



do little hurt and less good, from which the patient, day by day frustaneously expecting relief, is at last deferred" so long that Nature and Time effect a cure which the physician claims the credit of.

Side by side with the results of homœopathy were promulgated the views of some physicians, who were sceptical as to the use of drugs, and treated patients "expectantly." It was Dr. G. W. Balfour who, in 1847, brought before the Medico-Chirurgical Society of Edinburgh the practice and doctrine of Skoda in the general hospital of Vienna. Instead of dealing with pneumonia as if large bleedings were less dangerous than the disease, he put it into the category of maladies whose tendencies were to recovery, and believed that this was best promoted by abstinence from heroic treatment, and rest and regimen alone. The same with regard to the patients treated homœopathically, who took pretentious but inert medicines. This circumstance, combined with the fact that many English physicians, as Robert Williams (*Elements of Medicine*), had long treated fever with the mildest remedies, and Seymour treated rheumatic fever with guaiacum, bred distrust as to the necessity of heroic measures. In 1843 Dr. Todd published his *Lectures on Gout and Rheumatism*, in which he places rheumatic fever in the category of diseases with a definite duration, and therefore condemns large bleedings, which he says cannot cut short rheumatism "as we can arrest an attack of pneumonia or of pleurisy." This shows that Todd's conversion from bleeding to an opposite treatment was not complete in 1843.

Fifthly, the cell doctrine directed attention to processes outside and beyond the blood-vessels. Anyone who in 1844 studied J. Hughes Bennett's often-quoted *Treatise on Inflammation*, would be quite prepared for such a modification of treatment as should regard development of an exudation, rather than the "action of vessels."

Sixthly, practitioners in India, civil and military, were dissatisfied with the bleeding and calomel, which had been the routine treatment for fever and dysentery, and found quinine and Dover's powder more congenial.

The surgery of the Crimean war, as depicted by George Lawson, Williamson, Macleod, Matthew, and Lyons, presents a very different kind of treatment from that of the Peninsular war, described by Guthrie and Hennen. Not merely in inflammation, but to arrest hæmorrhage from wounds of the lungs and brain, military surgeons used to bleed; not so in the Crimea. Some measure of the change of opinion may be found in Todd's *Clinical Lectures on Acute Diseases* (1866), where he says, "I am not aware of any mode of treatment which can be said to cut short" pneumonia and pleurisy. "The plan by bleeding and tartar emetic does not do so certainly." Todd at this time taught that most spontaneous internal inflammations are connected with the gouty, rheumatic, or scrofulous diathesis, through which some morbid matter is generated, which accumulates and provokes inflammation, especially if determined to some particular organ by cold, fatigue, or injury. Such inflammations are to be cured by a natural process; by the "elimination of the morbid element through the channels of augmented secretion" from skin, kidneys, and bowels. Meanwhile there is great waste going on; the inflammatory exudations create a great drain on

the blood, and if this drain be not compensated, the healthy structures will be robbed and impoverished. So that, instead of bleeding, we ought, he says, to support and soothe the patient, "and gain time until, by antidotal means or by elimination, we can get rid of the irritation, whatever that may be."

From the influence of these causes, acting silently, without noticeable controversy, practitioners in the decade 1850-60 became conscious of the fact that they no longer used the lancet, or, if at all, with very much reserve.

The practice of the Royal Infirmary at Edinburgh underwent a total revolution between 1845-55. During the years '45-'50 bleeding was ordered to a great extent. One patient with pneumonia was bled to 20 ounces on the 1st day, to 15 on the 2nd, cupped to 15 on the 4th, and had 18 leeches on the 5th. A patient with epilepsy was four times bled in 8 days. A fever patient was twice bled, to 12 and 18 ounces. In 1850 bleeding began to disappear; and with it disappeared two other things—the great use of stimulants, and the habit which patients had of leaving the hospital "by their own desire" in the middle of the treatment. Leeches cost the Infirmary 141*l.* in 1839, and 1*l.* 14*s.* 6*d.* in 1870.

What took place in London and Edinburgh took place also in Dublin, in America, and wherever English-speaking surgeons practised. Dr. Belcher describes the difference in treatment at the Cork Fever Hospital, where one-fourth of the patients were bled in 1818, none from 1857-61.

Then arose the question, why was bleeding abandoned? Were human beings different, or had disease changed its type; or, whilst disease remained the same, had surgeons a different type of treatment?

a. There is nothing impossible in the idea that men may change. Hunter thought (*On Infl.* chap. ii. s. i.) that some "climates were less pernicious now than formerly, arising from the mode of living being different." Professor Laycock believes that changes in the nutrition and occupation of our population, rendering bleeding less needful and less beneficial, have arisen from the increasing accumulation in large towns. Here the nervous system is cultivated to the neglect of the muscular and blood-making; in-door occupations and defective ventilation lead to dyspepsia. Medical science prolongs the lives of the delicate, and the Peninsular and Crimean wars and the Indian army drained off the robust, leaving the delicate to propagate the species. The natives of hot climates, and vegetable feeders, do not bear bleeding, and the inhabitants of any climate possibly vary at different times. That common human feeling—the *laudatio temporis acti*—that belief that we are degenerate and unequal to our fathers, so that, as Homer said, ten men now cannot lift the stone that Ajax lifted; that peaches, as the Count in "Gil Blas" said, are smaller; that winters are warmer, summers wetter, prompts us to think that even our diseases are not such as they used to be, nor our people so well able to bear disease or remedy. Thus John Armstrong (*On Typhus*, 3rd ed. 1819), speaking of Sydenham's practice of depletion in erysipelas, says, that "probably in the time of Sydenham the constitution of the metropolitan poor was more vigorous than now, their diet more nourishing, their habits more temperate, so that, as a mass, they more nearly approached to what country people are at present."

Unluckily in Sydenham's time, the same complaints of degeneracy were rife. Willis thought the population had become scorbutic through using sugar. Dr. George Thompson, in 1670, ascribes it to the ale brewed from Thames water, which was so befouled by common shores, jakes and privies; he says also that English barley is degenerate!

b. Does the type of disease vary?

This question is to be answered thus. Diseases of different type are continually arising, and have done so from the earliest times—not only the pure or essential fevers, but “inflammatory fevers” (i.e. fevers with local inflammation, or idiopathic inflammation with fever, as we should now call it), such as the epidemic pleurisies of Lancisi, catarrhs, dysenteries, erysipelas, and puerperal fevers arising from atmospheric causes or from infection. In some seasons they are comparatively “sthenic,” in others accompanied with prostration from the first, and unable to bear the smallest “lowering.” Space does not permit me to refer to well-known passages in Hippocrates, Sydenham, and Huxham to prove this. “It is observed,” says John Hunter (at some uncertain time before 1793), “by some of the ablest physicians of this day, that the fever called inflammatory is now not so common in this country as it was formerly represented to have been; that it is now seldom that in fevers they are obliged to have recourse to the lancet, at least to the excess which is described by authors in former times. They are now more obliged to have recourse to cordials than evacuations, and indeed the disease called the putrid fever and sore throat are but of late date. I remember when the last was called Fothergill's sore throat, because he first published upon it, and altered the mode of practice. I remember when practitioners uniformly bled in putrid fevers; but signs of debility and want of success made them alter their practice. Whether the same difference takes place in inflammation I do not know, but I suspect that it does in some degree; for I am inclined to believe that fever and inflammation are very nearly allied.

... But I believe we have much less occasion for evacuations in inflammation than there was formerly; the lancet, therefore, in inflammation, and also purgatives, are much more laid aside.” He then goes on to account for this by the fact that they lived *above par*, or, as we say, *faster* than did their predecessors.

It may be granted that at times epidemic diseases are more asthenic than at others. But does evidence exist of a prevalent asthenia so fluctuating that during certain periods human beings in health, after accident, or in accidental inflammation, cannot bear a bleeding which they would have borne with benefit at another time. If this be so, what are the dates?

If we turn to Sir T. Watson's *Lectures*, published in 1843 (vol. i. p. 218), he says, that since about the time that the virulent cholera made its first appearance amongst us (1831) continued fever has neither required nor borne the abstraction of blood as it did bear and require it for some years prior to that period. He also describes the influenza of 1833 and 1837 as sometimes requiring bleeding, though “the persons suffering bore bleeding exceedingly ill.” Robert Ferguson, writing in 1839 (*op. cit.* p. 153), whilst eulogising blood-letting, general or local, as the most generally useful remedy in puerperal fever, declares that large bleeding has

not been borne during the last twelve years. This would fix 1827 as the end of a phlogistic and beginning of an asthenic period. Again, in 1819 we find Armstrong declaring that “the evacuant is succeeding to the stimulant treatment in the early stage of idiopathic fevers.” Thus it would seem that a phlogistic diathesis existed in 1819, and lasted till 1827, in London. Dr. Stokes says that “essential and local disease was of a sthenic type in Dublin from 1822 to 1828.”

The “change of type” at Edinburgh has been recorded by a most venerated authority, Dr. Christison, whose experience ranges over the period which is the subject of dispute (*Edinburgh Med. Journ.* vol. iii. 1858, p. 580.) He became resident medical officer in the Infirmary in 1817, at which time an epidemic of fever was commencing; “and within a few months blood-letting, which had been brought into vogue by the teaching and example of Dr. Gregory, attained its highest reputation and widest range in the case of diseases at large.” To the success of blood-letting in the treatment of this fever “may be traced the unreasoned adoption of it as a principal remedy for many years afterwards in most fevers and inflammation.” In 1826 and 1827 the same fever occurred, and was treated the same. (This fever corresponds to the Synocha, or inflammatory fever, now called “relapsing.”) “But in 1834,” says Prof. Christison, “I became satisfied that a change had taken place in the constitutional character of our fevers.” Speaking of 1848-49, he says, “The change in the constitution of our fever had begun twelve years sooner, and was perfected in the epidemic of 1843-44;” i.e. the inflammatory fever passed into, or was replaced by, typhus or typhoid. With regard to the eruptive fevers, he shows that measles, after a very low typhoid form from 1809 to 1817, put on a true sthenic type; having “the perfect tolerance of blood-letting and other antiphlogistic remedies,” which marked the epidemic fever. He adds, for at least fifteen years preceding 1858 that sthenic condition had vanished. The same fluctuation occurred in scarlatina at the same dates, and the same change of type, according to this distinguished Professor, occurred in pneumonia and other acute inflammations. Francis Adams of Banchoory, in his translation of Hippocrates (*New Syd. Soc.*, vol. i. p. 307), gives a similar account of the date of change in practice.

Again, there is evidence that a stimulating regimen in some fevers prevailed during the earlier part of this century—say from Hunter's time (vide *supra*) up to 1815. For instance, Mackintosh (1836) says, with the greatest contempt of Underwood, who in his work on *Diseases of Children* (1784, reprinted in many editions, down to 1826) speaks of scarlet fever as a disease of debility, “that he did not live long enough to profit by modern pathology.” He, too, quotes Dr. James Hamilton (1813) as speaking of a schoolmaster who gave wine and brandy largely to his scholars in scarlatina. “Poor boys!” says Mackintosh, who always bled in scarlet fever, and “never had occasion to regret it!” There is thus clear evidence of change in the type of some epidemics, with corresponding evidence of a conservative practice in fevers from G. Fothergill to Gregory, and of a bleeding practice from Gregory to 1830.

c. But that a change in opinion has occurred is clear; for it was during these years, 1817-30,



that the bleedings occurred which we have condemned in the art. ERYSIPELAS, and those which are equally condemned by Marshall Hall in the first part of his essay on blood-letting (1830). The years in which Watson describes a true and universal depression after the cholera, are those in which Craige and Mackintosh revelled in blood-letting.

From the foregoing details we may conclude that there is evidence of change of opinion, as well as of type of disease, to account for the cessation of bleeding.

But this cessation is not peculiar to the present day. It is well shown by Dr. G. W. Balfour, in an essay on *Hematophobia* (*Edin. Med. Journ.*, 1858-9 p. 214), and in his before-quoted work, that bleeding and no bleeding are recurrent phenomena. Erasistratus, the grandson of Aristotle, opposed bleeding on many of the grounds on which it is opposed at this day. He declared that it lessened the vital powers; that blood extravasated in inflammation (exudation) could not be withdrawn by bleeding; that if it were desirable to empty the vessels, one day's fasting was equivalent to the de-traction of blood. We have seen that his sect was in full vigour in Rome in Galen's time, 400 years later. Following Dr. Balfour, who has written exhaustively, we find Asclepiades (about 100 B.C.) declaring that pleurisy bore bleeding on the Hellespont, but not in Rome nor Athens. Van Helmont denounced bleeding, and relied on dried goats-blood in pleurisy. Bontekoe, James Sylvius, and Porzio, in the seventeenth century, were as averse to bleeding as Todd and Skey in the nineteenth.

Porzio published, in 1683, an amusing book entitled *Erasistratus*, in the form of a dialogue between this physician and Van Helmont against Galen and Willis. Of course blood-letting is demolished so far as rhetoric can do it, save that it is permitted in threatened rupture of blood-vessels. The most amusing part of the book, and the truest vindication of sensible practitioners who have bled in all ages, is a collection of the cautions and restrictions against blood-letting which are contained in Galen's works, and which, if literally acted upon, would serve almost as absolute prohibitions against bleeding any but robust men in temperate climates.

We must mention Gideon Harvey (art. on *Expectation*, Lond. 1689) as one of a class that is never wanting; a man who had the honour of an answer from Stahl (*Sileni*, &c.), and whose shrewdness in pointing out some obvious blots in the practice of his time was marred by the indecent scurrility of his language. His reprobation of the *Butcher Doctors*, as he calls those who bled, is closely imitated by the notorious Samuel Dickson of our own day. (*Fallacies of the Faculty*, &c. *What killed Mr. Drummond?* &c., Lond. 1843.)

An equally scurrilous person, Dr. George Thompson, whom F. Hoffmann calls Stahl's lickspittle, published in 1670, *Aquariacis*, or, *The True Way of Preserving the Blood*. His way was by purges and sudorifics.

Space does not allow me to do more than refer to Stahl, Bordeu, Hoffmann, and others who continued the tradition of moderation through the eighteenth century; but I may say of Huxham—that great physician who deserves to be called the Sydenham of his century—that whoever reads his description of pneumonia and pleurisy, will see that he knew well when not to bleed.

In the decade 1860-70, panic was allayed, and a slight reaction took place. W. O. Markham, in 1864 (*On Bleeding and Change of Type*, Lond. 1866), whilst scouting the change-of-type theory, and the ancient excessive bleeding, pleaded for the benefits of blood-letting in acute inflammations attended with difficulty of breathing, in order to diminish the work of the heart. Now inflammations of the chest and abdomen are both attended with difficulty of breathing; and the relief in cephalic inflammation is also great, so that Markham's plea applies to every inflammation of vital organs. Laycock, Gairdner, Stokes, Richardson, and most of our eminent teachers, showed that it was possible to hold middle ground between the "vampyre" and the "incendiary."

Thus then we may consider blood-letting a remedy which has been grossly abused, but which still has most valuable uses. It is quite impossible to conceive that every physician was mistaken, or that, for instance, Armstrong's report of the benefit he got from being bled in fever (*op. cit.* p. 141) was a delusion. Bleeding diminishes the mass of blood, lessens the labour of the heart and lungs, relieves pain, moves the bowels, and sets the skin perspiring; it increases the absorptive power of the blood; and produces a most delicious sense of languor and repose, like that of the Turkish bath. (*Surgeons' Vade Mecum*, 10th ed. p. 23.)

"The patients whom it is allowable to bleed are those who have blood to spare—the robust with red lips, firm muscles, rustic open-air occupations, firm pulse, and rigid fibre. Pregnant women usually bear bleeding well. If the lips and conjunctiva are pale, showing deficiency of blood; if the patient is bulky, soft, and flabby; if there is any weakness or degeneration of the heart; or if there is any continuous disease of assimilation—scrofula, Bright's disease, or the like—bleeding is not to be thought of.

"*Manner of Bleeding.*—General bleeding should be executed in such a way as to cause slight faintness as quickly as possible. For this purpose the blood should be drawn as quickly as possible from a large orifice; and, above all, the patient should sit or stand upright.

"Blood should be permitted to flow till paleness of the lips, sighing, nausea, fluttering pulse, and relief of the pain, indicate the approach of faintness; but full faintness should always be avoided.

"The quantity required to produce this effect on a healthy adult was ascertained by Marshall Hall to be about 15 oz.; but in robust adults affected with acute inflammatory or congestive attacks of the head or viscera, a greater quantity may be taken.

"The inflammations in which bleeding is permissible are sthenic inflammations of the great cavities, especially the chest and the eye. It is not allowable, as a rule, in the *hypinotic class* of maladies, nor in erysipelatous diseases; nor in the case of injuries producing suppuration, as compound fractures; nor if the disease be advanced towards suppuration or gangrene; and very seldom indeed in the case of any zymotic disease, or inflammation having a natural tendency to recover, or traumatic inflammation of parts not essential to life.

"*Local Blood letting.*—If in a past generation

general blood-letting was carried to an injurious excess, in the present day local blood-letting is too much neglected. It is a most obvious, rational, and mild process; and it imitates and seconds the efforts of nature by removing some of that blood which may be assumed to be impure, and by taking it from the part where it is in excess.

"The local means of abstracting blood are leeches, cupping, and scarifications. In order to apply leeches, the part should first be washed, and if they will not stick, a little milk or blood should be smeared on it, or some small punctures should be made with the point of a lancet; and the leeches should be well dried in a cloth. The best plan of stopping hæmorrhage from leech-bites is to apply a small piece of *matico* leaf, or to dip small pellets of lint in tinct. ferri chloridi, or powdered alum, and press them on the holes for a few minutes. But in order to prevent dangerous bleeding, directions should always be given that the leech-bites should be stopped before any patient is left for the night. Moreover, it will be prudent to apply them over some bone, so that pressure may be applied effectually. *Cupping*, when it can be adopted, is a more active measure, and relieves pain sooner than leeches. *Punctures* are of use in superficial inflammations of the skin; *incisions* are of use when inflamed parts are covered with a dense, unyielding fascia, as in whitlow; or when there is great tension, as in phlegmonous erysipelas; or when the inflamed part is infiltrated with an irritating fluid, as in extravasation of urine, or with unhealthy matter, as in carbuncle.

"Cold is a valuable means of diminishing afflux of blood, and morbid heat. It may be applied by *evaporation* by means of a single piece of thin linen frequently changed and dipped into cold water or *evaporating lotion*, and care should be taken that the vapour may pass off freely, otherwise the cold lotion will soon be converted into a hot fomentation. Or *dry cold* may be applied by means of india-rubber bags or bladders filled with ice, or frigorific mixtures. Or by irrigation, as recommended by Dr. Macartney. The inflamed limb is to be placed in a trough or piece of oilcloth, with a piece of lint on the inflamed part. A large vessel of cold water being then placed on the table by the bedside, one end of a broad strip of cloth should be dipped in the water, and the other end (which should be cut to a point) laid on the lint; and so the water will be carried in a constant, gentle stream down to the inflamed part. Dry cold applications are less irritating than wet; and india-rubber bags, or glass or metal bottles, less so than bladders. The surgeon must use his discretion as to the degree of cold. The possibility of causing sloughing must not be forgotten. Cold is well adapted to inflammations of the head, and of the skin, joints, and external parts."

If it act beneficially, it will give a sense of comfort; if it irritate, or cause aching, shivering, or intense coldness of the limb, it must be given up—it presupposes heat in excess.

The use of cold applications to wounds checks fermentative changes in the exuded liquids, as well as the abundance of the exudation, and they have always been preferred by military surgeons, as less likely to create suppuration and pyæmia. (*Es-murch on the Use of Cold in Surgery*, New Syd. Soc. 1861.)

Dr. James Arnott has long advocated the tem-

porary application of intense cold as a preventive of threatened inflammation, as well as a speedy remedy for such external or accessible inflammation as has been already established. Experimenting upon the use of this agent as a local anæsthetic, Dr. Arnott remarked that not only was there no sloughing caused by the application of a frigorific to the skin during some minutes (as had been generally supposed), but that the redness, &c., which usually remains for some days on the site of the freezing differed from the redness of inflammation. (*Contributions to Practical Medicine*, by James Arnott, M.D., Lond. 1864.) "The truth is that although the condition produced by congelation resembles inflammation in the obvious circumstance of the dilatation of the small arteries, and consequent redness of the part, it differs from it in several and much more important particulars. It is never followed by suppuration; it never spreads or extends; and, above all, it prevents and removes inflammations in parts subjected to it. . . . The actual congelation of a part for a few minutes, as of the skin in erysipelas, does more than suspend its vitality. Amongst other organic changes produced by it, the nerves continue more or less benumbed, and the blood-vessels which had been contracted or closed while the congelation lasted are afterwards expanded; the latter effect proceeding probably from the loss of tonicity caused by their previous excessive stimulation. This enlargement of the vessels continues for several days, and constitutes a condition incompatible with inflammation. . . . It (congelation) has been used in almost all the external inflammations, comprising erysipelas and other skin diseases, ophthalmia (applied to the closed eyelid), bruises, sprains, inflammation of the lymphatic glands of the neck and groin; and, when it has been used properly, the immediate arrest of the disease has generally attested its efficacy."

In the *London Medical Gazette* (March 9, 1849), the same writer contributed his experience of the use of congelation in averting and curing erysipelas, and other surgical inflammations. Certain cases are recorded in detail, and the following conclusion drawn. "Of external inflammation congelation is a certain, speedy, safe, and agreeable remedy."

So far respecting cold as a means of controlling local changes, but we have seen that the accumulation of heat in the blood has the most disastrous effects on that fluid, and like many other pathological conditions reacts and aggravates the very evils out of which it arises. As the most obvious antidote, cold has from time to time been used, though from various reasons its use has never become common. Of all medicines few are so grateful as pure ice in lumps crunched in the mouth, to abate the restlessness and sickness of fever. Sponging the surface with water, just below blood heat, or vinegar and water, and combing the hair with a comb dipped in water, are refreshing to most fevered patients, and are useful even in agues and other cases in which greater degrees of cold could not be borne; for cold applications must never be allowed to cause shivering. At the beginning of the present century James Currie used cold water largely (*Medical Reports*, 1805), by way of affusion in typhus and other fevers; it was largely used by military surgeons, and is highly spoken of by Bateman (*On Cutaneous*



*Disease*, 5th ed., Lond. 1819, p. 81). But it is more troublesome than the administration of medicines, and therefore went almost out of use.

Now, however, the question is raised, how shall cases of *hyperpyrexia*, in which the heat passes  $106^{\circ}$  or  $107^{\circ}$ , be treated? (See p. 79.) One remedy which sometimes answers is quinine in large doses, another brandy, but the failure of these, as well as of bleeding, veratrum, digitalis, &c., induced Dr. Wilson Fox finally to combat the morbid heat by cold. (*On the Treatment of Hyperpyrexia, as illustrated in acute articular Rheumatism, by the external application of cold*, Lond. 1871.) A patient, on the fourteenth day of rheumatic fever treated by iron, had a temperature of  $105^{\circ}$ , which slowly rose till it reached  $106.4^{\circ}$ , having risen  $4.4^{\circ}$  in nine hours. She was prostrate, pulse 112, and respiration 44. Six scruple doses of quinine were given at half-hour intervals; but still the thermometer rose to  $107$ ,  $108$ , and  $109.1^{\circ}$ , and the patient was unconscious and seemed dying; pulse imperceptible, face blue, breathing irregular, gasping and stertorous. She was put into a bath at  $96^{\circ}$ . The temperature still rose to  $110$ . Then Dr. Wilson Fox made a vigorous effort to cool the body; he applied lumps of ice to her chest, had an ice-bag tied to her spine, and had iced water poured over the patient whilst the hotter water of the bath was baled out. Within fifteen minutes the temperature had fallen to  $109.1^{\circ}$ ; in five minutes more to  $108.4^{\circ}$  (the temperature of the bath then being  $66^{\circ}$ ). In half an hour the register marked  $106.2^{\circ}$ , the pulse became perceptible, and there were signs of consciousness. The patient was removed from the bath and brandy was given. In an hour the temperature in the rectum was  $100.6^{\circ}$ , and in an hour and a half  $97.4^{\circ}$ . I must not give the details more minutely save to say that, by guarding the patient against too great a fall of temperature, by means of hot bottles to the feet, giving brandy, beef-tea, and eggs freely, and repeating a bath at  $64^{\circ}$  when the heat threatened to rise, or checking it by ice-bags to the spine, the patient was snatched from the jaws of *Erebus*, and in a week was sitting up in bed eating fish.

It must be noted that this treatment is not directed against rheumatic fever, but against that fatal rise of temperature which is liable to come on in rheumatic fever, as well as in scarlet fever, pyæmia, sunstroke, &c. When the rise of temperature, says Dr. Wilson Fox, is rapid, and has already reached a high standard, the cold bath is the most certain and speedy means for its reduction. The patient may be lifted from bed in a sheet, and placed in a tepid bath gradually lowered—the temperature meanwhile being watched by the rectum. In less urgent cases, an ice-bag to the spine, or packing in a cold sheet, enemata of iced water, or simply sponging with cold water may suffice. Be it noted that the first application of cold may be followed by a transient rise of half a degree. No visceral complication, pericardial effusion, &c., need deter, since it is the heat that kills, whether there be complication or not. Perspiration vanishes with the extreme heat, but often returns when the skin is cooled. I have shown that the surest way of checking perspiration is to heat the skin.

In a case of pyrexia arising from a suppurating ovarian cyst, with hot and dry skin, short dry cough,

pulse 120 to 136, and temperature  $102^{\circ}$  to  $104^{\circ}$ , Mr. Spencer Wells reduced the temperature in a few days by assiduously sponging the body with cold water every two hours, and putting an indiarubber cold water cushion under the head, and performed ovariectomy when the temperature had come down to  $100^{\circ}$ . True the removal of a cyst full of stinking pus may reduce a feverish temperature to the normal; but it would seem safer if possible to reduce the fever before operating. (*On Surgical Fever, Med. Times and Gaz.*, Jan. 27, 1872.)

*Ligation of Arteries for Relief of Inflammation.*—During the great civil war in America, 1862, the distinguished Professor of Anatomy in the New Orleans Medical School, devised a method of preventing destructive inflammation of the extremities by tying the main artery of the limb. This has been since practised both in England and on the Continent with considerable success. Used at first by Professor Campbell only in those severe cases of gun-shot wounds in which the successful double ligation, on Guthrie's plan, at the seat of injury was hardly possible, this Hunterian operation was found to exercise so beneficial an effect upon the wound in arresting or greatly diminishing the subsequent inflammation, that it was employed in other severe traumatic inflammations, and with the best results.

After the battle of Seven Pines (May 31, 1862), many of the wounded in the General Hospital at Richmond, Va. (to which institution Dr. Campbell was consulting surgeon), suffered from the most violent and uncontrollable inflammation. Gunshot wounds of both the upper and lower extremities resisted all ordinary measures of treatment. In his *Manual of Military Surgery*, Dr. Campbell tells us: "Suppuration in many cases had ceased, and in its place a bloody water was discharged from the openings and abrasions. The swelling in these cases was immense. . . . Ligation was determined on (in three cases of arterial lesion with secondary hæmorrhage). The extreme swelling and inflammation of the limb, extending even above the knee in all, and in one marked by large patches of incipient gangrene on the foot, presented great embarrassments to the operation at the seat of lesion. It was not the difficulties, however, which caused Mr. Hunter's operation to be preferred in all of these cases to Mr. Guthrie's, notwithstanding the risk of recurrent hæmorrhage. . . . The idea pursued in departing from the rule was no less than the experimental effort to cure the inflammation in the limb by cutting off its arterial supply by ligation of the main trunk which supported the inflammation. The femoral artery was tied in each case near the apex of Scarpa's triangle. The hæmorrhage ceased immediately in all three of the cases, the swelling began to decline within twelve hours, and in three or four days the limbs were reduced to very nearly their natural size, the discharge having changed from bloody water to healthy pus." In one of these cases the supervention of recurrent hæmorrhage, and the consequent great exhaustion of the patient rendered amputation above the knee necessary. In this operation, "only one artery, superficial and of small size, required tying in the stump. The stump healed by first intention—a most unusual result of a secondary amputation. It is not unfair to presume that the previous ligation

favoured this rapid recovery of the stump." Surgeon A. C. Thorn, of the Confederate States Army, forwarded to Dr. Campbell the notes of a similar case under his own care, in which the beneficial effects of Hunterian ligature of the femoral for destructive inflammation were markedly exhibited—"the inflammation relieved as by magic." Dr. Campbell sums up the deductions to be drawn from his experience in the following vigorous sentences: "Lastly, whether the principle be adjudicated as a new one, or simply as the revival of an old one, long lost and unjustly neglected, we derive, as a practical deduction from our cases, corroborated and confirmed by subsequent cases of others herein mentioned, the ever-safe conservative precept, that no hand, wrist, forearm, or elbow; no foot, ankle, leg, or knee, should ever be amputated for excessive destructive inflammation—especially those cases resulting from traumatic causes—without resorting, whenever the state of the patient will admit of it, to a previous experimental ligation of the artery supplying the affected region.

"In extremities already condemned to amputation, if time be allowed, the procedure can certainly do no harm; on the other hand, it will often save a useful limb, or at least contribute to the more rapid healing of the stump."

Acting on the same principle M. Nélaton and Signor Vanzetti have both practised *compression of the main artery of the limb* for inflammation of the extremities, and with singularly favourable results.

Neudorfer, reporting upon surgical cases in the garrison of Prague, is quoted in the *Lancet* for December 7, 1867, as expressing the following strong opinion:—"In the external idiopathic inflammations, and in those which follow operations, we have entirely abandoned the ordinary antiphlogistic treatment, blood-letting, calomel, nitre, &c.; and, as a unique treatment, we have employed only the digital compression. Tried in over 100 cases, we have acquired the conviction that it surpasses in efficacy every other treatment; the heat, the redness, the pain, are removed soon, even in employing only intermittent compression. Thus the digital compression proposed by Prof. Vanzetti is ever acquiring more confidence and credit. We believe that we ought to recommend it very warmly. It serves moreover, in many cases, to diminish very copious purulent secretions."

The same line of treatment has not been overlooked by our own London surgeons. Mr. Maunder, the able and experienced surgeon of the London Hospital, has tied the femoral artery in several instances of severe inflammation of the lower limb, and has spoken favourably of the results. Mr. Maunder's first case was so treated by him without any knowledge of the American experiences we have referred to, and his results were as satisfactory as those of Dr. Campbell. The late Mr. C. H. Moore also compressed the brachial artery for severe traumatic inflammation of the hand, acting on Mr. Maunder's suggestions, and in that case also the remedy had a very striking effect. Nevertheless the measure cannot yet be said to have taken much root amongst English surgeons, and it is probable that when the effect of cutting off the main arterial supply from an inflammation is duly appreciated, the simpler course of digital compression, as recommended by our continental confrères, is more likely to receive

general adoption than the comparatively severe measure of tying a large artery

*Antimony* is second to blood-letting alone in its power of depressing the pulse, and producing perspiration and stool. It is especially indicated in inflammation of the mucous membrane of the lungs, but it may be used in any sthenic inflammation, as of the testicle. Huxham, in 1750, says that a few drops of the Antimonial Wine merely excite perspiration; it is an Attenuant, Alterative, Diaphoretic, and Diuretic; in a larger dose it gently purges, and in a larger still, vomits. (*On Fevers*, Lond., 1750, p. 229.) Thomas Marryatt, in his *Therapeutics* (before 1790), describes what is called the *contrastimulant* method of giving tartarised antimony, that is in doses of at least a grain every three or four hours, spite of any vomiting it may cause. Then, it is believed that if an acute sthenic inflammation or fever exist, the antimony will cease to irritate, and will be "tolerated" just as blood-letting was said to be by Dr. M. Hall. Then it is said that it will spend its force in subduing the sthenic condition, which being accomplished vomiting returns, and the antimony must be given up. Marryatt first describes this method, in which he probably imitated the use of James's Powder; but the term "contrastimulant" was invented by the Italian school. (*Rasori, Teoria della Flogosi; Tommasini, Nuova Dottrina*, Firenze, 1817.) Tartarised antimony may be given in small doses, as gr  $\frac{1}{16}$ — $\frac{1}{4}$ , repeated according to the effect desired, and combined with purgatives, salines, or opiates.

The second class of remedies for inflammation eliminates, as Dr. Todd used to say, or purifies the blood through the excretions, thus getting rid of the *materies morbi* (if there be a *materies*) and discharging poisonous contents from the bowels, or irritating matters which may affect the nervous system. What Dr. Latham (*Lectures on Clin. Med.*, Lond. 1845) describes as Dr. Chambers's practice is of first-rate efficacy in quasi-gouty inflammations of well-fed people. From 5 to 10 grains of calomel are given at bedtime, and a black draught in the morning, and then repeated so long as they bring away "dark-coloured colluvies," and so long as the patient expresses himself as lighter, clearer, and better. But they must not be allowed to cause violent griping or bearing down, nor yet to bring away clear, inodorous mucus, or blood, or pure bile. The practitioner will learn the difference between the saline purgatives, such as the Epsom and Glauber's salts, which act quickly, and bring away much liquid, and are adapted for acute sthenic cases, and the resinous purgatives which act more slowly in moderate doses, and are more fit to bring away dark, bilious, feculent matter in patients with torpid liver and foul breath. Such are aloes, podophyllin, and scammony. Podophyllin in doses of  $\frac{1}{2}$ — $\frac{1}{4}$  grain, with two grains each of compound colocynth extract and henbane, is taking the place of the blue pill, which in Abernethy's hands did such wonders for our fathers.

In the acute inflammation of children, such as acute bronchitis, or threatened hydrocephalus, purgatives are largely trusted to, and especially calomel in half-grain doses, every hour or two, till stools are produced green, like chopped spinach.

Next to purgatives we may suppose that the blood is purified by diluents, salines, and antacids,



amongst which are comprised copious draughts of water, either pure or in the form of toast-water, barley-water, seltzer and soda-water, lemonade, apple-tea, the *gommès, tisanes*, and *thé de tilleul* of the French, and other means of washing out the blood and increasing perspiration and urine. With these are generally combined saline medicines, and especially the nitrate of potass, or the carbonate or bicarbonate of potass, more or less saturated with lemon-juice. Concerning the choice of them, the patient's taste should be consulted, and if the tongue be mawkish he will probably desire acidulous drinks, as lemonade, cream of tartar, or tamarind-water, hot or cold. If the tongue be red, and bowels loose, he will probably prefer something alkaline, as barley-water or seltzer-water. If the urine be very loaded, or if there be a gouty or rheumatic taint, it will be convenient to give the nurse a small bottle of bicarbonate of potass, and some slips of litmus-paper, and desire a small teaspoonful of the potass dissolved in any light drink to be given every four hours till the urine ceases to be acid. The thousands of sick and fevered patients who have felt the benefit of effervescing saline medicines for the relief of vomiting, thirst, dry hot skin, and scanty urine, ought to bless the name of Lazarus Riverius, who, about 1650, taught his brethren to mix a scruple of salt of wormwood (i.e., carbonate of potass) with a tablespoonful of lemon-juice. The *Liquor Ammoniac Acetatis*, or *Spirit of Mindererus* (Raymond Minderer was Physician to the illustrious Fugger family at Augsburg at the beginning of the seventeenth century), and the carbonate of ammonia are medicines of great power in promoting perspiration and expectoration. The nitrate of potass has long enjoyed reputation as a "refrigerant." It is said to hold fibrine in solution, and has been used with equivocal benefit by Dr. Basham and others, as a specific in acute rheumatism. Certain it is that it has a calming effect on the heart, and seems to clean the tongue; and I have always thought that its virtues as a calmant were of the same order, though less in degree than those of the bromide of potass. It gives off oxygen, in contact with carbon, at a red heat, but not in the blood; yet it has a marked effect on the colour of the blood corpuscles.

The third class of remedies for inflammation are such as allay pain and nervous irritation, to the intent, to use Hunterian phraseology, that the system at large may be kept in ignorance of injury to a part. All that we said of soothing remedies as preventives applies to them with double force as curative remedies. They are required to relieve pain and spasm, to divert mental anxiety, to procure sleep; and they have the property, also, of diffusing the circulation, keeping the skin and extremities warm, and promoting perspiration. They make the breathing slower, and the need of oxygen less urgent. They go with any other remedy. Thus, if it be deemed expedient to bleed, a full dose of opium prevents the reaction which may possibly follow the primary depression of the circulation. In idiopathic inflammation it will generally be expedient to purge first of all, but a dose of opium may be combined with the calomel or other purgative which is administered. With nauseating diaphoretics they act in a complementary manner. Perhaps the diaphoretic of

greatest celebrity is the powder of Thomas Dover, M.B. (*Ancient Physician's Legacy*, 5th ed. 1733.) This is now commonly prepared of sulphate of potass, with opium and ipecacuanha; the original must have contained carbonate of potass. Dover used it in gout; he first of all purged freely, and then allayed pain and irritation by full doses of his powder. The practice was well devised, and successful. In inflammations following injuries of the head opiates may be used freely in conjunction with purgatives or depletion. They are necessary to allay hard, dry cough; but the practitioner must be aware that in any chest inflammation attended with copious secretion, as old bronchitis, very small doses take very great effect, and that if the patient be so narcotised as to take away the desire to cough, he may soon die stertorous, and drowned in his own secretions. In pleurisy, following broken rib or blow on the chest, they may be used freely, with or without bleeding. But it is in abdominal inflammations of all sorts that opiates act most beneficially. "Independently," says Sir T. Watson (in a letter dated 1838, in *R. Ferguson*, *op. cit.*, p. 291), "of its controlling power over one of the elements of inflammation, I apprehend that opium is highly beneficial in peritoneal inflammation in another and more mechanical way; namely, by arresting the peristaltic movements of the bowels, and so preventing tension and friction of the parts actually inflamed, which should be kept as absolutely at rest, if possible, as an inflamed joint." Sir T. Watson quotes Bates, of Sudbury, as a little-known writer who early developed this doctrine. In dysentery especially, and in inflammation of the bladder, opiates are requisite to prevent the distress and mischief from frequent straining. In inflammation of joints, and after injuries and operations generally, opiates not only allay pain, but take away the tendency of the patient to shift his posture, as well as the spasms and twitchings dependent on reflex irritation.

The best forms of opium have been already mentioned, as the *Liquor Opii*, and the salts of morphia, as being more likely to agree with delicate persons than the crude opium. Of the dose we can only say generally that it should be sufficient; but treating of general principles, cannot enter into details. In order to economise the dose, the remedy should, if possible, be applied near to the disease. Thus, a lozenge of  $\frac{1}{2}$  gr. of morphia, will allay tickling cough, and an enema of 10 minims of "liquor" will allay irritation of the rectum, or bladder, or womb, better than double the dose through the stomach. The subcutaneous injection of  $\frac{1}{6}$  gr. of acetate of morphia is serviceable in local affections of bones, and joints, and nerves.

The patients who require opium most are the most irritable, exhausted, and intemperate. But this remedy gives the best example of *tolerance*; the more it is needed, the better it is borne. The youngest infants may take it in appropriate doses, if needed, with the utmost safety; and the rule of preventing inflammation by allaying the initial irritation applies to no case more forcibly than to threatened head mischief from teething. When the gum is divided and the bowels opened, it is better to procure sleep by the compound tincture of camphor, or conium, than to allow the child to pass a restless night through that fear of opiates which is taught in books on materia medica. Opium furnishes a means of diagnosis in some cases. If

very severe abdominal pain with constipation is not relieved by opium, internal strangulation may be suspected.

There are other soothing medicines of less power—as hemlock and henbane, extract of belladonna and its alkaloid atropine, aconite, and the like, which are of use as adjuvants, or in special cases, but in the general treatment of inflammation do not approach opium in value. Very often towards the close of a case the surgeon is glad to resort to hydrate of chloral in doses of 20 grains, or to bromide of potass in the same dose, to procure sleep, if by chance opium should fail.

Perhaps there are few soothing remedies more agreeable and beneficial than the application of warmth and moisture, special eulogies of which will be found in Abernethy's and Macartney's before-cited works. Steam may be applied by a local steam-bath; or a bran poultice or fomentation; or warm moisture, with something of a demulcent quality, may be applied by means of linseed or bread poultices; and any of these may be medicated with narcotics, of which the extract of poppies, in the proportion of a drachm to a pint of boiling water, is at once the most convenient and powerful. Laudanum, or the extracts of conium, belladonna, or aconite, may be added instead. The cases in which heat and moisture are indicated are painful inflammations with spasm, as croup, dysentery, &c., peritonitis and pleurisy, local inflammations from general blood-poisoning, phlegmonous, and other swellings tending rapidly to suppuration.

The fourth class of remedies for inflammation are such as support the strength. Now, it must be considered that, as Todd said, in inflammation as well as in health, waste and disintegration must be balanced by nutrition; and that, although a great deal of waste is inevitable, and it may be difficult to administer much nutriment, yet as much should be given as can be without mischief, in order to avoid the risk of prolonged convalescence or even of fatal exhaustion. Moreover, many inflammations (see section on CAUSES), especially pleurisies in young over-grown persons, have their root in a long course of exhaustion, and require abundant nourishment from the first. Everything in inflammation betokens expenditure of vital force, but this is a very different thing from that increase of force which Hunter taught, and which was the justification of remorseless blood-letting. Weber has proved that animals in whom fever and inflammation exist, waste faster, even though fed, than unfevered animals do if deprived of food. (*Henocque, Arch. de Physiologie, Paris 1868.*) During the first day or two of an inflammation—idiopathic or traumatic—in a young robust subject who has been indulging in meat and beer, and has foul tongue and loaded bowels, low diet with diluents will suffice. In others a middle diet from the first, of broth, vegetables, milky rice puddings, and the like; whilst, again, there are other cases which from the first, and most cases at their close, demand brandy and good soup to keep the heart going. "In every wound," says John Bell, "there comes a period of weakness, in which we repent of every bleeding we may have made, even when it was really needed." (*On Wounds, 2nd ed. 1800, vol. i. p. 238.*)

All men of sense are more or less eclectic and

empirical in practice; eclectic, because in so complex a matter as human disease, two theories of inflammation—such, we will say, as the humoral and the neural—may each be true and compatible with the other; and empiric, because, as John Hunter said, "the practice of medicine must be reduced to experiment," and no one can tell the effect of any given treatment without trying it. Thus we advise the student not to think of a depletory treatment and a supporting treatment as two things absurdly incompatible, but as being in reality complementary and adjuvant to each other. Blood may be taken from the arm to relieve an oppressed heart, brain, or lung, and any suffering organ may be drained by leeches to its infinite relief, and yet beef-tea and brandy may be given to replace old blood by new, to diffuse the circulation, and give comfort, hope, and tone to mind and body. The pet argument of the Erasistratean sect may be turned against themselves. If one says loss of food depletes as much as loss of blood, which is incontestable, then, *e converso*, bleeding without loss of food is no worse than loss of food without bleeding. Nay, bleeding may give at once, and without distress, the relief which abstinence, purgatives, and the like, take hours to give; and in surgery, time is often life.

We have already stigmatised the favourite medical syllogism, A is B, and C is B, therefore C is A. (See p. 44.) There is another to match it: A is B, C is not A, therefore C is not B. Under this delusion, some practitioners of twenty years since, instead of combining the benefits of depletion with those of rational nutrition, chose to consider the two practices incompatible, and set up an alcoholic treatment, as liable to be misused as the Sangrado practice which it took the place of. Todd, a genial and accomplished physician, who died too soon for his own reputation and the advancement of therapeutics, did the world the service of putting food into its proper place as a remedy, and of vindicating the use of brandy; but yet was led by his enthusiasm to spread doctrines, sure to be abused by imitators who have more than his zeal and none of his discretion. When Todd said of one case, "It is far more dangerous to life to diminish or withdraw alcohol than to give too much," such a dictum, taken *per se*, reminds us of the extravagances uttered about bleeding by Abernethy, Armstrong, Marshall Hall, Craigie, and Mackintosh. This, however, need not obscure Todd's great merit in using brandy both as food and comforter. I say as food, because practice shows that it acts as food in supporting the strength: and as a comforter, because, as I have shown elsewhere (*Report on Cheap Wines, Lond. 1866*), the one property common to all stimulants is, that they give a sense of comfort and quietness. There are cases in which it may be expedient to withhold it; but if the pulse be very rapid, the skin pungently hot, the patient restless, the mind anxious; if much blood have been lost; if the patient be of an anæmic, exhausted, debilitated, or intemperate habit; if great power be likely required for the reparation of injury or disease; if the inflammation arise from the exhausting causes mentioned at p. 36, or be a consequence of septic contamination, then brandy or wine may be used freely. When brandy is requisite, then the essence of beef also cannot be amiss. We may see young, innocent children in scarlatina, greedily



drinking cold brandy-and-water for the relief of thirst, heat, and misery; is it to be believed that they would not turn from it with disgust if it increased headache, or did other harm? One of the most popular American "soothing syrups" for infants is nothing but spirits-and-water sweetened. Nor must we forget what a share "cordials" had in the treatment of inflammation by our wise ancestors. Under this term were included many heterogeneous things intended to refresh a patient, as saline draughts, fruit syrups, &c. (*Willis, Pharm. Rat.*); but no one can inspect an old Pharmacopœia without being struck by the number of distilled "waters," that is, spirits flavoured with aromatics, as the *Aqua Alexiterii*, *Aq. Epidemica*, *Cinnamomi*, &c.; and in the works of Sydenham, Willis, Gideon Harvey, and Daniel Turner will be found examples of pearl juleps, that is, compounds of spirits and syrup with powdered pearl or chalk to "refresh the spirits" in fevers and inflammations, with remarks on their abuse. Nor must the universal admixture of sweet spirits of nitre to fever draughts be forgotten. It was added to allay restlessness and promote perspiration. In the case of young persons just "turning the corner" out of a pleurisy or bronchitis or effects of injury, good Bordeaux wine may be given with great benefit, but Rhine wine, Hungarian and sherry all have their place.

We have already called attention to the curious circumstance, that at the Royal Infirmary of Edinburgh, during the bleeding time, 1830-50, the consumption of port wine and Scotch ale was eight times as much as now, in proportion to the number of patients. Just as the lancet fell into disuse at the beginning, so did stimulants at the close of treatment.

Of chronic inflammations, many are the expressions of starvation, and disappear as soon as the proper food is supplied. (See p. 36.) Some ophthalmias, ozænas, sore throats, enlarged glands, husky coughs, boils, eczema, acne, &c., yield to a better diet and wine. But of all the remedies of a nutritive sort, the cod-liver oil is the most successful in cases of strumous and low inflammations, and this whether the patient be fat or lean. When life hangs upon a thread, the raw juice of beef, thickened with raw meat scraped or pounded, is the most potent restorative, if the patient can take it.

Tonics, such as decoction of bark or quinine, with mineral acid or with ammonia, are of service in the later stages of acute, and in all stages of chronic asthenic inflammations. The muriated tincture of iron, in doses of a drachm in water, frequently repeated, has been proposed by Bell and Campbell de Morgan in erysipelas, diphtheria and other cachectic inflammations. (See Art. Erysipelas, also *Druitt on the Use of Iron in the Cattle Plague*, Lond. 1866.) It seems to be a routine remedy in vogue with many practitioners in rheumatic and scarlet fever, and most acute diseases.

The fifth class of remedies comprises a list of substances which act upon inflammation, or some kinds of it, in a way which we find it difficult to explain on general principles, and, for convenience sake, they are called *specifics* or *special stimulants*.

a. *Mercury*.—This, the most important of the class, was extensively used by the Arabians and their early successors as an ointment in skin dis-

ease. Thence it was employed in the treatment of syphilis. "By use hereof," says Willis, "wheals and pushes, and all malignant ulcers, viz., venereal and scorbutick, are wont to be tamed." (*Pharm. Rat.* p. ii.) In the seventeenth century it was used sometimes in this way for eruptions; sometimes it was rubbed in to procure salivation for syphilis; sometimes in the form of calomel, or *mercurius dulcis*, as a purge in general, or to hasten salivation. Harsher preparations, as the turbith and red precipitate, were sometimes given internally, even by Sydenham. Willis praises the preparations of mercury as vomits and purges, and as causing so many "fluxes, dissolutions, precipitations, and separations of the serum . . . which is the reason that in old distempers, which are not easily cured, people have recourse to this medicin as their last refuge." (*Op. cit.*) In treating of mechanical theories of inflammation (p. 58) we showed how Belloste praised it at the end of the seventeenth century for the cure of chronic inflammation and obstructions of the glands, and what Astruc thought of its *modus operandi* in syphilis. During the earlier three-quarters of the eighteenth century we chiefly find it used as a purge in cachectic diseases, for which purpose calomel was given in the huge doses of 15-20 grains every other night. Daniel Turner praised cinnabar as a deobstruent, and said that calomel was the most efficient purge for pituitous humours. In 1747, Plummer's pill came into vogue. But in the year 1764 Dr. Robert Hamilton, of Lyme Regis (*Medical Commentaries*, 1785, vol. ix. p. 195) met with a "worthy surgeon of the navy," who told him that in India the established remedy for hepatitis was first a small bleeding, then mercury rubbed in, or calomel, so as to produce gentle salivation. It occurred to Dr. Hamilton that the coast of Coromandel and the coast of Norfolk agreed in being infested with remittent and intermittent fevers, with occasional hepatitis; he consequently tried calomel in hepatitis, combined with opium to ease the pain, and was satisfied with the result. Then it occurred to him that mercury is useful in ophthalmia; that it abates inflammation when applied in the form of ointment to the sores made in inoculation of smallpox; that it cured syphilis; and that probably, inasmuch as all inflammations must have certain conditions in common, so perhaps mercury was a remedy for the phlogistic diathesis generally, whatever the local effects might be. The new remedy was first tried in pneumonia with astonishing success. It was next tried in the pneumonia complicating measles and small pox, in "obstinate, dry catarrhus coughs," in pleurisies, "phrenitis and parapneumonia"; in inflammation of the intestines, inflammatory childbed fever, inflammatory angina, acute rheumatism, inflammatory gout, and in inflammations of the three visceral cavities caused by injury. The treatment began with blood-letting and a mild aperient, after which from "five to one grain of calomel, and from one to one-fourth of a grain of opium," was given every six, eight, or twelve hours, with plenty of diluents. If high inflammation continued the bleeding was repeated, and the calomel and opium given more often till the disease yielded or slight pyalism ensued. If the fever were violent and the skin hot, a little tartar emetic and camphor was added. Dr. Hamilton "always thought the opium of the most es-

essential service by relieving that most troublesome symptom, pain; but he had often used tartar emetic, opium, camphor, and salines without benefit till the calomel was added. "We generally look upon it as a happy presage of the patient's recovery when the salivary glands become affected by this noble medicine." Dr. Hamilton gave bark and wine freely, when the malady began to decline, especially in acute rheumatism. He refers to the *Medical Museum*, 1764, to observations of Dr. Lind in his *Diseases of Hot Climates*, and Dr. John Clark, of Newcastle. (See *Sir J. M'Grigor's Med. Sketches*, Lond. 1804, p. 174.)

Thus was "inaugurated" the treatment by calomel and opium which, as R. Ferguson remarks, was peculiar to modern English practitioners. Cullen and Hunter, Benjamin Bell, and John Burns, knew it not. Vitet (*Médecine expectante*, vol. i. p. 365, 1803) forbids mercurial inunction in enteritis. It was, however, praised by Elliotson in his *Inaugural Thesis De Infl. Com.* at Edinburgh in 1810. It meets with the warmest approbation from Armstrong. It was promoted by Abernethy, Cooper, Travers, Lawrence, and the other great successors of Hunter. It was considered by the elder Dr. Farre as "positively antiphlegmonous," but most decidedly opposed to those forms of inflammation characterised by strong adhesion and firm fibrine, whilst it tended to render inflammation loose, diffused, and spreading. He believed it useful in iritis, common and syphilitic, but that it stopped the effusion of lymph necessary for healing iritis after a wound. In the strictly inflammatory forms of puerperal fever (not in the ataxic or adynamic) and in inflammations generally, when the lancet cannot be used, it "equalised the circulation." (R. Ferguson, *op. cit.*) It continued the regular practice so long as bleeding enjoyed the vogue. Todd, in 1843 (*On gout, &c.*, p. 198), orthodoxically recommends the system to be brought as soon as possible under the influence of calomel and opium in pericarditis after leeches and blisters; "first" he says, "to check the effusion of lymph; and, secondly, to promote absorption of that which is already poured out." In acute rheumatism he, like Dr. Macleod, gave opium without calomel, because they believed that the calomel did no good. Latham and Watson praised it in pericarditis. In 1859, Todd tells a different tale. He says that the "vaunted powers of mercury" in causing absorption of lymph, are based upon false analogy and clinical ignorance. From the time when bleeding fell, "calomel and opium" have shared the same fate; and with scant justice; because although the analogy of the cure of syphilitic iritis with that of pleurisy may be false, although salivation is an unmixed evil and no safeguard—for I have known pleuropneumonia begin in a patient whose gums were sore—yet in the proper sthenic cases, the addition of calomel to the opium, which should be given if there be pain, will cause the liver and bowels to drain off much animal sewage, and help in the antiphlogistic work.

We may repeat that mercury may be employed in one of two ways, either to produce elimination by the liver and bowels, or to accumulate in the system till salivation or some approach to it show that no more can be borne. Used in the former way, after Abernethy's fashion, in the dose of 5 grains of blue pill at bedtime, with a dose of senna and gentian in the morning; or in the dose of a

quarter grain of calomel, or a grain or two of grey powder at bedtime, there is no doubt that it cleans the tongue, empties the bowels, brings down a healthy, yellow secretion, makes the urine clear, and so may get rid of a host of chronic, strumous, and other ill-conditioned local inflammations. In using it thus, care must be taken not to allow salivation, not to allow the bowels to be worried or to discharge inodorous mucus, and we should give a plain, nutritious diet, with some tonic. If it be desired in a chronic inflammation to use mercury to act upon the system at large, the best preparation is the corrosive sublimate, which does the work in the smallest dose. Chronic, strumous, and cachetic inflammations, opacities of the cornea, and the like, may be treated with  $\frac{1}{16}$  of a grain, thrice daily at meals, in a pill; and some efficient tonic should be given at the same time. Sir A. Cooper's compound of one grain of corrosive sublimate to an ounce of tincture of bark is a first-rate thing for strumous children; a solution of it in tincture of chloride of steel is equally good for chronic inflammation of the womb; it goes, also, well with cod-liver oil, and with sarsaparilla. When we say that it produces no sensible evacuation, we must not forget that it often causes a great flow of urine, and keeps the bowels regular.

Similar purposes are answered by the pill of Dr. Andrew Plummer, composed of calomel, golden sulphuret of antimony, and guaiacum. (*Med. Essays and Obs. by a Soc. in Edinburgh*, vol. i., 1747.) Donovan's Solution of mercury, iodine, and arsenic is a potent alterative.

b. Next to mercury we must treat of those lordly remedies, bark and quinine. In every inflammation where there is a suspicion of a malarious cause, in any visceral inflammation in the course of remittent or intermittent fever; in diseases arising from cold and damp, amongst which may be reckoned rheumatic fever, bronchitis, pneumonia, influenza; in diseases showing an intermittent tendency; in diseases arising from blood-poisoning, or attended with, or preceded by, a train of conditions exhausting the body and mind; in any acute inflammation where ordinary remedies do no good, and especially if the heat rise immoderately, quinine should be tried. In the unmistakably malarious series, it should be given boldly in ten grain doses, till the ears ring; to patients rather exhausted than poisoned it may be given in smaller doses. It goes along with any other remedy of any sort. In the malarious cases it of itself suppresses the disease; in the others it assists in the cure. It helps to promote ease and sleep, abates fever, and opens the liver and bowels. The substitution of quinine for calomel and bleeding in the remittents and dysenteries of the East is due to the Army Surgeons, amongst whom I must mention my friend, Inspector-General Edward Hare (*On Fever, &c.*, Delhi, 1847. *Med. Times and Gaz.* vol. ii. 1864) and Surgeon-Major Fleming. (See also *Therapeutics*, by Dr. Waring, an able Indian practitioner, Lond. 1865.)

c. Iodide of Potassium ranks as a specific in some syphilitic diseases of the bones and periosteum, and ulcerations of mucous membranes, and in neuralgic, rheumatic, strumous, and other non-syphilitic diseases of similar character. The desiderata in practice are remedies that shall cause morbid cell growths to waste;—as those of scrofula, syphilis, cancer, fibroplastic myeloid and



enchondromatous tumours of the bones, fasciæ and connective tissue, and in many cases the iodide does this. When the system is saturated with the iodide, there is lachrymation, frontal headache, coryza, and sometimes very severe irritation of the fauces and larynx. The bromide of potass, the chlorate, the bromide, iodide, and chloride of ammonium, the nitrate of potass, and the liquor potassæ, are remedies that rank together; and the iodide of potass and chloride of ammonium often go well together, especially with a bitter tonic. It must not be forgotten that large doses of iodide may be most pernicious in some cases of ulceration.

*d. Colchicum* is the remedy, *par excellence*, for the gout and affections allied therewith. The *modus operandi* is quite unknown. In large doses it produces bilious vomiting and purging, but in smaller doses it allays the pain of gout, and postpones or suppresses an attack, "without sensible evacuation." The surgeon in town practice finds it of enormous value in subacute and chronic inflammations of the urinary organs and testicles. It is supposed to suspend that action of the nerves which causes local inflammation to be set up, when the blood is loaded with the material of gout. The *white* and *green hellebore* are by some thought to have similar powers. If so they would be most valuable.

*e. Arsenic* is well known as a specific in chronic inflammations of the skin, and in chronic diseases subsequent to intermittent fevers. The solution of arsenious acid in hydrochloric acid was largely used fifty years ago by Dr. De Valingen of Bishopsgate Street, for strumous and other atonic diseases.

*f. Ipecacuanha* in full doses is supposed to have special power over acute dysentery, and in smaller ones over inflammation of the pulmonary mucous membrane.

*g. Oil of Turpentine* was largely brought into use by the eulogies of Dr. Copland. (*Dict. art. Inflammation*; also R. Ferguson, *op. cit.*) He recommends it in every form of inflammation; in the sthenic after depletion, in the asthenic at once. It may be used in draught, or enemata, or as an external application sprinkled upon hot flannel. The first author of this practice seems to have been Dr. Brennan, of Dublin (*On Puerperal Fever*, 1814), and in puerperal fever, administered internally and externally, it seems to relieve peritoneal and internal inflammation. At any rate it reduces tympanitis, and so gives relief to patient's breathing. Hence it is relied upon in many of the local inflammations and congestions of the last stage of fever, and in atonic pneumonia, bronchitis and pleurisy coming on in the course of erysipelas or pyæmia. In iritis it was particularly recommended by Carmichael, of Dublin. The general indications for its employment are a rheumatic or an adynamic state, copious effusion, septic or diffuse inflammation, blood-poisoning, and tympanitis; and it may be given so as to act as a speedy purgative, in the dose of half an ounce, once daily; or as a slighter purgative and diuretic in doses of a drachm twice daily; or as a stimulant and diuretic in doses of ten minims every hour or two. I have it made into pills, each containing five minims, with tragacanth powder. It may in any case be copiously used as an epithem. We may mention, by the way, that John Hunter thought highly of it as a styptic, in hæmorrhage from the

lungs, kidneys, and womb. (*Lectures*, Palmer's ed. vol. i. p. 483.)

*h. Special Stimulants.*—There are many other drugs which seem to have a predilection for special organs, and to be eliminated thereby; and whilst in health they may cause irritation, they may remove chronic inflammation. Thus the action of small doses of *turpentine* in hæmaturia; of *copaiba* and *cubebæ*, in inflammation of the mucous membrane of the urinary and pulmonary canals; of *savin*, *cantharides*, and *pennyroyal* in certain chronic inflammations of the womb; of *pepper*, in inflammation of the rectum; of *peppermint*, *anise*, and *ether*, in certain affections of the throat and lungs, is well known. Practitioners, in their anxiety for correct general principles, should not lose sight of the benefit obtainable from specific remedies, whose number we desire to see greatly multiplied.

But here we must pause for a moment to warn the student against an egregious error into which he may fall if he lose sight of the real meaning of words, and of the danger of substituting metaphorical and abstract expressions for real existences. We have had abundant illustrations of this (p. 56), where we have dealt with personifications of the Vital Force, Nature, Vis Medicatrix, and the like. But the most grievous and most mischievous remains—that of Homœopathy—which rests on a principle enounced by John Hunter, inflated by Hahnemann into the well-known system which he made public in 1796, and adopted even by the rational Trousseau, under the name doctrine of "substitution."

It is worth while to devote a few words to the radical investigation of this matter, in order that the practitioner may be fortified against a specious delusion. Homœopathy, like other systems, stands on two legs. One is the theoretical, according to which it is inevitably true, because deduced from infallible *à priori* premises. The other is the practical, according to which the attempt is made to show that effects are produced in accordance with the theory. We leave this latter, because anyone who chooses may satisfy himself whether inert drugs, as flint, blacklead, and chalk, do exert medicinal effect in infinitesimal doses. But we must say a few words on the theory, because it forms a part of the history of the treatment of inflammation, and if correctly understood it would cease to fascinate and delude.

Hunter, in treating of local remedies to inflamed parts (*On Adhesive Infl.* § 2, *op. cit.* vol. iii. p. 385), divides them into two classes, one of which produces a "simple cure," the other producing an "irritation of another kind in the part." Of the latter he says:—"The mode of cure by an irritation different from the disease appears to increase the disease; but by destroying the first mode of action, it produces another disease, viz., one according to the mode of irritation of the application, and which more easily admits of a cure than the first. I believe, however, that this takes place most readily in specific diseases, and not so readily in common inflammation, for a common inflammation would most probably be increased by it." He proceeds to say that some inflammations yield to this treatment, though not all, and gives as instances the cure of inflammation of the skin by solution of corrosive sublimate, and of inflammation of the eyelids by the citrine ointment.

In a parallel passage in his *Lectures (op. cit. vol. i. p. 478)* he says of local remedies, that unless they "act chemically, as caustics," they "affect the living principle by their stimulant or sedative qualities only." Sedatives diminish "action;" stimulants excite "natural actions." Irritants "excite new and unnatural actions." "Actions may be first of healthy parts; secondly, action produced by stimuli or irritants on healthy parts; thirdly, action of diseased parts; fourthly, action of stimuli and irritants on a diseased part. Irritants may produce very different effects on a healthy part, or whilst disease already exists: thus mercury will produce diseased action in a healthy part; but from the application of mercury to a part already affected with diseased action, an action results different to what would be produced by the application of it to a healthy part; for from the conjoined action of the two results the action of health."

Trousseau's doctrine of "substitution" is the same. He relates how practitioners, observing the resemblance of inflamed mucous membrane to a suppurating wound, applied to the former the caustics they were wont to apply to the latter. "It was soon perceived that the primary effects of these different agents was analogous to that produced by inflammation, and it was easy to understand that inflammation artificially induced in tissues already the seat of inflammation led to a cure of the original inflammatory attack. When this view was once acquired, there flowed from it the great therapeutic principle of *substitution*, which at present reigns supreme in medical practice." (*Clinical Med. Trans. by New Syd. Soc. vol. ii. p. 19.*)

The leading error in these theories is, that they take metaphysical instead of material views of the animal body, and of the substances that act upon it. In Hunter's time, as we have already said, there was a metaphysical verbiage of "action," "dispositions," "sympathies," &c., &c., to express changes which we now treat of as depending on chemical change, or on cell growth, or on the action of nerves on the diameter of blood-vessels, or on the appetite of the tissues for blood plasma. Now the "actions" of Hunter and the "inflammations" of Trousseau are merely names for our conceptions of certain physical changes in the animal body. But the progress of science demands that these changes be treated of as physical, not as metaphysical. When Chicago was burning, they blew up houses in order to get rid of that which would have been fuel for the advancing flames. To describe this, as the substitution of an explosion for a conflagration, may pass as a figure of speech, but it is not a true account of matter of fact. So, when a practitioner swabs a relaxed throat, it is mere laziness to be content with the notion that he substitutes a caustic inflammation for a catarrhal one. The man who is content with this may be content to prescribe hypothetical globules for conditions that exist in his own imagination; but the man of sense will seek to know first the fact—does the application of a new cause of inflammation relieve an inflammation already existing? and he will find it not to be generally true. Then, does a caustic swab relieve a relaxed sore throat, and, if so, how?—and he will find plenty of answers derived from the realm of sense and fact. It curdles, kills, and

sweeps off a host of epithelial cells, living lazily on the relaxed membrane, and multiplying themselves like paupers to the public detriment. It thus makes way for a healthier brood. It produces an impression on the nerves, deadens extreme irritability, flushes out the blood-vessels, drains them of serum, and braces up muscular fibres. Here, surely, are the elements of rational therapeutics; we need not stoop to metaphysical explanations, which only smell of the lamp or the tobacco-pipe.

Having thus cautioned the student against the too literal reading of some passages of these great medical practitioners, and having spoken of special stimulants adapted to atonic local inflammations, we may shortly discuss those which are applied by the hands of the surgeon, instead of being sent the round of the circulation to be attracted by the suffering organ.

The agents we are going to describe are applied to inflamed surfaces or open sores. The *nitrate of silver*, applied in strong solution or substance, acts as we have above described, and is useful in very irritable ulcers, as of the cornea, by deadening the surface; in relaxed sore throats, and chronic suppurations of mucous membranes, in incipient whitlow, irritable spreading inflammation from poisoned wound, and other cases where it is expedient to destroy a surface, and thus deaden sensibility.

The *carbolic acid* and *creosote* act in like guise on irritable ulcers and mucous surfaces. We may specify the nerve exposed in teeth by caries, as an example of an inflamed surface thus treated with unfailing success.

The *salts of lead*, especially the acetate, are famed for their soothing virtues, which seem explicable on the same principle. (*On Effects of Lead*, by Goulard, Surgeon of Montpellier, Lond. 1775.)

The salts of zinc, copper, alum, iron, alumina, and vegetable astringents used as local stimulants, seem to act in the same way. The trisnitrate of bismuth in fine powder is extremely soothing to irritated and denuded surfaces of skin and mucous membrane.

The blistering plaster of cantharides, applied so as to vesicate, is sometimes used to get rid of lingering erysipelas.

The sixth class of remedies comprises counter-irritants, revulsives or derivatives, and neurotics, and they are of two orders. Some are used as means of producing a local disease, in order to relieve a general state of constitutional disorder. Others are used to produce one local disturbance, in order to relieve another.

The former order were suggested by observed facts such as these. A woman, long suffering from bronchitis, loses it when she gets an ovarian tumour. A man has long been labouring under dyspepsia, disturbance of the heart, headaches, or urinary irritation. Then comes a fit of the gout, and his general uneasiness vanishes. Another has an itching patch of psoriasis on the small of the leg, which he gets rid of by citrine ointment. Bad health follows, ending with a fit of gout. It is assumed that the local disease in these cases relieves the constitution, and a ready explanation is offered from the pathology of the day, whatever that may be. A vent is formed for the "humours," or one "action" supersedes another, or a "materies morbi" is oxidised and discharged, or aberrant



nervous force is diverted and expended harmlessly. So in cases of general disorder it was formerly considered philosophical to establish a *fontanel* or *issue*, from which the peccant elements might be discharged. Gil Blas tells us that Dame Jacintha had an issue in her arm to preserve her complexion ; and this mode of treatment was employed in the case of eczema or other eruptions on the head and face, epilepsy, threatened apoplexy, fear of cancer and the like, and in cases in which old ulcers or bleeding piles were got rid of. The usual plan was to form a suppurating wound on the outside of the upper arm, by means of a seton, or by destroying a little patch of skin, and hindering the healing process by putting peas into the wound. Issue plaisters were common articles of sale fifty years ago. This plan of treatment was entirely in accordance with "pathology," but has fallen into disuse. Practitioners now strive to attain the desired objects by altering the diet, increasing the excretions, and prescribing air, exercise, and other agents to improve the general health. (See Art. ISSUES, SETONS, &c.)

The second order of counter-irritants is based on the fact that irritation of one part will divert the blood-stream from another, and alter the degree or kind of nervous influence. They comprise a vast number of substances of different degrees of force. Some called *rubefacients*, produce mere redness and smarting of the skin, followed, perhaps, by desquamation of the cuticle ; such are mustard (of which the most handy preparation is the mustard leaves of Rigollot), turpentine (see p. [70]), iodine paint, liniments of ammonia of moderate strength, and very hot water, applied by steaming bran poultices. These are used with the greatest possible advantage at the early stage of any internal sthenic inflammation, before the blood has become very hot ; and at any stage of bronchitis, pleurisy, or abdominal inflammation of a *low* type. Some are called *vesicants*, because they force the cutis to exude serum, which raises the cuticle into a bladder ; thus, in addition to diversion of the blood-stream, they evacuate a portion of serum. The best of these is the

*Emplastrum Cantharidis*, allowed to draw at leisure ; but if the case be very urgent, the *acelum cantharidis* may be used instead, though it is much more painful. We need hardly repeat the caution that in the case of young infants, and of persons of any age weakened by fever or otherwise, these blistering materials should be used with the greatest caution, and rather as rubefacients than vesicants. The second caution is, that vesicants shall not be applied too near the seat of disease if acute, lest they add to, instead of taking from the disease. Thus they should not be applied over the larynx or trachea, or over an acutely-inflamed joint. There is another reason why vesicants should not be applied in these situations, namely, that the skin there is very thin, and liable to incessant movement and extension, which render the blistered surface extremely irritable and difficult to heal. The nitrate of silver in solution (5j to the ounce) is sometimes applied to the skin to raise a blister, but the process has been described to me by patients as one of great torture. I never heard any person complain so pathetically of the needless sufferings inflicted by medical treatment, as a poor fellow with hopeless laryngeal phthisis, whose throat had been freely blistered by nitrate of silver by an

eminent authority on phthisis. Preparations of caustic ammonia require to be used with great caution to the throat, or they may destroy the surface of the skin, and produce scars like that of the vaccine vesicle or small-pox, in which a superficial layer is destroyed, and the surface left pale and glistening with the orifices of the sweat-glands exposed.

Still more powerful are the counter-irritants called *suppuratives*, which are generally considered useful for chronic cases, as vesicants are for the acute. Or rather there is a sort of rule according to which that form of counter-irritant should be chosen whose effects must nearly resemble those of the disease which has to be combated. Thus *rubefacients* like mustard are supposed to be suitable to cases in an early stage, marked by nervous irritation and hyperæmia ; *vesicants*, when there is already serous or plastic exudation, and *suppuratives* when a vascular ulcer of the eye or caries of the bone has to be opposed. The mildest form of suppurative is an ointment of savine or cantharides applied to an already blistered surface. A much severer one is the *actual cautery*. To use this a cauterising iron, with a wooden handle and an olive-shaped knob, at a dull red heat, is rapidly drawn, in lines two inches long and an inch apart over a suitable part of the skin near the disease. The object is to produce a series of narrow, shallow eschars, which shall soon slough off and leave healthy, active, suppurating ulcers. It must be noticed that the suitable place is always in a hollow ; where there is a depression between projecting muscles or bones—never over a projecting bone. The reason is clear, viz., that over a prominence the skin is never at rest ; it is on the stretch, and the resulting ulcer is difficult to heal and very painful. The actual cautery used lightly is not so severe as the *potassa fusa* or the less deliquescent *potassa cum calce*. These are made into a paste, and applied to the surface, the surrounding parts being first well protected with plaster spread on leather, with a hole corresponding to the surface in which the potass is desired to act.

It is a good general rule that no sore resulting from a counter-irritant should be allowed to cause severe pain, or to interfere with sleep, or to fall into an indolent condition. A brisk suppuration is the thing to aim at. The *issue* produced by caustic potass may be kept from healing, if need be, by an occasional touch with the potass or by binding peas on its surface. *Setons*, consisting in skeins of silk, caoutchouc, or *drainage tubes*, are suppuratives which have fallen greatly into disuse, but seem likely to be revived in moderation. The *mora* is a Japanese mode of producing an eschar by burning a kind of tinder on the skin.

In fact, of late years, counter-irritation shows a striking exception to the disfavour into which old and painful methods of treatment had fallen. In 1864, Dr. Herbert Davies published a work *On the Treatment of Rheumatic Fever in its acute stage exclusively by free blistering*. In the important clinical experiment which he records, Dr. Davies refused "the aid of alkalis, nitre, lemon juice, bark, opium, colchicum, or, in fact, any of the internal remedies which are and have been considered as specifics in this affection. The treatment has been *absolutely and entirely local*," and the results highly satisfactory. Believing that the lactic acid—

whether it be a wholly abnormal ingredient, or a normal one in excess—is the *materies morbi*, and that it is localised in the affected joints, and that the intensity of the local inflammations is a measure of the quantity of poison collected in the affected parts, he determined to attack the disease where it showed itself, and to attempt the elimination of the *materies morbi*. “I ordered blisters,” he says, “varying in width, but of considerable size, to be applied around each limb and in close proximity to the parts inflamed, and I hoped to relieve the affected joints, partly on the principle of derivation, but *mainly* and really by affording through the serous discharge from the blistered surface a ready means of exit for the animal poison. Armlets, wristlets, thighlets, and leglets, and even fingerlets, were applied near to, but *not upon, every joint inflamed*, at the very height of the inflammatory stage, when the local pains were the most severe and the constitutional disturbance the *greatest*.” “The results in rapid relief of the pains, quick convalescence, and freedom from cardiac disease, were highly satisfactory.” The blisters must be allowed to draw freely, and the serous discharge be encouraged by linseed poultices. Dr. Davies believes that the blisters eliminate acid to such a degree that any administration of alkalis is not only useless but injurious; nay, that it is deceptive, and leads to false security; that the urine becomes neutral or alkaline, and the serum regains its power of holding fibrine in solution, and of taking up any which may have been deposited on the heart’s valves; and that the temperature rapidly falls under the blister treatment. Dr. Davies believes that the relief from rheumatic pain, and the assurance of safety from heart disease, will enable any patient to bear the pain of blisters without a murmur.

But the Coryphæus of Counter-irritants is Mr. Furneaux Jordan, who has embodied his ideas in a work on the *Treatment of Surgical Inflammations by a New Method* (Lond. 1870). Mr. Jordan starts with the assumption “that the inflammatory process is one, in whatever part, and under whatever circumstances, it may appear. Its causes, modes of progress, degrees of activity and results, are many and various, but the process is the same; the phenomena in the main are also the same; and the same also are the changes in the tissue elements as discovered by the microscope. Inflammation, then, being *one* disease, why should we not have *one* treatment? Having discovered the best remedies in some inflammations, why not use them in all? If a slight mustard poultice will cure a slight bronchitis, will not a stronger counter-irritant be the best remedy for a severer bronchitis? More than this, if one inflammation is more quickly than by any other means subdued by counter-irritation, why not try the same remedy in other inflammations? Why not try whether a mustard plaster or other counter-irritant around an abscess or a phagedæna will not with equal superiority control their progress?” Mr. Jordan having argued that it is hopeless to attempt to extinguish inflammation by any single drug or internal remedy, says that there are certain “phenomena which are so regular that they may be said to be conditions essential to its existence,” and that the removal of any *essential* condition must remove the inflammation. Of the principal conditions necessary for the “prosperous beginning and progress of an in-

flammation,” he enumerates these, viz.—First, increased space,—room for swelling, for vascular distention, for the multiplication of tissue germs or development of an exudation. This condition is opposed by *pressure*. “If it were possible to keep any part of the body within its physiological precincts, it could not inflame. If by *pressure* we could in some degree restore an inflamed part to the area of health, the inflammation would be removed to a proportionate degree.” A second “essential condition of inflammation,” he continues, “is increased quantity of blood or ‘ministering’ fluid. No part of the body can be inflamed if the *health-quantity* only of blood be present.” “Local diminution (*general* loss of blood means loss of repairing power) can be effected by pressure and elevation where practicable.” Small local depletions, and pressure upon, or occlusion of the feeding artery, act upon the same principle. Thirdly, the removal of the cause is expedient when possible; but (says Mr. Jordan) the cause may be unknown or irremovable, and then the treatment must be based on other grounds; in many cases the cause “is transitory, and the result alone needs consideration.” Fourthly, movement must be prohibited; and lastly and chiefly, “where inflammation prospers there is no other inflammation present. If a second inflammation—say an abscess—arises, the first shrinks or disappears. There is no inflammation in which this condition may not be removed by establishing another and counter-inflammation. But the counter-inflammation must be strictly a second, and never an aggravation of the first inflammation, as counter-irritation over the thin parietes of the cranium, or thorax, or abdomen, or knee-joint, or subcutaneous abscess may readily be, if deeply-acting irritants are used.” The conclusion from these premises is that counter-irritation in every inflammation, and pressure in every accessible inflammation, with elevation, rest, and removal of cause, are the essential remedies, but that the chiefest of these is counter-irritation. Nay, more, he despises “drugs” (except that he gives iron “in all, or nearly all, inflammatory diseases”), and refers the beneficial action of purgatives to the principle of counter-irritation. But counter-irritation should be effected on a clear and definite system. “*It should be established over the next or another, or an independent vascular trunk or territory.*” For instance, in *intra-cranial* inflammation counter-irritation should be excited over the branches of the *external* carotid. The agents employed may be superficial or deep. Of the superficial, Mr. Jordan generally uses iodine paint or liniment, which is convenient from the circumstance that it can be made of any strength desired; the solution of nitrate of silver (2 drachms to the ounce, with 3 or 4 drops of strong nitric acid), and the *acelum lyllæ* made with glacial acid. Pressure is especially adapted to the chronic and the later stages of inflammation. Shot mattresses are convenient modes of applying it. Acting on the foregoing data, Mr. Jordan has constructed a kind of anatomical system for the definite use of counter-irritants in inflammation of various organs. Take the case first of abscess and bubo. A circular zone (or a horseshoe if more convenient) is to be painted with one of the liquid counter-irritants around the focus of inflammation—not upon it, but upon the sound skin. The zone must be broader or narrower according to the strength of the application; and it



is easy, after having applied cantharides to a first narrow zone, to use the iodine a few hours later for a larger zone outside. An important detail of Mr. Jordan's practice is this: "If an abscess be situated in the vicinity of a large artery (as in the limbs or neck), which large artery is a more or less independent, or 'next' artery, a stripe of counter-irritation may with advantage be established over it. In an abscess (or carbuncle, or boil, or erysipelas) in the axilla, or in the thorax near the axilla, a stripe of counter-irritation—narrow of acetum lyttæ, broader of iodine—may be carried along the brachial artery to the elbow. In abscess about the elbow, stripes of counter-irritation may be established over the radial and ulnar arteries. In abscess of the groin (bubo, strumous glands, &c.), a stripe of skin may be inflamed over the femoral artery. These stripes should be made in addition to the zones or circles, which may in consequence be made a little narrower. In abscesses of the hand or fingers, all the uninfamed part of the hand, and the whole of the fore-arm (a half or two-thirds in small abscesses), should be covered with iodine. At the same time, a linseed poultice, heavy and hot, should be applied to the abscess, and over it should be placed a bandage or a shot mattress, which of the two convenience and locality may determine. In either case, the object is to secure pressure, which should be moderately firm, but which also should never give rise to pain. Real trouble should be taken to elevate the part by light wood apparatus, or pillows, or both. . . . *With this treatment, as a general rule, it is not necessary to open abscesses.* No advantage is gained by opening them. The ill results which in the ordinary treatment of abscesses are avoided by the knife, are best avoided by a circumscribing belt of counter-irritation, assisted by the other remedies referred to. *A zone of cutaneous inflammation immediately removes the inflammation, and thereby immediately removes the pain, the pressure on adjacent parts, the tendency to either extension or diffusion, and the danger of opening into important cavities.* In a large proportion it is possible to obtain the absorption of pus. In others, spontaneous opening quickly and readily occurs. . . . The effect of counter-irritation on abscesses is very striking. It takes away the diffused swelling and hardness around the abscess, and leaves the pus in a circumscribed isolated cavity, which projects from the surface with all the distinctness and prominence of a tumour." This treatment ensures a greatly diminished formation of pus. "When efficient counter-irritation is used all the inflamed tissue which is not already pus is reclaimed from the suppurative process. Under such circumstances, when an abscess opens, or is opened, scarcely any or no discharge follows the first escape." Mr. Jordan does not altogether disclaim incisions, especially "where abscesses are under dense and tense tissue," when, "if counter-irritation does not relieve pain and swelling in a few hours, by all means let them be resorted to." But he seems not to believe that incisions cure by unloading the vessels, relieving tension, and affording an exit to discharge, but that they too, when they do good, act as counter-irritants. He affirms that the counter-irritation of incisions is tardy in its effects, that an incision does not inflame so quickly as cantharides or iodine, and that many an abscess has been cured by the counter-irritant effect of an

incision, which never reached its cavity nor gave exit to a drop of pus. Destructive and rapid ulceration, phagedæna, syphilitic sores, and hospital gangrene, are asserted to depend on intense inflammation, and to be cured by an artificial circle of counter-inflammation; and it is said that the nitric-acid treatment, when it does good, is really a counter-irritant to the mass of the sore. Erysipelas, simple and phlegmonous, is cited as a disease in which nitrate of silver, applied as a belt around, is known to check the disease—of course, by counter-irritation. "At whatever stage," continues Mr. Jordan, "a carbuncle presents itself the one great remedy is a zone of counter-irritation. A circle of iodine liniment or strong iodine paint, several times repeated, will greatly relieve all the symptoms in twenty-four hours." Boils are similarly treated according to their size. Whitlow receives the same treatment, which (says Mr. Jordan) renders incisions "often unnecessary," except in the thecal variety; "but where subsidence of pain and swelling are not immediate, an incision must be made without delay." In a bad case of whitlow, Mr. Jordan covers the entire hand and fore-arm to the elbow with iodine. New suppurative inflammations of bones, periosteum, nodes, synovitis, and inflamed bursæ, are blistered by most surgeons, so on that point we need not quote Mr. Jordan. In the graver chronic bone and joint-destroying affections classified as osteitis, and particularly that degenerative osteitis which is the chief element in joint disease, which leads to abscess and caries, Mr. Jordan unhesitatingly employs counter-irritation in its severest form, the actual cautery.

"The actual cautery," he says, "is now employed by many surgeons, but in far too limited a manner, and too near the joints. . . . For the shoulder, a stripe of eschar half an inch wide should commence high in the axilla and be carried six or eight inches along the axillary and brachial artery; two others should be made, one along the anterior, the other along the posterior, aspect of the joint, in such manner that the three stripes are equally distant from each other. If the knee is affected, four stripes of eschar should be made along the front, back, and sides of the joint. These should be ten or twelve inches long, and also equally distant from each other. . . . The spaces between may be covered with iodine liniment."

In disease of the hip-joint, "a broad stripe of eschar is made over the femoral artery, from the groin to the lower third of the thigh, and another posteriorly from near the crest of the ilium to the middle of the thigh." "Caries of vertebræ, whether with or without angular curvature, at whatever age, and in whatever locality at any stage," says Mr. Jordan, "should be treated by the actual cautery. The disease is deep, protracted and formidable. The counter-irritation should be deep and protracted, formidable it happily is not with the beneficent aid of chloroform. Two stripes of eschar, an inch wide and twelve inches long, one on each side of the disease, would not be too extensive for an adult. In the young the eschar should be proportionally less." In the inflammatory state succeeding injuries of the head, Mr. Jordan prefers painting the scalp with nitrate of silver to applying ice, which he says, "by diminishing the external can only increase the intra-cranial inflammation." In laryngitis and tonsillitis, strips of

vesication are established over the carotid arteries; in ophthalmia, the eye is surrounded with a horseshoe on its outer half circumference; gonorrhoea is cured in two or three days by blistering the penis; in deep-seated pelvic inflammations, broad strips are laid over the femoral arteries; the chief details of the method being to blister around and not over the focus of disease, and to carry the counter-irritant over the nearest artery which does not supply the seat of the disease.

Mr. Furneaux Jordan deserves great credit for his enunciation of intelligent principles in the use of counter-irritants, so far as blood-vessels and their areas of supply are concerned. That his doctrine and precepts are carried to extravagant lengths is obvious; particularly in the idea that the application of nitric acid to a sloughing sore acts by counter-irritation and not by destruction of a diseased surface; and in the idea that an incision in whitlow to the very focus of the disease is a mode of counter-irritation—a notion contrary to his own doctrine that counter-irritants ought to be applied *near* but not *to* the diseased part. We may safely leave these topics to time and experience. But in a history of surgical doctrine, his theories require notice as illustrations of the statement we set out with (*Sect. 8, p. 52*), that medical theories are stamped with the common infirmities of the human mind, and that though they vary in their details from age to age, their essence is the same. Mr. Furneaux Jordan's theories show him to belong to the sect of the *Methodists*, whose character was sketched by the illustrious Celsus when he described the Methodism of Themison. "Satis est," says Themison, "quædam morborum communia intueri." So Mr. Jordan denounces minute distinctions and differences of treatment based on them. Some one or more things must be essential; these alone require attention; inflammation is one, and our remedy ought to be one. "Selon leur système," says Renouard (*Histoire de la Médecine*, Paris, 1846, vol. i. p. 365), "une affection du genre constrictif, telle qu'une tumeur inflammatoire, réclame constamment le même genre de secours, sur quelque partie qu'elle fût située, quels que fussent l'âge et les forces du malade, la saison, le climat." . . . "Their desire," continues Renouard "to simplify the practice of medicine was such that they submitted all their sick to one regimen. . . . They cut down the study of medicine, so that they said all treatment could be learned in six months." Had they confined themselves to the classification of details, they would have done well, but they thought unwisely that a knowledge of the "general" would enable them to dispense with a knowledge of the "individual." Whereas the more general our ideas, the further are they of necessity from real objective truth. If, as Magendie showed, inflammation under one name, and with a certain family likeness, contains members of the most opposite origin, nature, and requirements, it is clear that the notion of one remedy is a mere dream. In chronic bone disease most surgeons get so good results by rest, nutrition, and anodynes, that counter-irritants are needless.

We have given this eminent surgeon due credit for showing emphatically that counter-irritants must not be applied at random, but on definite principles, which, according to his view, depend on the distribution of blood-vessels and the transference of vascular action. But there is a yet deeper

doctrine propounded by the neuro-pathological school, which insists on their application with reference to the trophic nervous system. On this point, Professor Laycock is the leading authority. "The laws," he says, "of reflex action adapted to a trophic anatomy and to neurotic changes in tissues and organs, must be our guide in the use of counter-irritants and rubefacients." (*Lecture, Medical Times and Gazette*, 1871, vol. i. p. 596.)

It must be remarked that Professor Laycock demonstrates that one part of the bodily mechanism, the lymphatics, whose office in inflammation is apt to be ignored, are as much under the control of the nervous system as the blood-vessels. They may, he says, be stimulated to their work, or plied by nervous influence transmitted from the central organ, and like other nervous influence, capable of being modified by afferent nerves, and therefore by local irritants. He gives a remarkable instance in which a woman with dropsy of both legs, had an attack of left hemiplegia, produced by embolism of the right middle cerebral artery. With the hemiplegia the effusion into the right leg and thigh disappeared; that on the left side remained. Why was this? Formerly it would have been said that there was metastasis of the serum to the brain; but a *post-mortem* disproved that hypothesis in this case. Professor Laycock believes metastasis to be, not a transference of a *materies morbi*, but of the place of nervous action. This point is most important in the philosophy of counter-irritation, which may in one sense be defined as the artificial production of metastasis.

"Here," says Professor Laycock, "was a new fact in vaso-motor pathology of wide practical significance; for precisely similar results are seen in cases of "metastatic" rheumatism, "retrocedent" or "suppressed" gout, "repelled" eruptions, and dried-up ulcers, from, as I think, similar causes—namely, changed conditions of the nerve-centres. In none of these instances of alleged transference of a *materies morbi* is there any proof of the fact of such transference, any more than in this case of "metastatic" dropsy. . . . On the other hand, the theory that metastasis is neurotic in origin is sufficient, and is practically available in all cases of the class. All we have to bear in mind is, that there are two conditions of the nerve-centres diverse in results and different in seat . . . —the one condition favouring the occurrence of certain changes, the other inhibiting it. This is the state of things when pain and inflammation cease in one joint and begin in another in gout and rheumatism. There are cases of hemiplegic jaundice, and of eruptive fevers, as measles, in which there is a phenomenon of the same class—on the one side there is a predisposing neurosis; on the other, an inhibiting condition, just as in cases of hemiplegic dropsy. To this class also belong those cases in which there is no eruption, or in which it appears and disappears like an urticaria evanida. A neurotic condition seems to be the reason why tubercles are absent in anæsthetic leprosy. We thus explain, also, why those cases of syphilis in which there have been no cutaneous affections are most predisposed to syphilitic diseases of the nervous system. It is only when grave symptoms coincide with a so-called repelled eruption that the neurosis upon which the cessation of the inflammation depends is of serious omen. To this



class belong other metastatic phenomena—as, for example, the cessation of the pulmonary symptoms in a case of phthisis when brain disease comes on. These clinical facts are illustrated by and illustrate the well-known experiments of Claude Bernard on the sympathetic cervical ganglia. It is usually said that the increased heat and congestion which result on the same side as the injury are due to a palsy of the vaso-motor nerves of the part, and no regard is had to an equally constant yet diverse condition—the coldness and pallor—on the opposite side. As a simple fact, we find that, on the one side, vascular activity is intensified, on the other inhibited, with corresponding changes in heat-production and nutrition, just as occurs in the hemiplegic and metastatic cases of dropsy referred to.

“For the purpose,” says Professor Laycock, “of effective counter-irritation, beyond merely local results, it is necessary that there be continuity of sensory or afferent trophic nerve between the surface irritated and the nerve-centre to be acted on, otherwise no change can be effected therein. Again, if there be no continuity of efferent or motor nerve between the part to be modified and the nerve-centre which modifies, no counter-irritation will avail, although the sensory communication be continuous. . . .

“Let us take up a few practical points. Firstly, we desire to alter the condition of the nerve-centres in centric diseases by counter-irritants. The time-honoured use of sinapisms to the feet and wrists in apoplexy and comatose affections generally is a familiar example. . . . I have seen cephalic snuffs of great use in epilepsy. The ancient Greeks used this class of remedies so systematically in head affections that they invented a double-piped syringe for the purpose of injecting counter-irritants into both nostrils at once. In cases in which it is advisable to stimulate the nerve-centres through the afferent nerves, hot applications, as Donovan’s button, may be applied, or rubefacients, which excite more or less pain and tingling. In certain cases of paraplegia I have found it very useful to cover the lower extremities with sinapisms for half-an-hour two or three times a day, so as thereby to excite vaso-motor activity in the motor cord through the sensory nerves. In these cases it is necessary that there be at least sufficient integrity of the sensory nerves and nerve-centres to evolve and transmit the regulative or sensory vis nervosa. If there be complete anæsthesia from structural change, little good will be done. . . .

“Upon the whole, in acute cases, both experience and theory are opposed to violent (i.e., inflammatory) counter-irritation—rubefacients, at the most, are all that are needed; but even these are more doubtful than local sedatives with warmth and moisture to the skin. The local morbid condition has already caused those centric changes upon which pain depends, and the normal reaction has followed; this being so, it seems advisable to relieve the pain rather than increase it. In this way the great additional suffering may be spared the patient which the “heroic” use of blisters, tartar emetic, croton oil, and other inflammatory counter-irritants inflicts.

“I think we can also make these views available to a better comprehension of the uses of counter-irritants when applied to induce absorption of fluid in dropsical joints and elsewhere. Do they act directly and solely on the absorbents, as is generally

believed, or on the nerve-centres as well? When a blister is applied to the side to excite absorption, it is more difficult to understand how it acts locally than through the nervous system, if we remember that the so-called serous metastasis is nothing more than the rapid absorption of serum from a change in a nerve-centre, as in the case in which rapid absorption followed on embolism of the middle cerebral artery of the same side. Again, if we give the so-called hydragogue cathartics in acute hydrocephalus, ascites, and general dropsy, we use very active counter-irritation of the intestinal surfaces, and in this way act as certainly on the nerve-centres as when blisters and rubefacients are applied to the skin. So, also, when we use the hot-air bath in dropsies we do much more than stimulate locally; we apply a powerful agent to the nervous system. On the other hand, blisters applied to joints under certain conditions will excite effusion.”

It is no disrespect to the distinguished Edinburgh Professor to say of his views, what one inspired Apostle said of another, that they contain *δυσνόητά τινα*, some things hard to understand. But the whole subject of the distribution of disease as influenced by the nervous system is but little explored, and we must be grateful to the pioneers.

One point must not be lost sight of in this obscure subject, which is, that irritation of a distant organ, acting diastatically through the spinal cord, may not produce the effect of diminishing diseased action, but the contrary. For instance, it is a common practice to apply mustard poultices to the breasts, in order to promote the menstrual flow. On the other hand, the infant is applied to the breast to induce contraction of the womb and divert the blood flow from it, in hæmorrhage after child-birth. Thus it seems that irritation of the breast sometimes increases, sometimes diminishes, the nutritive activity of the pelvic genital organs. I remember a case in which, after the use of sinapisms to the breasts for amenorrhœa, the patient died of abscess of the ovary, which was considered to have been, partly at least, due to the irritation. The question may fairly be asked how far blisters and setons are available in low degenerative inflammation, in which the trophic influence should be augmented, and not taken from. It is said that cauterisation of the helix of the ear relieves sciatica. Brown Séquard well observes that facts like these are of the utmost importance as showing the influence of the nerves in disease. (*Address, Harvard Univ. 1866, p. 27; Year Book, New Syd. Soc. 1862.*)

We must, in the last place, notice the very ingenious plan of acting on the spine by heat or cold, which has been introduced by Dr. John Chapman, as a means of treating local disease through the central nervous system. Dr. Chapman’s practice is founded partly on the now well-known relations of the sympathetic nerve to the arterial system, and partly on the existence of efferent trophic, nutritive, or positive motor nerves, which supply the glands and other tissues, and regulate their nutritive activity. He believes that “when the sympathetic ganglia are in a state of maximum hyperæmia the nervous effluence from them to the muscular coats of the arteries to which they are severally related stimulates them so excessively as to induce in them a state of tonic spasm—a spasm so intense as to result in shutting off the blood altogether from a large proportion of

the peripheral arteries." . . . "That when the sympathetic ganglia are in a state of maximum anæmia the nervous effluence from them to the muscular coats of the arteries becomes so extremely feeble that a condition resembling paralysis is induced ; the muscular coats of the arteries become consequently extremely relaxed, and as the blood flows in the direction of least resistance, the parts supplied by the arteries in question become suffused with blood to an excessive degree."

"That in the same manner as glands are supplied with positive (spinal) as well as negative (sympathetic) motor, so there is reason to believe every tissue in the body is thus supplied, and is thus placed and sustained in a state of elective affinity for the elements of the blood requisite for its nourishment and functions." Now come the therapeutical postulates. Dr. Chapman believes that the sympathetic ganglia and the spinal cord can be rendered hyperæmic or anæmic artificially, by means of heat in the one case, and cold in the other, applied along the spine. "That by means of heat applied along the spine the general circulation may be lessened, the activity of the glandular system may be increased, and in some cases cramps of both the voluntary and involuntary muscles may be induced. That by means of cold applied along the spine the general circulation may be increased, the activity of the glandular system lessened, and cramps be arrested or prevented." (*Diarrhæa and Cholera*, &c. 2nd ed. Lond. 1866.) The application of these doctrines to practice is obvious. In anæmia or defective nourishment of any part apply ice to that part of the back corresponding to the ganglia supplying the arteries of the ill-nourished part ; this will paralyse the sympathetic, and the blood-vessels will dilate. If the local supply of blood is to be lessened apply heat, this will produce hyperæmia of the ganglia and constriction of the arteries. "Pleurisy, bronchitis, pulmonary congestion, pulmonary hæmorrhage, can be alike restrained or arrested by applications of cold or heat, according to the special needs of the case between the scapulæ." Heat to the spine in these maladies (says Dr. Chapman) lessens hyperæmia by exciting the sympathetic, and promotes mucous secretion by exciting the positive motor, or, as Professor Laycock calls them, *trophic nerves*. "In treating pulmonary catarrh and bronchitis," says Dr. Chapman, "I apply heat along the dorsal region, in order by inducing a preternatural afflux of blood in the thoracic ganglia, to cause the arteries supplying the bronchial mucous membrane to contract. Now, if at this stage of congestion of this membrane, when it is dry, heat be applied to the dorsal region, not only will the congestion be lessened, but a secretion of mucus rapidly ensues, to the great relief of the patient."

This passage is fairly open to the criticism that if instead of heat to the spine a warm poultice had been applied to the front of the chest and abdomen the same happy result would have ensued. But in truth we are not so rich in remedies that we can afford to laugh at new ones because a flaw may be picked in the theory which they rest upon. Time and experience will show where the truth lies. In fact, the work of the nervous system in the control of nutrition and vascular supply has been so short a time made the subject of systematic study that we must be content to wait for the fruit of it. Meanwhile, we must

welcome the pioneers who are opening for us glimpses at what may be the therapeutics of the future. Laycock's doctrines are largely studied on the Continent. They harmonise with the views of Macartney and R. Ferguson, though they go further. I have satisfied myself of Dr. Chapman's fact that ice to the spine makes the feet warm ; but disease is so complex that we cannot believe in any one remedy for all things, though each remedy has its special use.

#### GENERAL CONCLUSIONS.

1. Inflammation cannot be defined as to its essence, so that the best plan is to define it by its accidents, as "a diseased process attended with hyperæmia and exudation," as we have said above ; or with pain, heat, redness, and swelling.

2. There are certain natural processes which resemble it, in some respects, as erection, ovulation, menstruation, lactation, salivation, and the action of the intestinal mucous membrane during digestion.

3. There are certain morbid processes into which inflammation passes by insensible gradations ; to wit, neuralgia, hypertrophy, tumours benign and malignant, mucous flux, and hyperæmia.

4. But as neuralgia, hypertrophy, tumours, fluxes and hyperæmia may (like the best examples of repair) occur without inflammatory symptoms, so it is clear that the term "inflammatory" applies to the manner in which these changes take place ; that is, if they take place in a rapid, violent, and painful manner. (W. Moxon, *Analytical Pathology*, *Med. Times and Gaz.* 1870, vol. ii. p. 441.) The diagnosis of inflammation is chiefly founded on hyperæmia, heat, exudation, and progressive change.

5. The superaddition of inflammatory characters to morbid processes brings into play a new order of phenomena, requiring special treatment.

6. The essential seats of inflammation are tissues in their minute structure. The vessels, nerves, and lymphatics are instruments, but not essential agents. Yet some inflammations are diseases *in* a part rather than *of* it ; beginning with capillary embolism or afflux of morbid blood elements (Beale), or with the intrusion of morbid leucocytes.

7. Theories of inflammation must be comprehensive not exclusive. All theories heretofore in vogue have some partial truth, but no one can be accepted as a view of the whole truth. The doctrine of the state of the blood, of humours, of the influence of the nervous system, of the action of vessels, the action of "cells," of exudations, of embolism and of leucocytes are not incompatible, but may be held as so many parts of a harmonious system.

8. Inflammation of any part must be considered an expression of irritation or wronged vitality ; of defective resistance to causes disturbing the processes of nutrition ; the liability increasing in proportion to the weakness and sensibility. Injury to living tissue "renders it incapable," as Goodfellow has well expressed it, "of exercising its proper affinities ;" of growing in harmony with the organism of which it forms a part. The same rule holds good, as Virchow has shown, with regard to vegetables as to animals.

9. It is the characteristic of high health and vigorous life that injuries are healed without nerve-irritation and inflammation, and that morbid states



of the blood, from improper food, cold, or the like, are got rid of by the normal processes of oxydation and excretion.

10. It is under conditions of weak health and lowered vitality that fevers and inflammations are most likely to occur.

11. There is nothing benevolent nor conservative in fever and inflammation. They are grievous wastes of force and substance, and imply a prodigal production of the lowest amœboid forms of organisation.

12. It is a pernicious doctrine to hold that "Nature feeling herself injured, sets up inflammation to restore the damage or recover the health." If there be damage, it is the duty of the practitioner to remove causes of irritation, and to quiet the nerves, till natural processes of oxydation and elimination shall have got rid of any material cause, and till an injured or fatigued organ can recover its nutrition.

13. The best result of inflammation is, that it sometimes produces a new organ of oxydation or elimination, as in gout, mucous flux, and critical abscess. But as these may risk life and health, it is the surgeon's duty to render them needless by the means just mentioned.

14. Of the causes of inflammation, some reach the part from without, as wounds; others through the blood. In the latter case, the blood is sometimes the mere vehicle, as of cantharidine to the kidneys. But the real blood diseases are those produced by some modification of that fluid, whether spontaneous or resulting from chemical substances acting as ferments. (6 *supra*.)

15. This last-mentioned class of cases constitute the "fevers" of which local inflammations are products and symptoms. In a true "local" and traumatic inflammation the feverishness is secondary and symptomatic.

16. But in all great idiopathic inflammations, and in the cases of injuries in which septicaemia has occurred, the local symptoms are as secondary, as are the lesions in typhoid or scarlatina.

17. For the great idiopathic inflammations, just as for acute rheumatism, we ought to restore the term "fever." Just as we speak of rheumatic fever, so we ought to speak of gouty, erysipelatous, pneumonic, pleuritic, and peritoneal fevers. So the greatest physicians always did—Hippocrates, Sydenham, Hoffmann, Huxham, and Fordyce. To speak of erysipelas, gout, or pneumonia, as *local* inflammations is absurd. Pathology in this instance must *reculer pour mieux sauter*.

18. Just so inflammation, tumours malignant and other, hypertrophy, "tubercle," elephantiasis arabum and the like, ought to be taken as members of one series.

19. We cannot attempt to give, even in the most general form, the treatment adapted to each kind of inflammation. For, in truth, that of every case must be adapted to the cause, the degree, the constitutional peculiarity, the organ or tissue involved, and the stage. Remedies that would be useful in an early stage may be useless or pernicious afterwards.

20. It is preventive treatment which should be the surgeon's great study. In all cases of injury or threatened inflammation, by rest; if there be a wound, by providing against putrefaction and germs; in many cases after exhaustion and exposure, by a moderate use of stimulants, with a warm bath and

nutritious food. In cases of wound or parturition, the first impressions on the nervous system should be neutralised by opiates. In cases where excess of food and a gorged condition of the alimentary canal exist, an incipient case may often be cut short by purgatives. In malarious cases, quinine; in gout, colchicum seems to have the power of suppressing that nervous condition which permits of local mischief; and it is for "specifics" of this kind, as preventives, that the practical surgeon should pray.

21. If an inflammation be already lit up, a different order of remedies may be requisite; just as fire-engines must be had to check a conflagration the first spark of which might have been put out by a housemaid's mop. Bleeding should be practised if the condition of the *patient* seem to render it expedient. If not, a labouring organ may be freely leeches. Purgative, saline, and opiate remedies, and wine, may be added according to the needs of each case.

22. In the fully-established inflammation, when the effusion or other usual result has taken place, the surgeon will think of giving vent to discharge, of supporting the strength, and repairing the mischief which he has not been able to prevent. There is nothing unreasonable in believing that a bath and brandy-and-water may prevent an attack, which may require bleeding if fully developed, and wine at its close.

23. In the reparation of injuries, and in diseases whose course is known and regular, the treatment must be chiefly expectant.

24. In every instance the surgeon at the bedside will do well to divest himself of all abstract and metaphysical notions, and to see before him not a "case" but a brother, a being of flesh and blood, whose body and soul require to be dealt with by moral and material agents, according to the needs of each.

Robert Druitt.

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IODINE. The following are the formulæ recommended by Brera:—1. *Tincture of iodine*, made by dissolving 48 grains of pure iodine in an ounce of alcohol. The dose for adults is from 5 to 20 drops, three times a day. The tincture is subject to decomposition, and should therefore be used fresh. Dr. Manson's tincture contains one drachm of iodine in 3 iiss. of rectified spirit. Of this he commonly prescribes thirty minims thrice a day. Mr. Buchanan puts 3j. of iodine to 3 iij. of rectified spirit, and prefers the external to the internal use of the medicine, as more efficacious and less likely to create nausea and other unpleasant symptoms. He has often observed, that when desquamation of the cuticle and great itching followed the external application of the tincture, the parts received more benefit than when the cuticle retained its natural appearance. (*On Diseased Joints*, p. 86.) 2. *Pills of iodine*, made by forming one grain of iodine into two pills, with elder-rob and liquorice-root; one to be taken every morning and evening. 3. *Iodine ointment*, made by mixing a drachm of pure iodine with an ounce of lard, or half a drachm of hydriodate of potass with an ounce and a half of lard; of the former, about a scruple, of the latter, a bit about as large as a filbert, may be rubbed on the part to which it is intended to be applied. Dr. Manson's ointment has 3ss. of the hydriodate to an ounce of lard. A *Solution of the iodurated hydriodate of potass*, made by dissolving 36 grs. of the hydriodate and 10 grains of pure iodine in 10 drachms of water. The dose should not, at first, be more than five or six drops, three times a day.



In administering iodine, care must be taken not to combine it with substances calculated to decompose it. The liquid preparations are generally given by Dr. Coindet in syrup and water. When ill effects arise from its too violent operation, such as pains in the stomach, chest, bowels, defective vision, loss of sleep, palpitations, tremors, convulsions, &c., or even inconveniences of a less dangerous kind, the medicine should be immediately discontinued. Iodine has obtained considerable reputation for its efficacy in bronchocele, scrofula, various chronic tumours, diseased joints, enlargements of the breast, bursæ, mucosæ, testicle, &c.

[Iodine (*Iodum*) is reputed a powerful alterative, that is, a medicine which usually, without sensible operation, induces such a change in the nutrition of the body as eventually to restore healthy function. It thus acts as a solvent in various chronic maladies accompanied with induration or enlargement, as in thickening of membranes such as the periosteum, and in benign tumours.

It has been found beneficial in scrofulous diseases, visceral and glandular enlargements disappearing under its use. Thus, in the chronic mammary tumour described by Sir A. Cooper, it has proved of service, alleviating pain and keeping the disease in check. In indurated enlargement of the parotid, of the testicle and of the lymphatic glands, it has been found a valuable medicine. It has been extolled as a remedy for bronchocele; here the morbid growth generally diminishes under its use, but seldom subsides altogether.

In checking or controlling the ulcerative process, iodine, according to Mr. Key, is one of the most powerful remedies we possess:—"The most active phagedenic ulcers that threaten the destruction of parts, are often found to yield in a surprising manner to the influence of this medicine, and to result in a healthy granular appearance." (*Med. Chir. Trans.*, vol. xix.)

Iodine and its preparations have been employed advantageously in chronic skin diseases, in old ununited fractures, in order to promote the deposition of ossific matter, in syphilitic affections of the bones and adjunct textures, as also in caries. There can be no doubt that in constitutional syphilitic affections, such as the hard periosteal node, iodide of potassium exerts a powerful influence in abating pain and swelling. Overbeck, a German author, ascribes its efficacy in such cases to its solvent action on the albuminous deposit occurring in the syphilitic dyscrasy.

As a topical remedy, iodine in the form of tincture has been resorted to successfully in lupus. By applying it not only to the ulcerous surface, but to the parts around, the process of ulceration is generally stopped, and cicatrization takes place. It has in like manner been employed in the instance of chilblains, erysipelas, inflamed absorbents, carbuncle, whitlow, diseases of joints, neuralgia. Where it is desirable to avoid discolouration of the skin, an ammoniated tincture according to the subjoined formula, will be found an available substitute for the ordinary tincture:—Ry. Iodi, ʒij.; Potass. Iodi, ʒiv.; Sp. Vin. rect., ʒij. ʒiij.; Liq. Ammoniac, ʒvj. ʒiv. In the treatment of housemaid's knee, Mr. Rodwell speaks highly of keeping a strong solution of iodide of potassium constantly applied to the part, rest being enjoined. "By this means the swelling is said to subside

more rapidly than under any other mode of treatment." (*Med. Times*, vol. xxi, p. 144.)

A powerful escharotic is formed by dissolving 60 grains of iodine and the like quantity of iodide of potassium in 120 grains of glycerine. In lupus and secondary syphilitic ulcers this is to be laid on the surface, and covered with a thin layer of gutta-percha, and allowed to remain from one to twenty-four hours, according as the patient can bear it. When removed it is to be replaced by a cold poultice.

Iodide of potassium or of sodium may be exhibited in the dose of from three to ten grains, twice or thrice daily, dissolved in from two to four ounces of water, about a couple of hours after a meal. The addition of half a drachm of aromatic spirit of ammonia to each dose tends to promote its efficacy. Iodide of ammonium may, in like manner, be administered in doses of from three to five grains. Where the patient's constitution is enfeebled, the iodide may be exhibited in some bitter infusion, or in decoction of Sarsaparilla. It may also be given in combination with cod-liver oil.

The Iodide of Potassium is the preparation in ordinary use. It is better to begin with doses of two or three grains thrice daily, and to increase the quantity by the addition of a grain to the dose every five or six days, till doses of ten or fifteen grains have been reached. If continued too long in the same dose it loses its effect, and in this way its full beneficial influence is often missed and the remedy discredited without sufficient cause. Again, if given in too large doses at first it is apt to disagree, and to produce headache and feverishness with running from the eyes and nose, all the symptoms, in fact, of acute coryza, and even occasionally salivation. In persons peculiarly sensitive to these influences, the iodide of sodium may be substituted with advantage for the iodide of potassium, as being less irritating and more readily tolerated, but even with this it may be necessary sometimes to begin with not more than half a grain or a grain for a dose.

In the British Pharmacopœia are contained three preparations of iodine, namely, liniment, tincture, and compound ointment. These may be advantageously employed in various cases of enlargement, and affections of the periosteum and joints. The linimentum Iodi is a rather powerful irritant, and must not be used too freely, or it will cause severe vesication. The liniment contains 2½ ounces of Iodine to the pint, and is five times stronger than the Tincture.

Tincture of iodine, pure or diluted with water, is now the approved injection in the treatment of hydrocele. (See HYDROCELE.) It is likewise used for injecting into sinuses, so as to induce contraction and obliteration; into the cavity of serous cysts for the same purpose; and into dropsical joints, in order to promote absorption and check further effusion.]

Alexander Ure.

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**INTESTINAL CONCRETIONS.** (*Gastro-intestinal concretions.*) Comprehending under this head both gall-stones and intestinal concretions, an interesting subject presents itself, certain parts of which have been chiefly elucidated in modern times. When the concretions voided are numerous, they are generally gall stones. Thus, Dr. Coe relates an instance in which several were voided in one day. In the same short time, Petermann knew of 72 being discharged from one individual; Birch, 100; Barbette, Sloane, and Vogel, 200; and Russell, 400. A patient, under the care of Von Sarsten, had voided 200, and was still continuing to expel others. Riverius speaks of another patient who had voided calculi from the bowels for several years whenever he went to stool. Fernelius likewise adverts to cases in which the concretions evacuated were innumerable (*Pathol. lib. vi. cap. 9*). Alvine concretions are of various sizes. Most of them are not larger than a pea or nut; but others are as large as an orange, and weigh four pounds. (See *Monro's Morbid Anat. of the Human Gullet*, &c.; and *Med. Chir. Journ.*, vol. iv. p. 118). Morgagni saw one which equalled in size a moderate finger, and Gooch, Guettard, Huermann, Mareschal, (*Journ. de l'Acad. Royale de Chi. t. iii. p. 55*) and others, have seen concretions of this nature, which were too bulky to pass out of the rectum without surgical aid. In certain examples recorded by Huermann and Mareschal, the passage of the concretion outwards lacerated the sphincter ani. Horstius speaks of one concretion which was as large as an apple (*Epist. I. ii. sect. 2. Opp. ii. p. 237*), and Marcellus Donatus, Schwind (*Schmucker's Verm. Schriften*, vii. p. 129), Hooke, Vennette, and Hequet, give the particulars of other examples, in which the concretions discharged were as large as a hen's egg. Mr. C. White extracted two from the rectum, which were nearly as big as the fist (*Cases in Surgery*, p. 18); and in a boy, who had died in an emaciated state, after continued pain in the abdomen, attended with frequent attacks of ileus, Mr. Hey found in the transverse arch of the colon so large a concretion, that it could not pass any farther along the bowel, and appeared to have been the sole cause of death. (*Practical Obs. in Surgery*, p. 509, ed. 2.) An analogous case is reported by White (p. 28.) Duhamel saw a concretion which had been discharged, and was two inches and a half in length, one inch and a half in diameter, three inches and a half in circumference, and weighed three drachms and a half. But, judging by their weight, how much larger those must have been which were seen by Schroekius and Lettsom, and weighed ten drachms; that reported by Dolæus, which weighed two ounces; that recorded by Orteschi, which, besides weighing two ounces, two drachms and a half, was eight inches in circumference, and was taken out by force; that recorded by Schaarschmidt, which weighed four ounces; and lastly, the specimen cited by Plouquet (*Literatura Med. Dig. vol. i. p. 171*), the weight of which is alleged to have been half a pound. (*Samml. Med. Wahrnehm. b. ix. p. 231.*) It is observed by Rubini, that although examples of alvine concretions being discharged by vomiting are not so frequent as the foregoing cases, yet they are tolerably numerous. Many of them have been collected by Schenck, and others are collected by Breyn (*Phil. Trans. No. 479*); by

Orteschi in his journal; by Moreali (*Dell' Uscita di una Pietra, per la Via del Esophago*, Modena, 1781); by Borseri; and by a long list of other writers, whose names and publications are specified by Plouquet. (*Lit. Med. Dig. art. Calculus Vomitus, &c.*) With this class of substances may also be arranged those concretions, which are found upon dissection either in the intestines or stomach, whence, probably, in time, they might have been expelled. Facts of this description are recorded by Portal, Vicq d'Azyr, Jacquinelles, Chandron, &c. The cases recited by White and Hey, in which the colon was completely obstructed, I have already mentioned; and to these may be added the instance quoted by Rubini, in which Meckel found the jejunum entirely blocked up by a similar substance. (See *Pensieri sulla varia Origine e Natura de Corpi calcolosi, che vengono talvolta espulsi dal Tubo gastrico*, Memoria, p. 5 and 6, 4to. Verona, 1808.)

With respect to the origin of alvine concretions, whether discharged from the alimentary canal upwards or downwards, some of them appear to be formed in that canal itself, while others pass into it from other situations; and they all admit of being distinguished according to the place of their origin and formation into three kinds: 1. *hepatic*, or *biliary*; 2. *gastric*, or *intestinal*; and 3. (what Rubini terms) *mixed*, or *hepatico-gastric*. *Hepatic alvine concretions*, as the name applies, are derived from some point of the hepatic system: the *gastric*, or *intestinal*, are formed within the alimentary canal; and the *mixed* commence in the hepatic organs, but afterwards get into the bowels, where they acquire an increased size.

The accuracy of the preceding statement is but trivially affected by the observation of the late Dr. Marcet, that he once found a stone in the alimentary canal, which came from the urinary passages: a communication existed between them, the rectum being imperforate. Here also, it should likewise be remembered, that some concretions are formed of substances swallowed, and afterwards cemented together and accumulated in such masses as to obstruct the bowels, and create dangerous effects, as, for instance, mustard seed, chalk, magnesia, and carbonate of iron.

If, when carbonate of iron is prescribed, the bowels are not kept open, large masses of it are apt to collect in the large intestines. Dr. Elliotson attended a man, who took two pounds of it every day for several days when labouring under tetanus, and large lumps of it were regularly discharged, covered with mucus, and without any pain, because their passage was facilitated with clysters. The patient under Dr. Elliotson, who took carbonate of iron, if he neglected to keep his bowels open, used to find his rectum become dry and distended; and, on one occasion, a shovelful was found in his bed, which he had amused himself day and night in removing. (See *Elliotson's Lectures, Med. Gaz. for 1832-33*, p. 598.)

Some hepatic concretions cannot pass from the place of their origin into the intestines, but only such as are situated in the hepatic duct, or its main branches, in the gall-bladder, the cystic duct, or the ductus choledochus. When their size is not disproportionate to the diameter of the ducts, they pass with facility; but, when their dimensions are larger than those ducts can naturally admit, the latter become stretched and dilated,



whence arise the sharp pains and colic which attend the disorder, analogous to the sufferings produced by the descent of large calculi from the kidneys to the bladder. The reality of these dilations of the hepatic ducts is proved by dissection. Heister found the orifice of the ductus choledochus, which is usually very small, so much enlarged that it could receive a finger; and Vieq d'Azyr saw this duct enlarged through its whole extent in a similar degree. (*Hist. de la Société Royale de Médecine*, an 1779, p. 229.) Galeazzi, in dissecting a body, found the ductus choledochus so dilated, that it resembled a kind of bag, in which several calculi were included. Mr. Thomas has likewise seen two cases, in which the point of the fore finger readily passed from the duodenum into the gall-bladder. (See *Med. Chir. Trans.* vol. vi. p. 105.) Morgagni saw this duct in one instance large enough to hold a couple of fingers, and he quotes many similar instances from Bezold, Trew, Verney, and others. We may conceive how dilated this tube must have been in a case recorded by Richter; where, though it was not completely obstructed, a calculus weighing three ounces and a half was lodged within it. (*Rubini, Op. cit.* p. 7—10.)

With regard to those concretions which are distinguished by the epithet *gastric* or *intestinal*, some are formed in the stomach, the rest in one or other of the intestines. Some are only partly formed in the digestive tube, having a nucleus, which is usually some substance which has been swallowed, round which certain matters accumulate and crystallise, though, without the accidental introduction of the nucleus, no concretion at all would have been formed. Other intestinal concretions are entirely produced in the intestinal canal. (*Andral, Précis Elémén. d'Anat. Pathol.* t. ii. p. 162.) They remain for a greater or less period in the place of their formation, according as they happen to be lighter or heavier, smoother or rougher, more or less adherent, or as local or general circumstances are more or less favourable to their retention or expulsion. Sometimes, they continue undischarged, until they have attained a very considerable size. In particular instances, instead of remaining constantly in one place, they successively pass through the whole intestinal tube, lodging at different points for a greater or a less time. The alvine concretion, of which Maréchal has given an account, was some years in traversing all the convolutions of the bowels. These gastric or alvine concretions, which are very common in animals, are less frequent in the human subject, as is proved by the observations of Fourcroy and Vauquelin, inserted in their valuable essay on this subject in the *Annales du Muséum Nationale d'Histoire Naturelle de Paris*. In the horse, they are sometimes of an enormous size, as we may learn from an instance on record, in which the concretion weighed thirteen pounds. (*Voigt, Magazin für das Neueste der Naturkunde*, b. iii. p. 578.)

As for the third species, which Rubini names *mixed*, or *hepatico-gastric*, they have their beginning in the hepatic organs, and augment in the intestinal tube. Here, if the extraneous body be detained, and the contents of the bowels have a disposition to become thickened and condensed round it as a nucleus, it may be rendered larger by additional strata of matter, and would increase

*sine fine*, if a stop were not put to the augmentation by the narrowness of the canal, or an effort made for the expulsion of the concretion. The crystallised appearance of alvine concretions is generally so conspicuous, that it did not escape the attention of several of the old writers, as we may convince ourselves by referring to the works of Corn. Gemma, Greisel, Baglivi, Scultetus, &c. It was noticed by Haller in his *Elementa Physiologiæ*, vol. vi., and by Morgagni in his *Epist.* 37, *de sedibus et causis*, &c. If, says Rubini, these crystallisations are not always plainly visible, distinct, and regular, this depends either upon their imperfection; the heterogeneous nature of the accumulated matter; or particularly unfavourable circumstances, which would equally affect the process of crystallisation out of the body.

Now, as all crystallisations depend upon the fluids in which they form, and from which they receive their crystallising elements, it must be evident that, inasmuch as the fluids of the hepatic organs differ in their constituent principles from the fluids contained in the intestinal canal, the concretions, produced in the first system, must differ from those originating in the second; whilst the hepatico-gastric calculi will combine the nature and properties of both together.

The fluid from which hepatic concretions are formed is unquestionably the bile, either some or all its ingredients entering into their composition. Indeed, previously to the new chemical doctrines, hepatic calculi were generally considered as being simply condensed indurated bile.

From investigations made in more modern times, however, when the art of analysis has attained a precision, of which the old chemistry was not susceptible, it appears, that, although human biliary calculi yield the same products as the bile, there is contained in them more or less of a peculiar substance, which was considered by the celebrated Fourcroy to be *adipocire* (*Mém. de l'Acad. des Sciences*, 1789, p. 323), or a substance very similar to spermaceti, but which has since been proved to be cholesteroline. This differs from spermaceti in requiring a temperature of 278° Fahr. for fusion, and by not being convertible into soap, when digested in a solution of potash. The presence of this substance in the concretion is of such importance, that, when it is abundant, and in large proportion, the calculus is regular and the crystallisation well finished; and, when it is in small quantities, the crystallisation is confused and disordered, the calculus only exhibiting an irregular misshapen concretion, more like a clot than true crystals. According to Chevreul, biliary concretions in general are composed of the yellow colouring matter of the bile and cholesteroline, the latter predominating, and being sometimes in a state of purity; "and," says Dr. Turner, "I have had frequent opportunities of satisfying myself of the accuracy of this observation." (See *Turner's Elem. of Chemistry*, p. 922, ed. 4.)

While the hepatic system contains a fluid which is always nearly of the same quality, viz. the bile; the alimentary canal, as Rubini observes, contains a hundred different fluids, and is continually occupied by substances of various natures, kinds, and properties, consisting of food, drink, and diverse secretions. All the principles, which are to serve for the formation and renewal

of the different species of living solids, and of the many kinds of fluids, at first remain more or less time in the alimentary canal, and there undergo peculiar changes. All the principles, which, under different circumstances, may contribute to the production of morbid concretions, either in the gall-bladder, the urinary bladder, the kidneys, or in any other part of the body, where they ever occur, pass at first into the intestinal canal, where they continue for some time. Such a multiplicity of principles, disposed to crystallise, and be converted into calculi, would almost daily produce these concretions in the bowels, were there not many circumstances which counteract this tendency, as, for instance, exercise, the incessant motion of the matter itself along the intestinal tube, the variety of these elements, whereby their natural tendency to unite is disturbed, and the decomposing and recomposing influence of the gastric secretions, whereby parts are united, disposed of, dissolved, and analogous matter kept divided, &c. But, whenever these circumstances are not actively operating, as may be the case in a noose, or fold of the bowels, or in some preternatural cyst belonging to them; whenever the intestinal fluids undergo such an alteration, that the production of these concretions cannot be prevented; or lastly, whenever some favourable circumstance, such as an extraneous nucleus, forms a centre of reunion for particular elements; then the saline matter, which is most disposed to crystallise, and the earthy and mucilaginous substances, &c. are attracted together, and produce more or less perfect crystallisations.

Some specimens, contained in the Edinburgh Museum, were carefully examined by Dr. T. Thomson; they at first swam in water, but afterwards sunk; the specific gravity varying from 1.376 to 1.540. Cold water acquired from them a brownish tinge, and took up albumen, which separated in white flakes by boiling. There was also a peculiar brown substance, at first dissolving in water, but rendered nearly insoluble by slow evaporation: soluble in alcohol; and most nearly resembling vegetable extract. The specimens likewise contained chloride of sodium, crystallising on spontaneous evaporation of the water; phosphate of lime, precipitated by ammonia; sulphate of soda in minute proportion; and, perhaps, sulphate of lime. Alcohol dissolved the peculiar brown matter and some of the salts; caustic potash, the albumen, brown matter, and perhaps some of the salts; and hydrochloric acid, a proportion of phosphate of lime. After all, there remained a peculiar substance, having the colour and texture of the calculus; in very short threads, light, resembling cork, or rather agaric; tasteless, insoluble in water, alcohol, ether, potash-ley, and hydrochloric acid; being blackened, and partly reduced to charcoal by sulphuric acid; slowly dissolving by heat without effervescence, in nitric acid; and leaving on evaporation a whitish residue, of bitter taste, and imperfectly soluble in water; burning with a bright flame; but differing from all other animal and vegetable substances hitherto examined, and distinguishable from wood, by its insolubility in potash-ley. The calculi consisted of alternate layers, or intimate mixtures of this substance and phosphate of lime, to which the albumen and brown matter served as a cement, the other substances being in small proportions. Phosphate of lime, mixed with a brown animal matter,

formed the external crust of some of the specimens. On the surface of a few were noticed crystals of phosphate of ammonia and magnesia. The presence of neither potash, ammonia, carbonate of lime, uric acid, nor urea, could be detected.

Varieties have also been found by Dr. Henry and Mr. Brande, exclusively composed of magnesia, of which the patient had been in the habit of taking vast quantities. (See *Thomson's Obs.*, in *Monro's Morbid Anatomy of the Human Gullet*, &c. p. 36, or in *Medico-Chir. Journ.* vol. iv. pp. 188, 189.)

From observations made by Dr. Wollaston, it appears probable that the above fibrous, light, thready substance is derived from oats, which are so commonly taken as food in Scotland. "If the oat-seed be divested of its husk, minute needles or beards, forming a small brush, are seen planted at one of its ends. Dr. Wollaston, on examining these needles and comparing them with similar ones detached from the calculi, and forming the velvet substance in question, satisfied himself beyond all doubt of their perfect identity." (*Marcet on Calculous Disorders*, p. 130. 8vo. London, 1817.)

Those composed of carbonate of iron, chalk, &c. have already been noticed. In cows, concretions are often found in the alimentary canal, consisting of their hairs, which they have licked off and swallowed. Millers' horses are likewise subject to alvine concretions, formed of collections of the grit of the stone dust in the mills, taken into their stomachs when they are fed with bran.

The specimen, analysed by Dr. Ure, he inferred to be a modification of ambergris. (*Dict. of Chemistry*, art. *Intestinal Concretions*.)

As for the mixed, or hepatico-gastric calculi, they have for their nucleus a biliary concretion, round which other substances contained in the bowels adhere: hence it is evident, that as they are formed at two distinct periods in two different situations, and amongst various fluids, two distinct compositions must be the result. Although, says Rubini, there has hitherto been no scientific analysis of this species of calculus, excepting the very imperfect one by Moreali, reason shows clearly enough, that, if two separate analyses were made, one of the nucleus, the other of the surrounding matter, there would be obtained from the nucleus the same elements as those of an hepatic calculus, and from the rest those of an intestinal concretion. (See *Pensieri sulla varia Origine, &c., de' Corpi calcolosi che vengono espulsi dal Tubo gastrico*, p. 15—17.)

The foregoing principles will enable us to determine with greater precision than formerly, the characters which appertain to the several classes of calculi liable to be voided from the intestinal canal; characters, by means of which there can be no difficulty in deciding, from the appearance of one of these concretions, the place of its origin, and its peculiar nature. The hepatic calculus being composed of bile, and also of *alipocire*, or cholesterine, its characters will be such as indicate the predominance of an uniform, oleaginous, and (what Rubini terms) a well *animalised* principle. The gastric or intestinal calculus, arising from the union of various salts, earths, and other principles, which happen to be in the alimentary canal, will have very different characters, generally indicating its earthy, saline composition. Lastly: the hepatico-gastric calculus will present an union of the different characters, viz. in the centre, the characters of the



hepatic calculus; more externally, those of the gastric.

The criteria for distinguishing the several kinds of calculi from each other may be divided into such as may be termed *external*, being derived from accidental circumstances attending the foreign body; and others, which may be called *internal*, being deduced from the inherent characters belonging to the composition and nature of these concretions.

The first of these external criteria is the age of the patient. C. Stephanus, Hoffmann, Durande, and Morgagni all agree, that biliary calculi seldom occur, except in subjects of advanced age, and never in youth. And Haller writes, "*Juniores et pueros, quantum novi, nunquam adfligit morbus.*" Morgagni met with sixty-one old persons who had alvine concretions, but with only eight young persons, not one of whom was a child, the youngest being twelve years of age, and the eldest twenty-nine. To these I may add the instance reported by Saye, in which a stone, as large as a hen's egg, was found in the gall-bladder of a girl only twelve years of age. (See *Journ. des Savans*, September, 1697.) The cause of this difference is attempted to be explained by Morgagni; but, probably, a more rational explanation than that suggested by him will be found in the analysis of the bile of old and young subjects, as made by Fourcroy and other modern chemists. From these and other observations, collected by Rubini, it is rational to conclude, that when an alvine concretion is discharged from a young subject, the chances are that it is not a biliary one; though, if the patient be of advanced age, it is not to be inferred that the foreign substance expelled must certainly be hepatic, because gastric or intestinal concretions are common to individuals of every age. (Rubini, op. cit. p. 18.) Indeed, with the latter kind of calculi, men of advanced age, and women are said to be most frequently afflicted; children and young persons rarely suffering, unless the formation of such bodies has been produced by the presence of fruit-stones, or other indigestible substances, which serve as nuclei. (Richerand, *Nosographie Chir.* t. iii. p. 433, ed. 4.) These concretions are also sometimes formed in patients who have been confined by disease a long while in a recumbent posture.

The second criterion is drawn from the symptoms which precede or accompany the expulsion of the calculus. Sense of heaviness, irritation, and pain in the region of the liver, pain about the ensiform cartilage and navel, bilious vomiting, jaundice, and either looseness of the bowels or constipation, are the symptoms, which (especially when they frequently occur) indicate the hepatic origin of the calculus, and proceed from its passing through the narrow ducts of the liver or gall-bladder towards the intestines. The most careful observations have proved, however, that these symptoms are only to be depended upon when taken collectively, and that no single one gives any certain information. Also, if their presence be sufficient to prove the hepatic origin of the calculus, their absence can by no means be regarded as a proof of the concretion being of the intestinal kind. (Rubini, p. 19.)

Third criterion. A calculus voided may be set down as undoubtedly hepatic, if accompanied by others unequivocally of this nature. In a case

recorded by Brunner, and in another by Vater, the absence of certain symptoms in the first, and the magnitude of the calculus in the second, created doubts whether the concretions were not more likely to be of the intestinal kind than of the hepatic. At length, the bodies having been opened, the presence of other similar calculi in the gall-bladders afforded adequate proof of their origin.

Morgagni lays down a fourth criterion, deduced from the number of the calculi voided; which, if very numerous, are to be considered as biliary. Rubini points out, however, the fallacy of this test; both hepatic and gastric concretions being sometimes single, sometimes in various numbers even up to a thousand; and he refers to a case where a very large number of concretions of the gastric description were voided, as reported by König. The test here suggested, however, may be considered as generally valid; for the number of intestinal concretions is rarely more than two, though sometimes very considerable. (T. Thomson. See *Med. Chir. Journ.* vol. iv. p. 189.)

I shall now follow Rubini, and notice those characters of alvine concretions, which he calls *internal*, and are deduced from their quality and composition, beginning with the criterion furnished by the size of the extraneous substance voided. As the biliary ducts are narrow, it is obvious that, if the calculus be above a certain size, it cannot have passed in this state suddenly through those narrow tubes, and, consequently, must be either of the gastric description, or mixed, having quitted the hepatic system while small, and afterwards increased within the alimentary canal. Unquestionably, as Rubini admits, this criterion has considerable weight, especially when the discharge of the calculus has not been preceded by pain, or other symptoms indicating such violent distension, as the above ducts must have suffered from the passage of the foreign body. These are certainly capable of being dilated to a very remarkable degree, as some facts already noticed in this article sufficiently prove; but such dilatation can never happen without pain, irritation, and a serious train of sympathetic effects. As Rubini remarks, this criterion will only apply to large, and not to diminutive concretions. A biliary calculus of prodigious size was found by Mr. Brayne, of Banbury, to have passed by ulceration directly from the cavity of the gall-bladder into that of the duodenum, whence it made its way through the rest of the bowels, and was voided from the anus. (See *Med. Chir. Trans.* vol. xii.)

A second criterion is the colour of the calculus; a test admitted by Moreau, who asserts that biliary calculi are yellow or green, and intestinal ones greyish-brown, or black. But, says Rubini, one need only look at various specimens of alvine concretions, and read the statements of authors who have seen a great many of them, particularly Morgagni and Soemmering, to comprehend that any criterion deduced from their colour is most fallacious, every species of them presenting great variety in this particular. And it is to be remembered, that the bile and the intestinal fluids, whence these concretions are formed, differ in colour in different individuals, according to a variety of circumstances, in health and disease. One species of hepatic calculus has a white colour, but is sometimes yellow or greenish. Another is of a round or polygonal shape, and often of a grey

colour externally, and brown within. A third is of a deep brown or green colour. (See *Ure's Dict. of Chemistry*, art. *Gall-stones*.) The smaller intestinal concretions, examined by Dr. T. Thomson, destitute of coating, resembled bad yellow ochre; the larger were encrusted with an earthy matter, of a coffee colour, and purple, or sometimes white. (See *Monro on the Human Gullet*, &c.; and *Med. Chir. Journ.* vol. iv. p. 188.)

Third criterion. The presence or absence of a nucleus, will enable one to judge whether a calculus be gastric or hepatic. A biliary concretion has no nucleus, properly so called; that is to say, it has no foreign body in its centre. When a transverse section is made of such a calculus, one finds either a cavity in its middle, or else nothing by which this part of its substance can be distinguished from the rest; or, if a nucleus, different from the other part of the concretion, be apparent there, it consists merely of bile, either grumous, differently coloured, or more or less fluid than the rest of the calculus, but which is nevertheless invariably bile. On the contrary, every gastric concretion has, as it were, an extraneous nucleus, as Fourcroy and Vauquelin have explained in their essay upon the intestinal calculi met with in animals. Ruysch, in the *Phil. Trans.* gives an account of some alvine concretions, which were formed round grains of seed. Birch records an example of a crystallised calculus, formed round a leaden bullet. Haller met with a calculus, in the centre of which was an iron nail. Concretions, formed upon fruit-stones, are recorded by Clarke, White, and Hey, and also in the *Edin. Med. Essays*. Instances in which the nucleus was a small portion of bone, are related in the latter work, and also by Hooke and Coe. Homberg and others describe alvine concretions, formed round indurated excrementitious matter: and many similar cases are specified by Vallisneri, Van Swieten, and others. In the hepatico-gastric calculus, the biliary concretions serve as a nucleus for the gastric. According to Dr. T. Thomson, the nucleus is commonly a cherry-stone, a small piece of bone, or a biliary calculus. (See *Med. Chir. Journ.* vol. iv. p. 188; *Cruveilhier, Anat. Pathol.* livr. xxvi.) In the work last referred to, the nuclei were cherry-stones, retained in the colon by an obstruction of it from cancerous disease.

A fourth criterion is deduced from a certain unctuousness, which belongs to biliary calculi, but not to those of the gastric class. This character is more palpable when the calculus has been recently voided, or when it is handled with warm fingers. The unctuousity is still more evident when the concretion is cut or sawn, as then the knife, saw, or fingers, become smeared with saponaceous particles which adhere to them. In order to denote an hepatic calculus, however, the unctuousity must pervade its whole substance, and not merely appear towards its outside; for a gastric, earthy, saline concretion, may by accident become coated, as it passes through the bowels, with a stratum of bile, or saponaceous matter. When the unctuousity is deficient externally, or in the outer laminae of a calculus, but is found in its interior, it is a clear indication of the hepatico-gastric formation of the concretion.

Fifth criterion. The specific gravity of a calculus, the property which it has of floating or sinking in water, has been long considered as a test of

its species. The hepatic calculus is generally specifically lighter than water, as most oily substances are: on the contrary, gastric calculi are specifically heavier than water, like all earthy saline matter, and of course sink in that fluid. This criterion was often employed by Reverherst, Fernelius, and others, for distinguishing various concretions. But it is by no means regular, as many biliary calculi swim only a little while and then sink. The specific gravity of that analysed by Dr. Ure of Glasgow, was 1.0135. (See *Med. Chir. Journ.* vol. iv. p. 179.) As Rubini observes, this test will not answer for hepatico-gastric calculi, which are subject to great anomalies. (*Pensieri*, &c. p. 22.) Nevertheless, the most correct modern examinations prove, that gastric concretions have a specific gravity, varying from 1.376 to 1.540 (*Dr. T. Thomson, in Monro's Morb. Anat. &c.*); and, consequently, their general character is to be heavier than biliary calculi.

A sixth criterion is that proposed by Vicq d'Azyr in the *Mém. de l'Acad. Royale de Méd.* and deduced from the figure of the crystallisation. According to this writer, intestinal concretions crystallise in concentric laminae, shaped like a cock's womb, while the crystallisations of biliary calculi are radiated and needle-shaped. Although this criterion is ingeniously founded upon the known laws by which every crystallised substance assumes a peculiar and determinate shape, yet it may be generally observed with respect to the mark of distinction here proposed, that the concretions of which we are now speaking are usually too compound, and too much disturbed in their crystallisation, to exhibit a regularity, for which simplicity and quietude are indispensable. Hence, many of these concretions do not present the slightest vestige of crystallisation, while others scarcely show a trace of it, in the midst of a large misshapen mass. The white-coloured hepatic calculus, when broken, is said to present crystalline plates, or striæ, brilliant and white like mica. The round, or polygonal one, which is often of a grey colour externally, and brown within, is described as consisting of concentric layers of inspissated bile, usually with a nucleus of the white crystalline matter in the centre. Lastly, the hepatic calculi, of a deep brown, or green colour, when broken, are said to exhibit a number of crystals of the substance resembling spermaceti, mixed with the inspissated bile. (See *Ure's Dict. art. Gall-stones*.) With respect to the special shape, assigned by Vicq d'Azyr to the two classes of alvine concretions, it may be observed, that his specimens were taken from animals, and that, consequently, the inferences made from them are not applicable to substances of an analogous nature discharged from the human body; because, as the bile varies in different animals, so must the formative principles of the calculous crystallisations. It is further remarked by Rubini, that the substance termed *adipocire*, which is the basis of biliary concretions, was not found by Poulletier in hepatic calculi taken from horned cattle.

A seventh criterion is founded upon the inflammability of an alvine calculus. A biliary concretion, being commonly made up altogether of unctuous matter, liquefies when subjected to heat, smokes, emits a flame, and burns. When this experiment is made in close vessels, the products are hydrogen, carbonic acid gas, oil, and



ammonia: some carbon and earth remaining behind. An intestinal concretion, on the other hand, decrepitates, or turns black, but generally does not burn. One specimen, examined by Dr. Ure, when heated to the temperature of 400 Fahr., fused into a black mass, and exhaled a copious white smoke, in the odour of which was recognised that of ambergris, mixed with the smell of burning fat. Exposed in a platinum capsule to a dull red heat, it burned with much flame and smoke, leaving no appreciable residuum. (See *Ure's Dict. of Chemistry*, art. *Intestinal Concretions*.)

The eighth criterion depends upon the solubility of calculi in any oily menstruum. Haller dissolved biliary calculi in oil of turpentine; Dietrick found them soluble in oil of sweet almonds; and Gren in oils in general. But intestinal calculi are not so readily dissolved by any of these menstrua.

The ninth criterion is founded upon the consideration that, while hepatic concretions are almost always more or less dissolved by alcohol, those of the gastric kind resist this menstruum.

Though the above criteria are interesting, as tending to establish distinctions betwixt the different species of alvine concretions, it merits attention that not one of them, taken separately, is at all certain and pathognomonic. It may happen that some peculiarity in the biliary secretion, and an irregularity in the crystallisation and accumulation of the matter may cause salts and earths to predominate in hepatic concretions, in which circumstance their usually oily quality will be defective. On the other hand, in the formation of an intestinal concretion, oily adipose matter may accidentally adhere to it, so as to disguise its wonted character. If uniformity of characters and physical properties depend upon uniformity of elementary constituent principles, it can hardly happen even in the natural healthy state of the secretions, because age, sex, and other particular circumstances of the individual, will always make a difference in the proportions of those principles. How then can identity of results be expected in a diseased state of the process of secretion? Such reflections may explain how Morgagni, amongst others, met with many biliary calculi which were not inflammable; with others, which did not give a yellow tinge to water; and with some which floated, or sunk in water, according as they had been recently or long discharged; while Gren found some of these calculi insoluble in alcohol, &c. (*Rubini*, p. 24, 25.)

Moreali put a piece of the outer part of an alvine concretion into nitrous acid, when a considerable effervescence took place, and the substance afterwards completely dissolved. Now, as this calculus had a nucleus, it must have been of the hepatico-gastric kind, and the experiment was therefore made only with the intestinal part of it. Should the experiment be often repeated with the same result, says Rubini, it would furnish another criterion for distinguishing the two species of calculi: those being intestinal, which effervesce; and others being hepatic, which do not effervesce, but yield globules of wax-like oily matter. (P. 28.)

With respect to the treatment of cases of biliary calculi, the subject not being generally one for which any surgical proceeding is advisable, I may be brief. The medicine, which was alleged by Durande, a physician at Dijon, to be the best

solvent for them, consists of three parts of sulphuric æther, and two parts of oil of turpentine. It is to be given in the dose of ʒij every morning; purgatives being previously exhibited for a few days. The efficacy of this medicine is also corroborated by Soemmering and Richter. To these statements, however, some doubts must be attached, because, what symptoms and circumstances will ever unequivocally prove, that there were biliary calculi in the bowels; and that they have been dissolved by this medicine? And how can the product of such solution be got at and examined? But, admitting the authenticity of the cases, doubts must exist of the solvent action of the remedy, since, at a temperature below that of the human body, the æther separates from the turpentine and is volatilised. (See *Dict. des Sciences Méd.* t. iii. p. 464, 465.)

A calculus in the gall-bladder, or one of the biliary ducts, sometimes produces so much irritation, that inflammation and suppuration take place; and, if the abscess point outwardly, the stone may escape externally, and a termination be put to the patient's sufferings. Heberden records a case of this description; and another is given by Blagden. (See *Med. Trans. of the College of Physicians*, vol. v. and *H. L. Thomas in Med. Chir. Trans.* vol. vi. p. 106; *Acrel, Diss. de Cholelithis*, Upsal, 1788, p. 204; *Act. Natur. Cur.* vol. vi. obs. 69; *Bartholinus, Act. Hafn.* iv. obs. 46; *Block, Med. Bemerk.* p. 27; *Goock's Works*, vol. ii. 157—161; *Johnston in Phil. Trans.* vol. l. p. 2. 548; *Petit, Mém. de l'Acad. de Chir.* i. p. 182—185; *Sandifort, Tab. Anat. Fasc. 3*; *Haller, Collect. Diss. Pract.* iii. No. 107.)

J. L. Petit first suggested the bold practice of making, under certain circumstances, an incision into the gall-bladder, in order to extract biliary calculi. This proceeding, however, is liable to serious objections, arising not only from the usual difficulty of knowing positively whether there is a calculus in the gall-bladder, but also from the difficulty of ascertaining whether this viscus is adherent to the peritoneum, without which state of things the operation would cause an extravasation of bile into the peritoneal cavity, enteritis, and death. Petit himself, indeed, mentions three cases, in which distension of the gall-bladder was mistaken for an abscess, and punctured. In two of these examples the consequences were fatal, there having been no adhesion between that organ and the peritoneum to prevent the bile from getting amongst the bowels; the other patient was saved by this fortunate circumstance. (See *Traité des Mal. Chir.* t. i. 262, &c.) However, if a case were to present itself, in which an abscess had formed, and broken, leaving an aperture, in which the calculus could be plainly felt, the surgeon would be justified in attempting to make a sufficient opening for its extraction.

The symptoms, induced by the lodgment of large concretions in the bowels, are of a formidable description: severe pains in the stomach and bowels, diarrhœa, violent vomitings of blood and mucus, a discharge of thin foetid matter from the rectum, a difficulty of voiding the excrement, an afflicting tenesmus, extreme emaciation, and debility. That the foregoing account is not exaggerated may be seen by a perusal of the cases, and remarks published by Mr. C. White, and the late Mr. Hey.

In cases like that reported by Mr. Hey (*Pract. Obs.* p. 509, ed. 2), where the colon was entirely obstructed, surgeons have been advised to cut into that bowel, and extract the foreign body. Let the inexperienced admirer of curious feats with the scalpel, however, pause a little, before he ventures to make up his mind upon this matter; and, at all events, let him know, that some serious mistakes have nearly been made: "upon the very bold operation of cutting out these concretions, when lodged in the colon, proposed by Dr. Monro, senior (see *Monro's Morbid Anatomy of the Human Gullet*, &c. p. 63), we think it our duty to state, that the diagnosis is so difficult, that in one case, where the operation was strongly advised, it turned out, upon dissection, that the disease was a *scirrhus pylorus*." (See *Edinb. Med. and Surg. Journ.* No. xxxiii. p. 112.)

Sometimes patients ultimately get well by voiding the concretions either by vomiting or stool. Mr. C. White gives us an account of some instances of this kind: in one, fourteen concretions on plum-stones were discharged from the anus; in another, twenty-one similar bodies were ejected from the stomach.

When such concretions are not particularly large and indurated, they sometimes admit of expulsion by castor-oil, oleaginous clysters, &c. But, in other instances, their extraction must be attempted, if their situation in the rectum will permit. It may be done with a pair of lithotomy forceps, or with a sort of scoop used for taking fragments of stone out of the bladder. In this manner Mr. C. White succeeded in removing two alvine concretions from the rectum, nearly as big as his fist. When the sphincter ani will not allow the concretion to be taken out, the muscle should be divided at its posterior angle. According to Richerand, such a division does not permanently weaken its fibres in a perceptible degree, and its paralysis never originates from this cause. (*Nosogr. Chir.* t. iii. p. 434, edit. 4.) Maréchal, after a proper dilatation with a scalpel, extracted from the rectum an alvine concretion, which weighed two ounces and a half, and was of an oval form; its greater diameter being two inches eight lines, and its smaller, one inch seven lines. (See *Mém. de l'Acad. de Chir.*)

*Alb. Haller*, De Calculis Felleis frequentioribus, 4to. Güt. 1749. *Walther*, De Concrementis Terrestribus in variis Partibus Corporis humani repertis *Pol. Acol.* 1775. *Vicq d'Azyr*, Hist. de la Société Royale de Méd. 1779. *Durande*, Mémoires sur les Pierres biliaires, et sur l'efficacité du Mélange d'Éther vitriolique et d'Esprit de Térébinthine dans la Colique hépatique produite par ces Concretions, vol. i. des *Mém. de l'Acad. de Dijon*, 8vo. p. 199, an 1783. *S. T. Soemmering*, De Concrementis biliaris Corporis humani, 8vo. Traj. ad Rhen. 1795. *B. Brunie*, Essai sur les Calculs biliaires, 4to. Paris, 1803. *Fourcroy*, *Mém. de l'Acad. des Sciences*, 1789. et *Syst. de Connoissances Chim.* t. x. p. 53—60. *Dr. Bostock*, in *Nicholson's Journal*, vol. iv. p. 137. *Marcet's* Chemical History and Medical Treatment of Calculous Disorders, 8vo. Lond. 1817. *J. F. Meckel*, *Handbuch der Pathol. Anat.* b. ii. p. 455, &c. *Leipzig*. 1818. *P. Rubini*, Pensieri sulla varia Origine e Natura de'Corpi calcolosi che vengono talvolta espulsi dal Tubo gastrico, Memoria, 4to. Verona, 1808. *James Kennedy*, An Account of a Morbid Concretion discharged from the Rectum, and in its Chemical Characters closely resembling Ambergris; see *Medico-Chir. Journal*, vol. iv. p. 177, &c. 1817. *Monro's* Morbid Anatomy of the Human Gullet, Stomach, and Intestines, 8vo. Edinb. 1811. *E. Sandifort*, *Mus. Anat. Lugd. Bat.* Leidæ, Nov. 1793. *Moscovius*, Diss.

de Calculorum Animalium, eorumque imprimis biliosorum Origine et Natura. Berol. 1812. Cases in Surgery, by *C. White*, 8vo. Lond. 1770. p. 17. *Philos. Trans.* abridged, vol. v. p. 256, et seq. *Edinb. Med. Essays and Obs.* vol. i. p. 301. *Ibid.* vol. v. p. 431. *Essays, Phys. and Literary*, vol. ii. p. 345. *Leigh's* Natural History of Lancashire, plate l. fig. 4. *W. Hey's* Practical Obs. in Surgery, p. 507, ed. 2. *Thomas*, in *Med. Chir. Transactions*, vol. vi. p. 98. *T. Brayne*, An Account of Two Cases of Biliary Calculi, of extraordinary Dimensions; *Med. Chir. Trans.* vol. xii. *Ure's* Chemical Dict. articles Intestinal Concretions and Gall-stones. *G. Andral*, Précis d'Anatomie Pathologique, t. ii. p. 163, 8vo. Paris, 1829. *Ikin*, *Lancet*, vol. i. 1835—36, p. 965. *Cruveilhier*, in *Anat. Pathol.* livr. xxvi. fol. Paris, 1837. For an account of adipocirous and fatty concretions in intestines, see *Elliotson's* Lectures, and his papers in *Med. Chir. Trans.*; also *Good's* Study of Medicine, vol. i. p. 251, ed. 4.

[INTESTINAL OBSTRUCTIONS may be classified under two heads: those which are *sudden* in their operation and depend upon direct strangulation of some portion of the intestinal tube; and those which are *slow* in their effect, and are consequent on morbid conditions of the coats of the bowel itself, or of disease originating in some other organ, and affecting the bowel secondarily. Under the former heading may be ranked all kinds of external hernia, and every possible variety of internal strangulation and hernia. For varieties of hernia (see Article HERNIA.)

The sources of rapid internal obstruction are very numerous; the chief being intussusception, strangulation by bands of false membrane, by the remains of the omphalo-mesenteric vessels, by an abnormal aperture, whether of the omentum, mesocolon, or mesentery through which a portion of bowel has passed, a twist of the bowel; these are especially referable to the small intestines. On the other hand, a twist of the sigmoid flexure, malignant disease of the colon, and especially of its sigmoid flexure, diseases leading to enlargement of, or outgrowths from, other organs, affections of the rectum, whether congenital or morbid, (see ANUS, imperforate, and RECTUM, stricture of), functional derangements; these, for the most part, may be ranked among the sources of slow obstruction, and are associated with the large intestine. At the same time, it will be readily understood that both the large and the small intestines are occasionally conjointly concerned in the production of intestinal obstruction, as for example in intussusception.

Having simply enumerated some of the many causes of intestinal obstruction, we will proceed to the consideration of symptoms common to many varieties before attempting to form a differential diagnosis.

*Symptoms.*—The chief of these is obstinate constipation, attended sooner or later by vomiting, the ejecta being the contents of the stomach, then bilious, and lastly stercoraceous matter, or more probably the contents of the small intestine; distension of the abdomen, due to the presence partly of fluids and partly of gases within the bowel which is on the proximal side of the obstruction; pain of variable character and intensity, sometimes referred to one spot and rendered severe on pressure, at other times relieved by pressure, and diffused; occasionally paroxysmal, sometimes dull and permanent; a dragging rather than actual pain is expressed by the sufferer in some cases. The secretion of urine is variable in quantity, as will be hereafter explained.

In accordance with the position, intensity, and nature of the obstruction will general prostration



and anxiety of countenance be present, and be attended sooner or later by symptoms of inflammation.

It will be convenient to refer to these symptoms in relation to the particular form of obstruction with which each may be associated, and in the order of frequency in which each lesion is supposed to occur in the human subject. It will also obviously be a matter of first importance to determine the seat of obstruction, whether it be in the small or large intestine.

*Obstructions in the Small Intestine.*—This portion of the alimentary canal will probably be the seat of mechanical obstruction, if the above symptoms set in rapidly and with great severity. *Constipation* will be obstinate, but occasionally, not until the lower bowel has disposed of its contents, as is observed in certain cases of external hernia. *Vomiting* will set in after the lapse of from one to several hours, in proportion as the obstruction to the onward passage of the contents of the bowel be near, either to the stomach or to the ilio-cæcal valve, and in a similar degree will the nature of the vomited matters be changed from the simple contents of the stomach to bilious matter, and the contents of the small intestine. Even to this rule an exception exists, and, as in a case recorded by Dr. Bird and Mr. Hilton, vomiting may not set in until after the lapse of days from the supposed date of obstruction. This delay depends probably upon the empty condition of the stomach and bowels above the seat of stricture at the time the lesion occurs, and upon the patient subsequently partaking of food, which gradually accumulates and becomes a source of irritation. Thus, at length, peristalsis is excited and vomiting supervenes. (*Med. Chir. Trans.* vol. xxx. p. 51.)

The presence of the contents of the bowels in the ejecta is usually ascribed to the reversed action of the intestines; but this so-called theory of anti-peristalsis is believed by Dr. Brinton to be founded on error. "The movement proper to the healthy intestine is a circular constriction or peristalsis, which, travelling slowly down its muscular wall, propels its contents in a direction from the stomach to the anus, and, when any part of the intestine has its cavity obliterated by an immovable mechanical obstacle, its contents, propelled by such a peristalsis, are stopped at the obstructed point. Here they gradually accumulate, so as first to fill and then to distend a variable length of the canal, with a more or less liquid mass. But a peristalsis, engaging the wall of a closed tube filled with liquid, and falling short of obliterating its calibre, sets up two currents in that liquid: one of the surface or periphery of the tube, having the direction of the peristalsis itself, and one in its centre or axis, having precisely the reverse course. Those particles of the liquid which are in contact with the inner surface of the tube, are propelled onwards by the muscular contraction of its walls, and the propulsion is necessarily accompanied by a backward current in those particles which occupy the axis or centre of the canal. . . . Amongst the circumstances which modify this process are the following:—1. The dilatibility of the obstructed bowel, which, on the one hand, by yielding to the pressure of peristalsis, delays and opposes the axial current, while on the other (since the intestine acquires much of its increased width at the expense of its normal length) it diminishes the length through which this current must extend to provoke faecal vomiting. 2. The paralysis, which sooner or later results from increasing distension,

removes, as it were, the point of reflection of the peristalsis, or the commencement of the axial current to a higher point of the bowel. 3. In the large intestine, the presence of faeces above the obstruction seems sometimes to have a temporary effect of the same kind; the impacted mass forming a secondary obstruction, to and from which the peristalsis and its reflected current respectively tend." (*See Croonian Lectures, Lancet*, April 30, 1859.)

*Distension of the Abdomen* consequent on the accumulation of gases and fluids in the bowels, will be less remarkable in obstruction of the small than it will be in a similar condition of the large intestine, in proportion as the obstacle be near to or at a distance from the stomach. It will also increase with the duration of the disease, by the gradual failure and cessation of the peristaltic action of the bowel, the muscular coat of which, becoming fatigued and paralysed by its unsuccessful endeavours to overcome the obstacle, gradually yields to the increasing accumulation within, and is no longer able to maintain the natural calibre of the tube. This distension is more distressing than absolutely painful to the sufferer, excepting when the bowel repeats its efforts to liberate itself, rolling, tumbling, and compressing its contents so as to give rise to unpleasant sensations and gurgling noises, attended by cramps, as they are termed; and presently perhaps to be followed by eructation and an interval of abdominal repose, while the imprisoned bowel recovers its strength for a fresh attempt. These fits of peristalsis are of use in a diagnostic point of view, not only from the fact that they may sometimes be both seen and felt through the abdominal wall, but because the patient is often able to indicate the course of the contents of the intestine by these movements and the sensation communicated by the passage of gas through fluids, causing gurglings. The greater amount of uneasiness is experienced at the close of this fit; doubtless at the moment when the portion of bowel immediately adjoining the stricture becomes the seat of this action. Again, gurglings in the small intestines are usually referred to the umbilical region, the greater protrusion of the abdominal wall being also umbilico-hypogastric, with a corresponding flattening along the course of the colon. The possibility of introducing a flexible tube per anum to the extent of several inches, and of injecting a copious enema into the larger bowel, will direct the surgeon's attention to the small intestine.

*Pain* in connexion with mechanical obstruction of the small intestine, varies greatly both in degree and character. In one instance it will be severe localised, and attended by prostration, indicating most probably a sudden and tight constriction of the higher bowel; at another time it is paroxysmal and contemporaneous with peristalsis; while at a later period it is constant, augmented by pressure, and apparently increased by peristalsis, indicating the accession of inflammation. Unless always referred to one spot, pain is not a valuable symptom in reference to the locality of the obstruction.

*Secretion of Urine.*—It is worthy of note that, in very many instances of obstruction in the higher part of the small intestine, attended by vomiting, very little if any urine is passed. This circumstance is thus accounted for by Dr. Barlow (*Guy's Hospital Reports*, series ii., vol. ii.):—"In cases of this nature, where no fluids can pass into the alimentary canal, and where, in consequence,

none can be absorbed, we should be led to expect, *a priori*, that the urine would be very little in quantity. We have, then, rational grounds for believing that in cases of constipation, where the urine is very deficient in quantity, the obstruction is probably at the upper part of the canal; and that where it is abundant, at the lower." In reference to the above explanation, Dr. Brinton says—"I should substitute for it on grounds strictly pathological, at least three or four contingent causes; among which suppressed or restricted absorption by the bowel would find but a very subordinate place. That it has no share in causing such a diminution of urine would be a hardy assertion. But contrasting the copious vomiting seen in some of these cases with the moderate ingestion of fluid often accompanying it, and with the enormous quantity of liquid further found distending the bowel after death, it does seem to me that the effusion of such vast quantities of liquid from the affected tube constitutes by far the most obvious and simple cause for a diminished secretion of urine, especially when viewed by the light derivable from the analogous diminution seen in Bright's disease and Asiatic cholera, in which we may often notice the same mucous surface acting vicariously to the kidney, on the one hand, and depriving it, by a similar process of effusion and expulsion of the watery materials which conditionate its function, on the other hand."

*Prostration and Anxiety of Countenance.*—These constitutional indications of local lesion will be severe in proportion as the obstruction is situated near to the upper end of the intestinal tube, and consequently in proximity to the solar plexus. A similar effect is often produced in cases of strangulated umbilical hernia, and probably for a similar reason. Also, the tighter the stricture is the more firmly are the filaments of the sympathetic nerve compressed, and probably in an equal ratio will prostration ensue.

*Obstructions in the Large Intestine.*—The symptoms indicative of sudden mechanical obstruction in the course of the small intestine, are more or less common to obstructive disease of the larger bowel, but in the latter case they are usually less severe in their character, though not less sure to present themselves, if sufficient time be afforded to fulfil their anatomical requirements.

*Constipation* is of course decided; *vomiting* and extreme distension set in after the lapse of days rather than of hours; the vomiting being later in its appearance by reason of the greater length of tube which must be filled before that peristalsis can produce the backward current already referred to. For instance, in a case recently in the London Hospital, in which constipation had existed nineteen days, and where the obstruction was believed to be at the upper part of the rectum, sickness had occurred once only, and then after a dose of croton oil. Mr. Adams performed Amussat's operation upon this case on December 4, 1861, and relieved the constipation. The distension at length becomes excessive, partly from muscular fatigue and relaxation, and partly in proportion as the whole or portion of the large as well as small intestine become occupied by gases.

The *pain* is rarely severe, while the passage of these gases to and fro through the more or less fluid contents of the large intestine is appreciated by the patient, and will often assist the practi-

tioner to recognise the seat of obstruction. In some instances, the abdominal wall being thin, the sacculi of the distended transverse colon may be recognised by palpation, while percussion may enable us to detect, by the varying sounds which it elicits, the local obstruction. Thus, supposing the seat of stricture to be in the sigmoid flexure of the colon, the larger bowel may be distended and resonant up to or near to the left iliac region, while that region itself yields a dull sound on percussion, from the detention of solid and fluid matters above the seat of stricture. Dr. Brinton is of opinion that fluctuation of the fluid contents of a distended bowel, may sometimes be detected. If so, it would be local, and distinguishable from general peritonitic effusion.

*Diagnosis.*—The above described symptoms refer generally to obstructive bowel disease; but, in order that treatment may be at all appropriate to any particular instance, the practitioner must enlist other assistance in his service, and in contemplating a case of obstinate constipation should endeavour to reply to the question, *where* is the obstruction seated? Let him ascertain, whether or no the patient be the subject of external hernia, and if he be, what is the normal condition of that hernia, and if any alteration have taken place in it, whether or not the alteration and onset of the symptoms of obstruction have any relation in reference to cause and effect. Should strangulation exist, the course to be adopted is evident. But, to the enquiry, are you ruptured? an answer in the negative should not suffice; a careful manual exploration must be instituted of all the regions, common and uncommon, in which hernia may occur, and this exploration is more absolutely necessary in the case of females, who, from timidity or delicacy are induced sometimes to make a false statement. The case of Queen Caroline, consort of George II., is a remarkable instance. Failing to detect an external strangulation, the pathological history of the patient must be interrogated with a view to determine the cause of the symptoms. Thus, early age will suggest the possible presence of intussusception; a previous dysentery or peritonitis will indicate false bands of organised lymph, or a glueing together of the abdominal contents, provided that there be little distension; a severe but perhaps short illness, attended by excruciating pain in the region of the liver with or without jaundice, will suggest the presence of a gall stone. These are some of the many sources of obstruction in the small intestine. A comparison between the present and past state of health in reference to the possible presence of malignant disease leading to stricture, probably of the colon at some point, and if so, the nature of the alvine evacuations lately passed, must be enquired into, while the condition of the rectum and its relation to other organs is ascertained by a careful digital examination. Any unnatural discharge from the rectum should be examined by the microscope. These and a few others are sources of obstruction in the large intestine. Having thus thoroughly examined every feature of the case, both as exhibited by the condition of the patient and his past history, the practitioner arrives at the conclusion that one or other form of obstruction is present, but he cannot determine precisely its etiology.

*Prognosis.*—The probable termination of a case of obstinate constipation, so wrapped in obscurity



as to its cause, cannot but be regarded with anxiety, and it will be well for the practitioner, both in justice to himself and to the friends of the sufferer, to express a decidedly unfavourable prognosis. In the instance of mechanical obstruction in the small intestines the hope of obtaining relief from drugs is indeed slight, while the surgeon's art, if called to the aid of medicine, inflicts an injury from which few recover.

*Treatment.*—Cause of obstruction *doubtful*. When contemplating a case of intestinal obstruction, the following question will at once arise in the mind of the practitioner: where is the seat, and what is the nature of the obstruction? In some instances the symptoms may be sufficiently decided and will respond at once to the above query, but in the majority of cases approximation to the truth will not be reached. Under such circumstances, general principles of treatment must be adopted. The first indication is, to restore the natural channel of the intestine and to relieve constipation. To effect this object, provided that there be no distinct indication of mechanical obstruction, an aperient guarded by a previous dose of opium should be administered by the mouth, while if the above do not suffice after a second or third repetition at most, the colon should be washed out by copious enemata of warm water, or further excited to action by purgative and stimulating injections. There is a possible fallacy in connexion with the use of the flexible tube, for which the surgeon must be prepared. He must not be deceived by a simple disappearance of many inches of tube introduced per anum, and be led thereby to believe that the lower bowel is free, because it will sometimes happen that the extremity of the tube impinging upon some obstacle, such as the promontory of the sacrum, a fold of membrane or morbid growth will yield to the pressure from behind and bend upon itself. To avoid such accident, the fore finger of one hand should be introduced into the rectum to direct and watch the progress of the tube, while the surgeon occasionally removes the pressure in order to give the tube an opportunity of recoiling, if it should have met with an obstacle. Both the tube and the enema should be introduced carefully and slowly—carefully, to avoid laceration of the bowel; slowly, to give the bowel an opportunity of accustoming itself to increasing distension. The use of the flexible tube in a diagnostic point of view is shown in a case related by Dr. Barlow (*Guy's Hospital Reports*, Series ii. vol. ii. p. 389) in which fatal obstruction arose from a twist of the sigmoid flexure to the right side. "The extremity of the tube was most distinctly felt in the right hypogastric region." In reference to the flexible tube, Mr. Gowland insists upon its being well softened in hot water, and also that as it advances along the bowel this latter should be prepared to receive the tube by previous distension with water. He believes that on one occasion, occurring at the London Hospital, the tube passed as far as the ileo-cæcal valve, the water being heard flowing from the tube, by the ear applied over the right iliac fossa. The autopsy showed the seat of strangulation to be at the lower part of the ileum. These means having been fairly tried and perhaps proved to be rather injurious than useful, aperients must be abandoned and a soothing and sedative mode of treatment be adopted. Opium by the

mouth and per rectum should be freely administered; it alleviates pain, supports the strength, procures sleep and tends to check peristalsis, and by so doing not only prevents the accession of inflammation by insuring rest to the bowel, but also affords nature the time and opportunity to effect any reparative action that may be necessary to recovery. Although the value of opium cannot be over-estimated, there is one disadvantage associated with its use—it masks symptoms and morbid changes which might be acted upon with advantage to the patient, if recognised by the practitioner as soon as developed. Bearing in mind this delusive effect of the drug, the surgeon must endeavour to detect the progress of disease through the opiate atmosphere in which he has enveloped his patient.

The *second* indication is to prevent and subdue inflammation; by the combination of calomel and antimony with opium, by the local application of leeches, or even by venesection, provided the symptoms of peritonitis or enteritis be sufficiently severe, and the vascular system be tolerant of depletion, as indicated by a hard, resisting, and perhaps small pulse.

*Thirdly*, the strength should be supported by the administration of nutrient enemata, should the stomach be intolerant of food; while thirst may be allayed by portions of ice allowed to melt in the mouth. By thus husbanding the patient's powers, and affording nature the opportunity of working some beneficial change within, the constipation will sometimes, however unexpectedly, be relieved, and a recovery result. Under any circumstances, the patient's sufferings will be alleviated, his life may possibly be prolonged, and hope expires only with his last breath.

*Lastly*. We would again insist upon a cautious employment of aperients, whether vegetable or mineral. If, under their use, vomiting continue or become stercoraceous, and abdominal distension be on the increase, we may be certain that the time for such treatment has passed, and that it cannot be continued with impunity.

*Abdominal Manipulation and Posturing.*—No evidence of ulceration being present, and the patient being completely under the influence of chloroform, and muscular volition in abeyance, the abdomen should be relaxed as much as possible by flexing the thighs and chest upon the former cavity. The abdomen is now to be gently but thoroughly kneaded in every possible direction by the hands of the operator, while the posture of the trunk is as often changed, with the hope that some fortunate alteration may take place amongst the viscera within—such as the untwisting of the bowel, the restoration of an invagination to its normal position, or the dislodgment of a gall-stone. The surgeon's attention and manipulations should especially be directed to the suspected seat of obstruction. In a case treated by Mr. Childs, the symptoms were removed by placing the patient upon his head. In a case of obstruction under the writer's care in the London Hospital (*Lancet*, Dec. 1861), a thorough kneading and shaking of the contents of the abdominal cavity caused a discharge of flatus, and was followed by recovery. (See also *Med. Times*, Nov. 22, 1856, p. 515, case reported by Mr. J. Long.)

*Typical forms of Intestinal Obstruction.*—Intussusception or intromusception, volvulus. A disease produced by the passing of one portion of an intestine

into another, commonly the upper into the lower part. Of about 600 necropsies of internal intestinal obstructions analysed by Dr. Brinton, the frequency was in favour of intussusception, being 43 per cent., while the different parts of the intestinal canal are affected with the following proportionate frequency:—"In 56 per cent. the ileum and cæcum are carried into the succeeding large intestine; the cæcum and colon becoming inserted to a variable distance from the ileo-cæcal valve inwards, to form a middle layer, the interval between which and the ileum contains a variable length of the vermiform appendix. There the ileo-cæcal valve generally forms the lower end of the intussusception. In 32 per cent. the small intestine forms all the layers, and of these 32, in 25 the ileum is specified (though, I think sometimes inexactly) as the seat of the lesion, the jejunum only three times.

"In 12 per cent. the colon including the end of its sigmoid flexure is the bowel exclusively involved. The rectum scarcely ever forms more than the outer layer of an intussusception which has descended into it from above. Half the large class of ileo-cæcal intussusceptions are infants under seven years of age; many but a few months old. In them the occurrence of the lesion immediately followed a casual or artificial diarrhœa; a coincidence which also obtained in some of the adults."]

On this subject, Mr. Langstaff remarks, that the small intestines of children are so often affected with intussusception, in a slight degree, that most practitioners must have had opportunities of observing this form of the complaint. The greater part of three hundred children, who died either of worms or during dentition, at the Hôpital de la Salpêtrière, and came under the examination of M. Louis, had two, three, four, and even more examples, without any inflammation of the parts, or any circumstances leading to a suspicion that these affections had been injurious during life. "These cases (says M. Louis) seem to prove, that intussusception may be formed, and destroyed again by the mere action of the intestines." (*Mém. de l'Acad. de Chirurg.* 4to. t. iv. p. 222.) This opinion is confirmed by the authority of Dr. Baillie (*Morbid Anatomy*, 2d edit. p. 162), who observes, that in "opening bodies, particularly of infants, an intussusception is not unfrequently found which had been attended with no mischief; the parts appear perfectly free from inflammation, and they would probably have been easily disentangled from each other by their natural peristaltic motion." A rare example is on record, where the displacement existed at birth. (*Beirceil, De Intestinis se intussuscipientibus, &c.* Helmst. 1769.)

According to Mr. Langstaff, the disease assumes a more dangerous, and, indeed, generally a fatal form, when it occurs at the termination of the small intestines in the cæcum. A contracted state of the part to be intussuscepted, and a dilatation of that portion of the canal, into which this part must pass, are essential conditions to the formation of an intussusception; and they exist nowhere so completely as in this situation. The extent to which the affection here proceeds would appear almost incredible, if it were not proved by well-authenticated facts. A person who considered the natural situation and connexion of the parts, would of course require the strongest evidence before he would believe that the ileum, cæcum, ascending and transverse portions of the colon, may descend

into the sigmoid flexure of the latter intestine; nay, more, that they may pass through the rectum, and be protruded in the form of a procidentia ani. Such cases, however, are recorded. (See *Lettson's Case in Phil. Trans.* vol. lxxvi.; and *Langstaff, in Edin. Med. and Surg. Journal*, No. xi.)

Mr. Langstaff relates the case of a child three months old, the body of which he inspected after death, and found to confirm the truth of the preceding account. The example was particular, in there being, in addition to an extensive intussusception in the usual way, a smaller invagination in the opposite direction, like what probably occurred in the case related by Mr. Spry. (*Med. and Physical Journal*, No. xi.) Sir E. Home mentions a retrograde intussusception, in which a worm was found coiled up round the intussuscepted part. The disease took place in a boy who had swallowed arsenic. (See *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i.)

If the following mode of accounting for intussusception be just, it will most frequently happen downwards, although there is no reason why it may not take place in a contrary direction; in which case, the chance of a cure will be increased by the natural actions of the intestinal canal tending to replace the intestine; and, probably, from this circumstance, it may oftener occur than commonly appears.

When the intussusception is downwards, it may be called *progressive*, and when it happens upwards, *retrograde*. The manner in which it may take place is, by one portion of a loose intestine being contracted, and the part immediately below relaxed and dilated; under which circumstances, it may very readily happen by the contracted portion slipping a little way into that which is dilated, not from any action in either portion of intestine, but from some additional weight in the gut above. How far the peristaltic motion, by pushing the contents on to the contracted parts, might force these into the relaxed, Mr. Hunter could not determine, but he was inclined to suppose that it did not have this effect.

*Mechanism.*—An intussusception is composed of three layers of bowel, an inner, middle, and outer: the inner, being a prolongation of the upper portion of the intestinal canal into the lower or receiving portion; the middle, being the inverted portion, having its mucous surface directed outwards towards the mucous surface of the outer layer, and its serous surface directed inwards towards the serous surface of the inner layer; the outer contains the middle and inner folds of bowel. The outer fold is the only one which is active, the inverted portion being perfectly passive, and squeezed down by the other, which inverts more of itself, so that the angle of inversion in this case is always at the angle of reflection of the outer into the middle portion or inverted one, while the innermost is drawn in. From this we can readily see how an intussusception, once begun, may have any length of gut drawn into it. The external portion, acting upon the other folds in the same way as upon any extraneous matter, will, by its peristaltic motion, urge them farther; and, if any extraneous substance is detained in the cavity of the inner portion, that part will become a fixed point for the outer or containing intestine to act upon. Thus it will be squeezed on, till at last the mesentery



preventing more of the innermost part from being drawn in, will act as a kind of stay, yet without entirely hindering the inverted outer fold from going still farther. For it being the middle fold that is acted upon by the outer, and this action continuing after the inner portion becomes fixed, the gut is thrown into folds upon itself; so that a foot in length of intestine shall form an intussusception not more than three inches long.

The outer portion of intestine is alone active in augmenting the disease when once begun; but if the inner one were capable of equal action in its natural direction, the effect would be the same, that of endeavouring to invert itself, as in a prolapsus ani; and the outer and inner portions, by their action, would tend to draw in more of the gut, while the intermediate part only would, by its action, have a contrary tendency.

The action of the abdominal muscles cannot assist in either forming or continuing this disease, as it must compress equally both above and below, although it is capable of producing the prolapsus ani.

From the natural attachment of the mesentery to the intestines, one would, at the first view of the subject, conceive it impossible for any one portion of gut to get far within another; as the greater extent of mesentery that is carried in along with it, would render its further entrance more and more difficult, and we should expect this difficulty to be greater in the large intestines than in the small, as being more closely confined to their situation; yet one of the largest intussusceptions of any known was in the colon, as related by Mr. Whately. (See *Phil. Trans.* vol. lxxvi. p. 305.) The intussusception appeared to have begun at the insertion of the ileum into the colon, and to have carried along with it the cæcum and its appendix. The ileum passed on into the colon, till the whole of the ascending colon, the transverse arch, and descending colon, were carried into the sigmoid flexure and rectum. The valve of the colon being the leading part, it at last got as low as the anus; and when the person went to stool, he only emptied the ileum; for one-half of the large intestines being filled up by the other, the ileum alone, which passed through the centre, discharged its contents. (*J. Hunter.*)

[It will be readily conceived that a short invagination, which, though it must necessarily narrow, need not at once completely close the intestinal tube, cannot long remain patent, inasmuch as the presence of the invagination within a portion of bowel becomes itself a source of irritation, inducing peristalsis in its recipient, and thereby increasing the intussusception. By exercising compression, vascular congestion and swelling set in, the canal is obstructed thereby, and if the lesion persist, inflammation, ulceration, and sloughing will almost surely follow. These changes doubtless result from the pressure exercised by the outer fold upon its contents, which induces inflammation in the bowel immediately above the obstruction by opposing a barrier to the onward passage of its contents, and, by cutting off the supply of blood to the invagination, tends to produce sloughing of the same. The sloughing, although morbid in its origin, may, in one sense, be regarded as conservative in its progress, for by it the obstructing intussusception is cast off, and the channel restored to the intestinal tube. Referring to the mechanism

of intussusception, Dr. Brinton says: "The immediate cause of the displacement must be sought, not only in an abnormal violence, extent, and abruptness of that contraction of the transverse muscular layer which is one element of peristaltic movement, but in a deficiency of that co-ordinate contraction of the longitudinal fibres which is an equally important, though less energetic, constituent of healthy peristalsis. The sudden and forcible constriction of a considerable length of bowel, forced, as it were, behind by the hitherto unrelaxed contraction from which it has extended, and bounded in front by a relaxed and flaccid bowel (unstretched by the due contraction of its longitudinal fibres), must, as it suddenly diminishes the width of the segment it involves, simultaneously increase its length; and thus push a variable portion of it into the succeeding dilated segment. This explanation, which seems to be a simple and incontrovertible application of the laws of intestinal movement to the facts of intussusception, refers the lesion to two causes, an active and a passive, one thrusting the bowel forwards into the next segment, and the other permitting this segment to receive it. The liability to this displacement seems to increase with the proximity of the small intestine to the ilio-cæcal valve. And this increase seems referable (like the effect of diarrhœa) to some general peculiarity in the muscular action of the end of the ileum, which may equally affect both the above conditions of invagination. But the remarkable frequency of the ilio-cæcal invagination seems to depend on three circumstances: an irregular activity of the ileum, a resistance by the valve itself, and a laxity (probably congenital) of the cæcum. The first tends to invaginate the end of the ileum; the second prevents the bowel from being forced through the valve; the third permits the pliable cæcum to form the middle and outer sheaths."

In the *Medical Times* for Nov. 3, 1855, p. 456, a case of double intussusception is mentioned. It occurred in the practice of Mr. H. Guy. The patient was four months old, and on the occasion of the fatal attack awoke screaming, and died in sixty-six hours. The autopsy disclosed a double intussusception, one in which the cæcum and ascending colon were received into the transverse colon, the other in which the ileum appeared to have been recently received by the latter. The cæcum and ascending colon looked like a dark, firm clot of blood. Blood had passed per anum on the day of death.

*Diagnosis.*—The symptoms of intussusception are more or less common to other abdominal affections: as enteritis, many forms of mechanical intestinal obstruction, idiopathic ileus. It is ushered in by sudden and severe pain referred to a particular locality, attended by constipation, vomiting, and distension, and some depression and anxiety of countenance. Early age and the existence of diarrhœa favour the probability of the presence of intussusception. Should the lesion persist, tenesmus, with sanguineo-mucous discharges per anum, may possibly occur—the former being a prominent symptom in proportion as the lesion is near to the anus. Of all the diagnostic signs, the existence of a tumour, felt either through the abdominal wall or per rectum, appearing at the anus or voided at stool, is the most conclusive.]

In cases related by Mr. Hunter, Mr. Thomas Blizard (*Med. Chir. Trans.* vol. i. p. 170), and

Mr. Spry, the seat of the disease was clearly denoted by a hard tumour on the left side of the abdomen. This circumstance, together with the impossibility of throwing up more than a very small quantity of fluid in gylsters (*Hevin, Spry, Langstaff*), and the presence of the other symptoms, would lead us to suspect the nature of the disorder. If the invaginated portion descended so low as to protrude through the anus, and we could ascertain that it was not an inversion of the gut, the case might be considered as clear, and we should have no hesitation in delivering a prognosis.

It must be confessed, that both surgery and medicine are almost totally unavailing in the present disease; yet here, as in many other instances, the resources of nature are exhibited in a most wonderful and astonishing manner, while those of art completely fail. The invaginated portion of intestine sometimes sloughs, and is discharged per anum, while the agglutination of the parts preserves the continuity of the intestinal canal. The annals of medicine furnish numerous instances, in which long pieces of gut have been discharged in this manner, and the patient has recovered. Hence, some hope may be allowed under the most unpromising circumstances. In a case related in *Duncan's Commentaries*, vol. ix. p. 278, eighteen inches of small intestine were voided per anum. Three similar instances occur in *M. Hevin's Memoir*; twenty-three inches of colon came away in one of these, and twenty-eight of small intestines in another. Other cases occur in the *Physical and Literary Essays*, vol. ii. p. 861; in *Duncan's Annals*, vol. vi. p. 298; in the *Med. Chir. Trans.* vol. ii., where Dr. Baillie states that a yard of intestine was voided. The patients did not, however, ultimately survive in every one of these instances. (*Langstaff, in Edinb. Med. and Surg. Journal.*) A very interesting case, in which a recovery was effected on this principle, and in which from 15 to 18 inches of the ileum were discharged from the anus, was recorded by Mr. Bush (1823) in the *Med. and Phys. Journ.*

Langenbeck has recorded an instance, in which a prolapsus of the large intestines protruded half an ell out of the anus. The disease had lasted thirty weeks. Langenbeck made an incision into, or rather through, the protruded inverted bowel, immediately below the sphincter ani. He first divided the inner vascular coat, then the muscular, and lastly the outer coat, with great caution. He now discovered, within the protruded inverted bowel which he had opened, another part of the intestinal canal, which was not yet inverted. He remarked upon it the appendices epiploicæ, and the white shining peritoneal coat. This last portion would also have become inverted had the disease continued. He next reduced the latter uninverted part, and afterwards succeeded in replacing the rest of the protrusion; which did not fall down again when the boy had stools. No bad symptoms immediately followed; but the lad, being very weak, survived only eight days. (See *Bibl. für die Chir.* b. iii. p. 756. Gott. 1811.)

In the example recorded by Mr. Thomas Blizard, the lower part of the ileum, immediately above the intussusception, was a little inflamed; "but otherwise the effects of the derangement of parts were so strictly confined to the intussuscepted bowel, that, had the child's constitution been able

to sustain its separation, the inflammation necessarily accompanying this process would, no doubt, have produced an union of the ileum with the lower part of the colon; the continuity of the canal would thus have been maintained, the separated part might have passed, and the child have recovered." (*T. Blizard, in Med. Chir. Trans.* vol. i. p. 170.)

[*Prognosis.*—Judging from the above cases, and from Dr. Brinton's analysis, "that probably no less than thirty or forty per cent. of suspected intussusceptions recover," either by resolution or by casting off the invagination, the practitioner would be able to hold out the hope of a possible, if not probable, recovery from the immediate disease; at the same time, not forgetting the possible consequences of the lesion; such as death from exhaustion, even after expulsion of the invagination, and the formation of false membranes and cicatrices between the viscera, which may hereafter become sources of fatal strangulation.]

*Treatment.*—In the treatment of intussusception, bleeding, to lessen the inflammation that might be brought on, and quicksilver, to remove the cause, have been recommended.

Quicksilver would have little effect either in one way or the other, if the intussusception were downward; for it is to be supposed that it would easily make its way through the innermost contained gut, and, if it should be stopped in its passage, it would, by increasing its size, become a cause (as before observed) of assisting the disease. In cases of the retrograde kind, quicksilver, assisted by the peristaltic motion, might be expected to press the intussusception back; but even under such circumstances it might get between the containing and inverted gut into the angle of reflection, and, by pushing it farther on, increase the disease it is intended to cure. (*J. Hunter.*)

Everything that can increase the action of the intestine downwards is to be particularly avoided, as tending to increase the peristaltic motion of the outer containing gut, and thus to continue the disease. Medicines can never come into contact with the outer fold; and, having passed the inner, can only act on the outer farther down, and therefore cannot immediately affect that portion of the outer which contains the intussusception; but we must suppose that whatever affects or comes into contact with the larger portion of the canal, so as to throw it into action, will also affect by sympathy any part that may escape such application.

[It appears to us that the treatment of a case of this kind must be conducted on one of two principles, the selection of either being allowed to depend upon the duration of the affection. Supposing the lesion to have existed a short time only, say two or three days, and the symptoms of inflammation be not severe, active means may be had recourse to. These consist especially in the employment of copious enemata, either of warm water or of gruel, carefully, slowly, but perseveringly injected per anum (under chloroform, if necessary); the object being to endeavour to dis-tend the large intestine, the probable recipient of the invagination, and to exercise pressure upon the intussusception, with the view to push it back to its normal relative position. This failing, after one or two repetitions, inflation, as adopted with success by Mr. Erichsen (*Science and Art of Surgery*, edit. 3, p. 945,) should be tried.



Thus, the treatment is confined to the bowel below the obstruction, such being the indication from the peculiar nature of the lesion. Purgatives by the mouth are by no means to be employed, since they cannot but assist in the maintenance and increase of the affection, by exciting useless and injurious peristalsis. Supposing the disease to persist, and with the knowledge of the fact that, notwithstanding the accession of inflammation, ulceration, and sloughing, nature occasionally works a cure, the practitioner should have a sufficiency of resolution and moral courage to enable him to resist the temptation to employ active measures; he should know how to wait, and give nature the opportunity of doing that which his art cannot avail to effect. But he may assist nature by *palliative* treatment, by arresting or checking excessive inflammation by the local application of leeches, by the free administration of opium, and by supporting the strength of his patient with nourishing enemata. In the early stage, copious enemata are of great use, purgatives always injurious; in the later stage, enemata even may be injurious, by interfering with the process of repair, which can alone afford the sufferer a chance of life. The most absolute rest in bed should be maintained by the patient, who should not be allowed to move his trunk in the least degree by his own efforts, lest, by disturbing any existing effusions of lymph, thrown out to isolate and repair the lesion, extravasation of the intestinal contents and a fatal peritonitis ensue. For a similar reason, physical examination of the abdomen should be conducted with the greatest delicacy and caution.

*Inflation.*—This method dates from the time of Hippocrates, and is recommended by Haller (*Physiol. Corporis Humani*, tom. vii. p. 95). Like injections of water, it must be resorted to at an early stage of the malady to be of service. It should also induce extreme distension of the bowels, although causing great suffering to the patient, and may be repeated once or twice with intervals of a few minutes: these intervals being employed by the surgeon in kneading and manipulating the abdomen.

For its performance a glyster-pipe and common bellows will suffice, but preference should be given to the double-action enema syringe. This instrument, resting on the edge of a jug or other convenient vessel, half filled with hot water, and worked in that position, will transmit warm air into the bowel. During the performance of the operation the anus must be carefully closed by clothes and compression of the nates. The success of the operation will probably be recognised either by the patient experiencing a sensation as of something giving way, or by gurglings, heard both by the patient and attendants. (See *Case by E. Cousins*, *Brit. Med. Journ.* June 21, 1862.)

*Fluid Mercury.*—Although this agent introduced by the mouth cannot but in all probability add to the lesion present, we believe it might possibly be of use at an early period when introduced per anum, should enemata and inflation fail in the accomplishment of the wished-for object. The patient should lie over upon the right side, with the buttocks well elevated on pillows, or by an inclined plane. A tube is to be introduced per anum to the extent of many inches, when the mercury may be poured through it into the gut, and

when it is supposed to have reached the right bend of the colon, the subject should gradually be raised to the sitting and standing posture, with the hope that the metal may gravitate towards the cæcum, the possible recipient of the invagination.]

*Question of Operation.*—If the equivocal and uncertain nature of the symptoms of volvulus were not sufficient to deter us from undertaking an operation, which, under the most favourable circumstances, could not fail to be extremely difficult, and imminently hazardous to the patient, the state of the invaginated parts would entirely banish all thoughts of such an imprudent attempt; for the different folds of the intestine often become agglutinated to each other, so that they can hardly be withdrawn after death (*Simpson's Edin. Med. Essays*, vol. vi.; *Hevin's 4th Obs.*; *Malcolm's Physical and Lit. Essays*, vol. ii. p. 360; *Hunter, Med. and Chir. Trans.*; and *Soemmering in Trans. of Baillie's Morb. Anat.*); nay, the stricture on the intussuscepted part may cause it to inflame and even mortify. (*Soemmering. T. Blizzard, Case in Med. Chir. Trans.* vol. i. p. 170.) It is very clear that in this state of parts the operation of gastro-tomy would be totally inadmissible, even if the symptoms could clearly indicate the nature of the case, and the affected part could be easily reached and examined.

However, in the *Transylvanian Journal of Medicine* may be found a case, in which Dr. John R. Wilson undertook the operation with success. The patient was a young negro, who had laboured for seventeen days under bilious colic and stercoraceous vomiting, in defiance of every remedy. An incision five inches in length was made in the direction of the linea alba. The portion of intestine involved in the stricture was found to be in the ileum. The bowel was grasped above and below the obstruction, and, after several efforts, the adhesion gave way. The patient soon afterwards voided the mercury which he had taken on the previous day, and rapidly recovered.

[The peculiar character of the lesion, and its possible consequences, whether resolution, casting off the invagination, or a fatal issue, all tend to deter the practitioner from resorting to gastro-tomy as a means of relief. (*Portal, Cours d'Anatomie Médicale*, vol. v. p. 247.) The supposed lesion, if left to itself, has been believed to right itself spontaneously; while, if it persist, so large a per-centage recover from its immediate effects as to enable the surgeon to hold out the hope of recovery by a casting off of the invagination. Should the consequences be fatal, the condition of the parts implicated in the affection show how useless would be the attempt to endeavour to restore the invagination to its natural relative position, and this, too, without taking into consideration the probably fatal result of gastro-tomy itself. Ere an operation could suggest itself to the mind of the surgeon the disease would have done its worst. There will be at least adhesion between the serous surfaces of the inner and middle folds, itself an obstacle to the withdrawal of the invagination; but more than this, the bowel above the lesion, distended and irritated by the long presence of feces, has become inflamed, perhaps ulcerated, and all but perforated at certain points, while the probability of extravasation is prevented by a glueing together of the adjacent and diseased viscera, and by a copious effusion of protecting and conservative lymph. Again, the

undue pressure of the outer fold upon its contents may have led to sloughing of the latter, and thus the only chance of recovery offered to the patient is the maintenance of the continuity of the canal, by the effusion and organisation of lymph, to unite the free edges of the portions of intestine situated on either side of the invaginated bowel.

The attempt to withdraw the invagination would probably lead to rupture of the bowel in most instances, although a successful case has been mentioned above.

*Obstruction from Bands, Adhesions, &c.*—Bands, adhesions, diverticula, lesions of the peritoneum, and impacted gallstones, come next in order of frequency as sources of intestinal obstruction, being, according to Dr. Brinton's analysis, 32 per cent.

These sources of obstruction usually affect the small intestine, and may well be considered together. The symptomatology of these lesions has already been referred to generally under the head of obstructions of the small intestines; and I fear the present state of our knowledge will scarcely enable us to indicate the symptoms by which either of the above may be individually recognised during life as a source of strangulation. (See *Case by Mr. Bryant, in Lancet*, Feb. 25, 1860.)

*Pathology of Bands.*—The diagnosis will be assisted by a careful enquiry into the history of the patient in reference to the possible occurrence at one time or other of certain diseases or injuries which favour the effusion of lymph in the abdominal cavity; such as blows and wounds, hernia, disease of the mesentery, peritonitis, dysentery, or typhoid fever. These affections in some instances lead to the effusion of lymph upon the serous surface of the peritoneum at one or more points, and this exudation, according to its extent and situation, may tend to the glueing together of more or less of the abdominal viscera, and to constrictions of the same during the process of organisation. Also a mass of lymph originally localised and adherent to one organ, or to one portion of intestine, may by contact acquire a second point of attachment to another organ, or to another coil of intestine, and by the change of place of one coil of intestine (for example) in the performance of its functions may become stretched into a band attached at both ends, or, yielding to tension, may give way at one extremity and float loosely in the abdomen, to become, perhaps, in time, the source of strangulation.

Mr. Gay has endeavoured to show that "this band is usually solitary (*Trans. Med. Soc. London*, vol. i. part iii.) and differs from common plastic exudations in the fact that it is rarely, if ever, attached but at its extremities; in having a distinctly glistening surface, as though it possessed a peritoneal investment, continuous with that of the abdominal viscera; in the fact that it is frequently found to be tubular when it stretches from one hollow viscus to another, and forms a channel of communication between them." He also quotes Andral, to show the order of frequency in which the different portions of intestine become the seat of ulcerative and perforating affections: "The jejunum in one; the rectum in four; the colon in twenty-three; the ileum in thirty-eight: and proceeds to show that the production of these bands is the process by which such lesions have been repaired."

In a similar manner, diverticula and the appendix vermiformis may become *adherent* by their originally free extremity to some adjacent organ, and form loops and sources of intestinal obstruction. But although these bands and adhesions may be accounted for by previous disease, instances arise in which the obstructing band may very probably be a relic of foetal life. (See *Meckel, Manual d'Anatomie*, vol. iii. p. 431); also, Struthers (*Anat. and Phys. Observ.* Part I. p. 137, &c.), who says, "Diverticula are of two kinds, true and false." He quotes Monro, who has observed: "There are two kinds of diverticula, original malformations, and those formed consequent upon the protrusion of the intestines. The preternatural appendices occasionally found within the sac of a hernia are generally formed as stated by my grandfather, viz. by the gradual elongation of the side of the intestine, which being tied down becomes gradually elongated into a cul-de-sac of some length. There is also another species of appendix, which seems to be formed by a protrusion of the mucous membrane through the outer coats of the intestine." The true diverticula are congenital. Meckel says, "that their character indicates them to be primitive formations, having the same structure as, and continuity with, the intestinal coats; that they occur almost always at the same part of the intestine, and that the connexion between the umbilical vesicle and the bowel occurs at this same part, viz. on the ileum, near the cæcum; that we sometimes perceive in very young fœtuses a canal which goes across the umbilical sheath, from the vesicle to the abdomen, and by which we can at pleasure empty the vesicle of this fluid and fill it again; that it is not unfrequent, proportionally speaking, to find in the full-grown fœtus a canal which extends from the intestine to the umbilicus, which opens in the latter place, and is always attended by the omphalo-mesenteric vessels." "The occurrence of a cord or ligament passing from the extremity of the diverticulum is a point of considerable interest. This cord, which may be called the terminal ligament, may be looked upon as the remains either of the early vitelline canal or of the more persistent pedicle of the vitelline sac, and of the omphalo-mesenteric vessels which passed along it. Its presence was distinctly noted in only five out of the twenty cases of the true diverticulum above recorded by me. It might also have been present in the now dried preparations, and removed in the dissection, without leaving any trace." Struthers quotes cases in which fatal strangulation resulted from the passage of intestine through a loop formed by the adhesion of the extremity of the terminal ligament to an adjacent organ. Referring to the omphalo-mesenteric vessels, Carpenter (*Human Physiology*, p. 1030) says: "It was formerly believed that the nutrient matter of the yolk passes directly through the vitelline duct into the (future) digestive cavity of the embryo, and is from it absorbed into its structure; but there can now be little doubt that the vitelline vessels are the real agents of its absorption, and that they convey it through the general circulating system to the tissues in process of formation."

*Diagnosis.*—A proximity to the truth as regards the seat, if not of the nature of the obstruction, may be arrived at by a careful investigation of the pathological history of the patient, as well as by an account of the mode of onset of the complaint.



The suddenness of the attack while the individual is in the enjoyment of his usual health; the date of vomiting, and nature of vomited matters; the sex, a preference being on the side of the female who may have borne children, and whose uterine appendages may have contracted adhesions during gestation, which after delivery and contraction of the organ may have become stretched into bands; the age, because, supposing a band to exist, the longer the patient lives, the greater the risk of entanglement of the bowel. A minute physical examination must be made. Cicatrices upon the surface of the abdomen, whether accidental and the result of injury, or the consequence of leeches or scarification, should be looked for, and their causes and reason for employment explained. Local and persistent pain, with dulness on percussion, and perhaps some fulness, point to the seat of stricture. It is usual for the pain, if localised, to be about the umbilicus, and from it downwards, and to the right side; distension at first should be slight, and also round about the umbilicus, while the colon, if not the seat of obstruction, will probably be empty, and cannot be traced by percussion; hiccup and vomiting will be early and distressing symptoms, and if the stricture be near the pylorus, the urine will be scanty. Should the obstacle persist, the pain will become more severe and perhaps diffused, indicating either inflammation of the bowel about and above the stricture, or general peritonitis; there will be great anxiety of countenance, with a hard, wiry pulse, vomiting of the contents of the small intestine, and great depression, and the patient dies either exhausted, or from the shock of extravasation of the contents of the bowel above the stricture into the peritoneal cavity; and perhaps, after having expressed himself more comfortable and free from pain a few hours previously.

The probable presence of a gall-stone lodged in and obstructing the bowel, may be inferred if there have been history of severe pain occurring at some previous period in the region of the liver. Dr. Watson (*Principles and Practice of Physic*, vol. ii. p. 465) mentions the case of a lady in whom an impacted gall-stone gave rise to the symptoms of mechanical intestinal obstruction. On one occasion, when examining the abdomen, she fancied the pressure made had displaced something within, and soon the bowels were relieved, and a gall-stone was found. Some years previously the lady had suffered severe abdominal pains, which at the time were ascribed to the passage of a biliary calculus. (For obstruction by foreign bodies, see Mr. Poland's Article in *Guy's Reports*, vol. ix. 3rd series.)

*Treatment.*—This must be strictly palliative as regards the administration of drugs; opium alone being freely used, and more especially if the symptoms point to the right iliac region as the seat of obstruction, observation having shown that the ileum near the cæcum, of all the other portions of bowel, is the most likely to have been the seat both of disease and of congenital malformations, leading either to the formation of adhesions, or to the presence of diverticula, and consequently to a tendency to strangulation.

On Sept. 1, 1861, E. P., male, aged 37, was subjected to herniotomy by the writer at the London Hospital, to relieve a strangulated inguinal hernia of the right side. To effect reduction it was necessary

to open the sac, which contained apparently about two feet of small intestine. This was returned gradually into the abdomen, and terminated in a cul-de-sac at least twelve inches in length; probably an unusually long diverticulum. The patient recovered. Nutrient enemata to support life, and copious to effect some doubtful object, may be freely used, and in the early stage of the disease abdominal manipulations should have a fair trial, provided that symptoms of inflammation be not present.

*Strictures, Twistings, and Compression of the Bowel.*—These sources of obstruction are more commonly associated with the large intestine, under which circumstances the surgeon's art can be brought more nearly into contact with the disease, and with a greater prospect of affording relief. According to Dr. Brinton, strictures occur much more frequently in the sigmoid flexure and rectum than in any other part of the large intestine, and less frequently in men than in women who have borne children.

*Stricture and Compression. Diagnosis.*—The history of the disease, which will, in all probability, have been slow in its progress, and attended occasionally by temporary fits of constipation and a gradually increasing difficulty attending defæcation; intermittent diarrhœa; muco-sanguineous discharge per anum and small size of the fæces, tend to indicate disease of the bowel at some point. The constitutional disturbance will be at first less severe in its character than in obstruction of the small intestine. The constipation will be obstinate; vomiting will occur at a later period, or perhaps not at all; the urine will be plentiful; the distension great; the colon above the stricture may be traced by percussion, and its position recognised by tympanitis up to within a greater or less distance of the stricture, where, in consequence of the presence of fæces, and unless overlapped by distended small intestines, dulness will be elicited and pain may be expressed. The possibility of introducing a tube per anum many inches up the bowel or otherwise, and the quantity of water that can be injected, will assist in determining the probable seat of obstruction. The general aspect, age, and hereditary predisposition, or otherwise, to malignant disease will assist the diagnosis. The patient will sometimes complain that the contents of the bowel travel to and fro in a certain direction. Mr. Luke informs me that he once assisted at an operation to relieve an obstruction believed to be seated in the upper part of the rectum, when, on opening the peritoneal cavity in the groin, the sigmoid flexure was found to be empty. Being confident of the seat of stricture, he advised that the contracted sigmoid flexure should be opened and fixed to the cutaneous wound, and soon the bowels were satisfactorily relieved. This case proves that the bowel immediately above the stricture is not necessarily loaded with fæces. A similar case is recorded by Mr. Adams (*Med. Chir. Trans.* vol. xxxv. p. 59). "The descending and sigmoid flexure of the colon could be felt undistended, and of their natural size. On passing the finger along the colon downwards towards the rectum, a hard tumour could be distinguished in the upper part of this gut."

*Treatment.*—The rectum must be explored, and its diseases, if any be found, be properly treated. A neighbouring organ may be enlarged and close the bowel temporarily, as an ovarian tumour, a distended bladder; in these and analogous cases the

treatment must be directed to the cause and not to the effect, to the encroaching organ rather than to the viscus injuriously affected; the ovarian tumor must be either diminished in size by tapping, or be removed by a more serious operation; the bladder must be evacuated either by catheterism or by puncture; feces, impacted in the rectum or colon, in consequence of functional derangement, as in hysteria, or from muscular intonicity or inability to contract upon or expel the contents, as in anæmic individuals and persons of lax fibre or paralytics, should be removed by scooping out the rectum, assisted by copious and stimulating enemata, as well as by purgatives administered by the mouth. Of these latter, small and repeated doses of the aqueous extract of aloes or of sulphate of magnesia are to be preferred. Galvanism, also, as recommended by Dr. Abercrombie, may be tried. (See *Case successfully treated by the writer in Med. Times*, Feb. 7, 1863, p. 137.) Strychnine, too, should have a fair trial. An interesting case of fatal obstruction, apparently arising from loss of contractile power in the muscular coat of the bowels, is recorded by Dr. Waller (*Trans. Lond. Med. Soc. New Series*, vol. i. p. 130); also two cases of impacted feces, lasting over many years, recorded by Mr. J. Long (*Med. Times*, 1856). The history and occasional presence of a solid tumour in either case made the diagnosis easy.

*Twistings of the bowel.*—These are more generally connected with the sigmoid flexure. In respect to their causes Dr. Brinton says, "these twistings seem to differ materially in different cases; tumours, abnormal laxity of the meso-colon, and still more frequently hernial displacements of other parts of the canal, are the circumstances often found in connection with them; and, taken in conjunction with the great age of those subject to them, go far to suggest a failure of peristalsis, as forming at least a frequent immediate cause of their occurrence. The relation of a case reported in *Guy's Reports*, 2nd series, vol. ii. p. 286, will best illustrate the above lesion.

"J.J., aged 26, admitted into Guy's Hospital March 8th, 1844. Twelve years before admission he had an attack of constipation, which yielded to common purgatives. One year ago he had another attack which lasted six days, and was removed by the introduction of a long tube into the bowel. On admission, constipation had existed eight days, attended latterly by a remitting screwing pain at the epigastrium. Abdomen much distended with flatus, and the track of the colon particularly resonant upon percussion. No sickness; urine plentiful. During the treatment, the tube could be introduced to the extent of twenty-three inches, and favoured the escape of faecal matter and gas, but no satisfactory evacuation was obtained. Died on the 18th day of the disease." *Post mortem.*—"The abdomen was almost filled by an enormously distended and hypertrophied sigmoid flexure which had twice turned on its axis." Dr. Barlow remarked, "It is evident that the twisted sigmoid flexure, where it passed in front of the rectum, did not exert any strong compression upon the latter, as the œsophagus tube passed readily through the rectum into the distended portion of bowel, where its extremity could be felt through the abdominal wall; but it is also obvious that at this point the peristaltic motion of the intestine, or at least the passage of its contents, must have

been arrested, for it was just above this point that the increase in the calibre of the bowel and thickness of its walls commenced. There was also another seat of obstruction just above the distended convolution at the point where the upper turn of the colon occurred, for it was just above this that perforation took place. The history of the case and post mortem revelations showed that a diseased action had been going on for a long period."

Should it be possible under circumstances of twist of the colon to feel the end of a tube through the abdominal wall in some unexpected locality, the nature of the lesion would be at once recognised. At the same time the tube cannot be introduced with too much care and caution, lest, instead of travelling along the intestinal canal, it perforate its wall.

*Treatment.*—In these cases there is little choice of remedies, the chief being the free but cautious use of the tube and copious enemata.

*By Puncture.*—In a case similar to the above, M. Trousseau, after seeing the condition of the sigmoid flexure at the autopsy, suggested the possible benefit which might have arisen from puncture, with a fine trocar and canula, of this portion of the intestinal tube through the anterior abdominal wall, with a view to evacuate the gas contained, in order to relieve distention, and consequently temporary paralysis. By this means the volvulus might have been untwisted and peristalsis restored. (*Nélaton, Eléments de Path. Chirurgicale*, tom. iv. p. 479.)

A case of twist of the small intestine consequent on shock, recorded in the *Medical Times*, Nov. 22, 1856, p. 514, is worthy of note. "A gentleman 53 years of age who had previously enjoyed good health took a draught of cold water while heated, and was immediately seized with pain in the abdomen and vomiting; on the fourth day abdominal distension and tympanitis, except in the right iliac, lumbar, and adjoining portion of umbilical regions, which were dull; no pain on pressure; on the ninth day dulness was replaced by tympanitis; coffee-ground vomit. Some offensive feces passed now and then. Death. *Autopsy.*—A portion of mesentery was twisted to a cord-like state, and behind this a portion of ileum had passed and was strangulated; lower two thirds of the ileum, the cæcum, &c. were collapsed, while the rest of the ileum and the jejunum were enormously distended and occupied nearly the whole abdomen." Apparently the cause of the twist in this instance was the application of cold administered by the mouth.

With this case before us, it will be justifiable to try the effect of this agent in obstinate cases of obstruction, either by injecting ice-cold water *per anum*, or by dashing a quantity of cold water over the surface of the abdomen.

*Treatment.*—Twists of the small intestine, resembling, as they do, other sudden mechanical lesions, must be treated on similar principles.

*Question of Operation in Intestinal Obstructions.*—Hitherto, with the exception of intussusception, the propriety of calling in the aid of the surgeon in cases of intestinal obstruction, where medicine fails to relieve, has not been discussed here. The subject must be considered under two heads, corresponding with the two principal divisions of the intestines, small and large; and in reference also to the peculiar sources of obstruction to which



each portion of the canal is more particularly liable. The operations which have been resorted to up to the present time are as follows: Gastrotomy, *i.e.* opening the abdominal cavity with a view to relieve an internal strangulation, and without disturbing the integrity of the intestinal tube; Gastro-enterotomy, *i.e.* opening the abdominal cavity, followed by opening the intestinal tube, with a view to the formation of an artificial anus; Enterotomy, opening the intestine at some point external to the peritoneal or abdominal cavity, also with the intent to form an artificial anus.

The first is resorted to in supposed lesions of the small intestines the third, in obstructive disease of the larger bowel; the second, or gastro-enterotomy, under peculiar conditions of both divisions of the intestine.

*Gastrotomy.*—History tells us that Praxagoras, and in the sixteenth and seventeenth centuries Pierre Franco and Paul Bardette, advocated this operation in cases of internal strangulation. We are not aware how frequently the operation has been performed, either in this or other countries, but up to the present day we believe not one successful case has occurred in Great Britain; some few attended by success have been recorded both in Europe and America. Mr. Hutchinson informs us that, some time since, he requested to be informed, through the medium of the *Medical Times*, of a case or cases in which gastrotomy had been successfully performed in this country; but received no response. Unhappily, the sources of internal mechanical obstruction are so numerous, and the symptoms of many so similar, that it is difficult, and indeed impossible in most instances to determine either the nature or the seat of the lesion. A proximity to the truth, as regards the seat of obstruction, may be arrived at, should the lesion be situated either near to the pylorus (case by Bird and Hilton, *Med. Chir. Trans.* vol. 30) or to the anus; but as the ileo-cæcal valve is approached, the symptoms upon which we rely to form an opinion are often so contradictory, that an inference must be drawn with the greatest caution. Mr. Phillips, who has collected and analysed 169 cases of intestinal obstruction, and who also quotes various authors upon this subject, says (*Med. Chir. Trans.* vol. 31, p. 16.): "For some time I had hoped that by arranging the cases in small groups the symptoms might be made to assume a more characteristic form; but I found that distressing sickness, severe pain, and abdominal tension might be present or absent in any case, no matter what may have been the cause of obstruction; that life might be extended as long in a case where the intestine passed through an unnatural opening, as in a case of gradual malignant contraction." Hevin says, (*Mémoire de l'Académie de Chirurgie*, tome iv. p. 211): "The uncertainty as to the cause of these affections, and the equivocal nature of the symptoms which are similar, from whatever cause arising, and these are very varied, will always deter a prudent man from having recourse to an incision very dangerous, and which would be very often useless, since the volvulus which it is proposed to remedy is the least frequent cause of the iliac passion. There is not, moreover, any indication which marks the precise locality, the positive seat, of the malady." Dr. Watson says (*Principles and Practice of Physic*, vol. ii. p. 468): "This procedure contemplates no compromise between certain death and

complete recovery . . . and if the peril were my own, and all other prospect of relief had failed me, I would submit myself to this forlorn hope of rescue." When called to decide upon or to discuss the propriety of opening the belly to search for the seat of obstruction, all means to aid the diagnosis will of course be employed, and the surgeon should determine, and be able to explain, why he arrived at the conclusion that the seat of strangulation would be found either here or there. His inference may possibly be wrong; but we hold that some good reason should be assigned for attempting the relief of a disease, the nature and seat of which cannot with any degree of certainty be foretold, and from which recovery, even at the eleventh hour, is just within the limits of possibility, by the terrible alternative of an operation, which, in all human probability, will prove fatal. On the other hand, should the locality be sufficiently marked, and especially, should symptoms point to the right umbilico-iliac region, where observation and experience have shown that sources of strangulation are apt to arise either from congenital malformation of the lower part of the ileum, or from disease of that bowel; and should age and tolerable health concur with the absence of signs of local and general inflammation to warrant an operation, the surgeon will be justified in recommending gastrotomy. At the same time, he will do wisely to explain fully both to the patient and to his friends the impending probabilities whether an operation be performed or not. It will rest with them either to accept or to refuse the apparently only chance of life.

*Period for operation.*—This is a most momentous question. It is easy to recommend an operation, but to the last degree difficult to say when it should be performed! Few would be willing to advise such a procedure until all the resources of art have been exhausted, many of them, unwittingly, to the detriment of the sufferer; while there may be greater danger from delay, until either the powers of the patient are exhausted beyond hope of recovery, or morbid changes have taken place in the parts implicated, rendering life impossible, or fatal and general peritonitis has set in. *Medio tutissimus ibis.* The practitioner must carefully watch the pulse of his patient, because, since death begins at the heart in these cases, the condition of the vascular system will best indicate the influence exercised by the disease upon the constitution. The gradually increasing frequency and decreasing power of the pulse, the increasing anxiety of countenance, the persistence and aggravation of the symptoms, especially that of stercoraceous vomiting, clearly indicate that the time for operative interference, if admissible at all, has arrived. The operation having been decided upon, the temperature of the room in which it is to be performed should be raised to 80° Fahr., in order that the contents of the abdomen exposed during the operation may not be injuriously affected by cold. A ready mode of doing this and of rendering the atmosphere humid also, consists in hanging damp towels before a large fire made in the room. Chloroform may or may not be administered according to circumstances; and the patient having been placed with his buttocks upon the edge of a table, with his legs depending, and supported each on a chair, the operator takes up his position between the patient's thighs, and evacu-

ates the bladder with a catheter. With a view to favour an exploration, should it be necessary, of the whole cavity of the abdomen, it will be prudent to select the median line for the incision. The hand introduced here can readily penetrate to any part of the abdomen; no important structures are divided, and there will probably be no hæmorrhage. The incision should be made at first sufficiently large to admit the hand of the operator into the abdomen, say, from one finger's breadth below the umbilicus to the same distance above the pubes. The integuments, linea alba and transversalis fascia, having been divided with a scalpel, the subperitoneal fat will be reached. A small puncture of the peritoneum must be carefully made to admit a director, upon which, or upon the finger introduced and passed behind the serous membrane, the probe-pointed bistoury will safely complete the section. The distended intestines will now endeavour to escape from within the abdomen, and must either be repressed by assistants, or, if allowed to protrude, be protected and kept warm by hot flannels; while, should the wound be too small to enable the operator to effect his object, it must be enlarged in an upward direction to enable him to proceed. His object will be to find the seat of obstruction, and to do so he will of course commence the search in the region indicated by the symptoms, and in doing so should endeavour to find a portion of bowel situated below the lesion, and which will be pale, empty, and contracted. This done, the contracted gut is to be traced to the spot at which it is apparently cut off from the portion of bowel lying on the proximal side of the obstruction, and which will be more or less distended, injected, and probably undergoing certain pathological changes. A false membrane, if found, may be torn or cut across (a fine ligature being placed upon any bleeding vessel requiring it, and cut short); a loop of intestine must be withdrawn cautiously from any aperture through which it has passed; and, indeed, whatever the cause of obstruction, its appropriate remedy must be resorted to. Should the stricture be relieved, the contents of the distended bowel will probably commence to enter the contracted portion, and success so far will be recognised by a gradual distension of the latter and proportionate diminution of the former.

But it may happen that the obstruction, although found, cannot be removed; and if so, a knuckle of distended bowel as near to the lesion as possible, and on the proximal side of it, must be united to the inferior angle of the wound by suture, be opened, and the establishment of an artificial anus be attempted.

It is also possible that the portion of bowel which is the seat of obstruction, may have undergone such pathological changes (gangrene for example) as render it quite unable to resume its functions; under these circumstances this disorganised portion must be brought out and maintained at the wound, with the hope that an artificial anus may result. The exploration completed, the viscera must be retained within the cavity, while the wound is being closed by twisted or interrupted sutures. The pin of the former should penetrate all the strata of the abdominal wall, including peritoneum, while the knot of the latter should be tied on one side of, and not opposite to, the incision. Strips of adhesive plaster may be employed to support

the sutures. If the distended intestines interfere materially either with the progress of the operation, or with the closure of the wound, their gaseous contents may be removed by puncture with a fine trocar and canula.

The patient, having been returned to bed, the treatment will consist in endeavouring to prevent peritonitis, by the free administration of opium by mouth and rectum, and in supporting the flagging powers of life by the use of concentrated fluid nutriment, and probably stimulants also, by mouth and rectum.

References to some of the cases of gastrotomy are as follows:—Hilton two cases, *Med. Chir. Trans.* vol. xxx. xxxi. Druitt, *Med. Chir. Trans.* vol. xxxi. Fergusson two cases, *Lancet*, January, 1850. *Prov. Med. Surg. Journ.* May, 1853. Gay, *Med. Gazette*, August 29th, 1851. Lawson, *Trans. Path. Soc.* vol. 12.

*Gastro-Enterotomy.*—A large number of cases of intestinal obstruction will occur, in which it is utterly impossible to determine with any degree of probability the nature and seat of the lesion. All the resources of medicine shall have been tried in vain to remove the symptoms, and the patient's life is evidently in jeopardy. What then is to be done under these doubtful circumstances? Is gastrotomy to be attempted and the abdomen to be explored? We hold that, unless, as already stated, the symptoms indicate the probable seat of stricture, an exploratory operation is not justifiable, since the length of time requisite for its accomplishment, and the handling and exposure to which the viscera must be subjected, too much diminish the chance of life to render such procedure advisable.

But the sufferer is not to be allowed to succumb without an effort being made to rescue him from his perilous position. Gastro-enterotomy must be performed with a view to the establishment of an artificial anus. In determining the site for the operation it will be obviously of great importance, as regards the future nutrition of the patient, to select a portion of intestine above the stricture, but as far from the stomach as possible; as, for example, the cæcum, or lower part of the ileum. With this object in view the right iliac region should be chosen. Chloroform having been administered or not, an incision from two to four inches in length, nearly perpendicular, but with a slight convexity directed outwards, should include the three muscular strata and the transversalis fascia of the anterior abdominal wall, seriatim, midway between the course of the deep epigastric artery and the anterior superior spine of the ileum, its inferior extremity terminating about one finger's breadth above Poupart's ligament. The peritoneum, having been punctured and slit up to a similar extent, either on a director or on the finger of the operator, the distended bowel will probably protrude at the wound, and having been secured to the same by interrupted sutures, may be laid open in a longitudinal direction to the extent of an inch, when the operation is completed. Should there be a choice between two portions of bowel presenting, the large intestine should be selected in preference, and, next to this, a portion of small intestine having none or few valvulæ conniventes, which circumstance may be ascertained by palpation. To obviate the inconvenience of an artificial anus, M. Maisonneuve has proposed to substitute an "anas-



*tomose intestinale.*" This operation consists in opening the tube both above and below the obstruction on its free border, to the extent of an inch, and in uniting them by means of sutures. Thus a communication is established between the segments of bowel on either side of the lesion. (*Nélaton, Elém. de Pathol. Chir.* tom. iv. p. 482.) This operation appears to be the most dangerous of any yet recommended.

*Enterotomy.*—This term is usually associated with opening the colon in either loin, with a view to the formation of an artificial anus. The history of this operation dates from the time of Callisen, who says (*Systema Chirurg.* vol. ii. p. 688 :) "Quæ proposita sub hoc rerum statu (imperforationis ani) fuit incisio intestini cæci vel coli descendentes, sectione in regione lumbari sinistrâ ad marginem musculi quadrati lumborum factâ, ut anus paretur artificialis, remedium præbet omnino incertum, atque hac operatione vix vita miselli servari poterit. Quanquam intestinum in hoc loco facilius attingatur, quam supra regionem inguinalem." There is no evidence to show that Callisen himself performed this operation; but in 1839 Amussat proposed and executed a modification of Callisen's. In this, as in the previous operation, the intestine should be opened as near as possible to the seat of stricture, i.e. on the left side, should the rectum or sigmoid flexure be the seat of obstruction; on the right side, should the obstacle be beyond the ascending colon, but on the proximal side of the sigmoid flexure.

*Choice of operation.* Amussat's and Callisen's methods.

Amussat (*Mémoire sur l'Anus Artificiel.* Paris, 1839) describes and draws a comparison between his own and Callisen's method, thus: "For Callisen's method the external border of the quadratus lumborum cannot be taken as a guide, as is commonly said, because it is not possible either to see or to feel this muscle through the integuments, and it is very difficult to cut exactly upon its outer border. Besides, this border is only exposed in its lower half. On cutting deeply, the latissimus dorsi, generally the external oblique, always the internal oblique, the transversalis, some vessels, the aponeurosis of the transverse, some nerves are divided, and at length one falls upon the fatty cellular tissue which covers the intestine, and then upon the bowel itself if it be dilated. Should it not be dilated, it must be sought for posteriorly under the quadratus lumborum. . . . By my method the site for the operation is more easily defined. The transverse incision is made two fingers' breadth above the ilium; or better still, at the centre of the space comprised between the last false rib and the crest of the ilium. It should be begun at the external border of the erector spinæ, and be prolonged as far as the middle of the upper border of the ilium, or indeed as far as the lateral line of the body, thus giving it an extent of four or five fingers' breadth. The lumbar spines, the last false rib, and the crest of the ilium, are the bony points, which may be taken as landmarks. Nevertheless, the crest of the ilium is the safest guide; and it may be said that the transverse incision ought to correspond to the middle third of this bone. After having divided the skin and the superficial tissues, the deeper structures may be cut crucially, in order better to discover the intestine; by means of the

transverse incision the operation is performed in a large space from before backwards; the external border of the quadratus can be readily raised and be incised, if necessary. . . . By my method, the latissimus dorsi is divided transversely in the posterior third of the incision, and the external oblique in the two anterior thirds, the internal oblique and the transverse longitudinally and somewhat transversely; sometimes the quadratus, few vessels and nerves, the aponeurosis of the transverse muscle, then the fatty cellular tissue and the areolar tissue which immediately covers the intestine; at length the colon itself is found."

The conclusion drawn from the above comparison cannot but be accepted by us, and therefore in favour of Amussat's method. At the same time, Mr. Hilton gives the preference to Callisen's or to the longitudinal incision, and describes its performance as follows (*Guy's Hospital Reports*, vol. xviii. 1853, p. 189): "If it be important, in cutting down upon the subclavian artery, to recognise the omohyoideus and scalenus anticus muscles, so, in the operation of opening the colon in the lumbar region, behind the peritoneum, it is essential towards an exact and proper performance of this operation that the surgeon should bring into view by his incision the outer edge of the quadratus lumborum. In a thin patient, the outer edge of the erector spinæ muscle may be distinctly felt, as also may the apices of the transverse processes of the vertebræ; and these signs will be sufficient guide to the position of the quadratus lumborum muscle. But in a very fat person, in whom neither of these points can be determined, it will be necessary to draw a line parallel to the spinous processes, directly downwards from the angle of the seventh, eighth, or ninth rib, across the costo-iliac space, to the crest of the ilium. This line corresponds with the outer edge of the erector spinæ and the apices of the transverse processes; and a measured inch from it outwards corresponds with the outer edge of the quadratus lumborum. I assumed that the quadratus lumborum might be about one inch wide, and therefore made a vertical incision nearly two inches long between the last rib and the crest of the ilium, extending nearer to the ilium than to the rib. One well-directed cut divided the skin and cellular tissue, the tendon of the internal oblique muscle, and exposed the outer edge of the quadratus lumborum. Two small arteries required ligatures. The last dorsal nerve lying across the upper part of the line of incision was divided. The transversalis abdominis muscle was divided vertically, to the extent of nearly two inches, parallel to the outer edge of the quadratus lumborum; a considerable quantity of loose lobulated fat was exposed, a part of which was taken away, and the rest displaced by the blunt end of a director, in accordance with the direction of the original incision. An artery required to be ligatured at both ends, and then the intestine was clearly and perfectly brought into view, of a greyish pink hue, and somewhat bulging. A director and forceps cleared a portion of the surface of the intestine of fat and areolar tissue to the extent of an inch at least. The intestine was now rendered more prominent at the bottom of the wound by the anterior part of the abdomen being pressed upon, so as to push the intestine towards the opening in the loin. A long curved needle, armed with silk, was passed through the intestine, and then through the integuments at the point

nearest the anterior edge of the wound, so as to fix the intestine anteriorly; and in a similar manner the part nearest to the posterior edge was likewise fixed. An incision of about an inch in length, vertically between the transfixed points above alluded to, was then made into the intestine."

For the *transverse* incision (Amussat), the landmarks are, the last rib, the crest of the ilium, and the spinous processes of the lumbar vertebræ. The incision should correspond to the middle third of the crest of the ilium, and to a line two fingers' breadth above this. It should be commenced, the patient lying on the opposite side, and slightly on his face, over the outer border of the erector spinæ, and be carried outwards to the extent of from two to four inches, in proportion to the degree of obesity of the subject, dividing the latissimus dorsi and external oblique, the former in the posterior third, the latter in the anterior two-thirds, of the incision; the internal oblique and the posterior aponeurosis of the transverse, with a few of the fibres of the muscle itself; the outer edge of the sheath of the quadratus lumborum may be notched if necessary. If thought desirable, the deeper structures may be divided crucially, and the operation be completed, as by the method of Callisen. At least two sutures should fasten the bowel to the wound before an opening be made into it; the number may be increased at a later period to four or six.

*Bauden's method.* This surgeon prefers an oblique incision to either of the above, and advises that it should be commenced one inch below the last rib, immediately external to the erector spinæ muscle, and be carried downwards and outwards, and terminated about one inch and a half external to the same, and near to the crest of the ilium.

The loin having been opened by one of the above methods, the surgeon should carefully avoid mistaking the kidney for hardened fæces. In consequence of the position of the liver, the right kidney will occupy a lower level than the left, and will therefore be more probably met with when the right loin is opened.

*Period for operation.*—The symptoms of obstruction having existed for many days, say from ten to twenty, without any amelioration from treatment, and the cause and seat of the lesion being tolerably evident, no advantage can accrue to the patient by delay. The operation itself is moderately easy of performance, and may be classified with those considered to be not dangerous to life.

*Littre's Operation.*—In the year 1710, Littre proposed to relieve obstruction of the lower part of the large intestine by opening the sigmoid flexure in the left iliac region; and at the present time surgeons occasionally resort to this method in preference to that performed in the loin. The groin having been opened, the sigmoid flexure must be brought to the surface, and be treated as stated under the head of Gastro-enterotomy. The surgeon may, in some instances, prefer to attempt to reach the sigmoid flexure, or the cæcum, if the right side be selected, behind the peritoneum; but failing in this, the general cavity of the belly must be opened. Littre's method should have the preference in infants, and in cases of tumour of the groin, inducing suspicion of the position either of sigmoid flexure, or of cæcum loaded with fæces.

*Comparative merits of Littre's and Amussat's or Callisen's operations.*—The first object desired by

resorting to either of the above operations is to prolong life; and secondly, to place the artificial anus in such position as shall render existence tolerable to the patient and his friends. Mr. Casar Hawkins (*Med. Chir. Trans.* vol. xxxv.), in his analysis of the result of forty-four operations to relieve intestinal obstruction, whether performed through or external to the peritoneum, says: "There remain, then, only (for reasons assigned above) twelve cases of peritoneal section to compare with twenty-six cases of operation behind this membrane; and it is found that, of the former, seven died, and five recovered; while of the latter only ten died, and sixteen recovered. The right colon and cæcum were opened through the peritoneum in four cases, all of which died; and an artificial anus was made in the right colon behind the peritoneum in six cases, of which two died, and four recovered. As far as these numbers go, the preference on the right side is unquestionably due to the lumbar operation. The left colon has been opened through the peritoneum in eight cases, of which three died three, and five recovered; and of twenty cases of lumbar operation on the left colon nine died, and eleven recovered. While, then, a comparison of the whole number of operations, and also of those on the right side alone, is in favour of the operation external to the peritoneum, the comparison of the two methods of procedure on the left side is favourable to the peritoneal section, so far as so small a number as eight cases of the one, compared with twenty of the other method, can be considered of value." Mr. Luke (*Med. Chir. Trans.* vol. xxxiv. p. 274) discusses the merits of the two operations, and concludes by saying: "It (Littre's method) affords facilities for modifying the treatment, as may be advisable, after immediate examination of the cause of obstruction, either by opening the intestine when incapable of relief by other means, or by dividing or removing any existing cause of constriction or strangulation. It enables the surgeon to extend his search within a limited range when his diagnosis of the seat of obstruction has been proved to be incorrect. When requisite and proper, it enables him to open the colon close to the seat of obstruction, and thus preserve to the patient, for the performance of its proper functions, the utmost extent of intestinal canal of which the case is susceptible; and it eventually secures to him those facilities for attending to his own comfort which appear almost a necessary condition to make life endurable under such circumstances."

A case recorded by Mr. Hilton (*Guy's Hospital Reports*, vol. viii. p. 479) shows the desirability of opening the bowel near to the seat of constriction. "It sometimes happened that feculent matter passed into the ascending and transverse colon beyond the artificial opening; this occurrence always produced some slight distress by its distension, and led to a rumbling noise in the abdomen, which terminated in a retrograde action of the large bowel, expulsion of its contents through the artificial anus, and immediate relief."

Notwithstanding the evidence furnished by statistics, which is in favour of Littre's operation on the left side, and the preference, for reasons assigned, given by Mr. Luke to gastro-enterotomy, experience of abdominal surgery does not warrant a section of the peritoneum when such can be



avoided. Stronger motives than those already urged must be assigned before the surgeon adopt an operation which a wholesome prejudice at least deems to be fraught with great danger, in preference to one (the lumbar) comparatively harmless. Notwithstanding Mr. Luke's preference for Littre's operation, he records a case in which he failed to find the seat of obstruction by this proceeding, although he anticipated its presence either in the top of the rectum or in the sigmoid flexure. The autopsy disclosed a strangulation of the ileum by a band. The wound in the loin is deemed to be more disposed to close than that made in the groin, and the comfort to the patient is greater, and its management more easy, when seated in the groin than in the loin. In reply, I quote the case of Mr. Hawkins (*Med. Chir. Trans.* vol. xxxv. p. 89): "The artificial anus has shown the usual tendency to contraction, to obviate which I have had an ivory plug made of the requisite length and size. The plug is attached to a small brass plate, which is inclosed in a larger one of India-rubber, which covers the adjacent parts, and is retained in its place by an elastic bandage or by plaster. This plug is generally withdrawn for an hour or an hour and a half in the morning for the escape of the contents of the bowel, after which it is again introduced for the rest of the day, and with it the lady is able to ride and walk out, and enter into society without inconvenience."

Also, supposing the bowel lying between the artificial opening and the anus to become competent to the performance of its functions at any future time, the permanent existence of the artificial opening may be deemed unnecessary, and in the loin no difficulty will be experienced in closing it; but in the groin the probable presence of a spur-like process projecting into the intestinal tube from the mesenteric margin of the bowel opposite to the fistulous opening, cannot but be an obstacle to the ready transit of the intestinal contents beyond the fistula towards the anus. This spur is due to the altered and fixed position of the free margin of the bowel to the anterior abdominal wall, and to the angle necessarily formed at this point. This complication, while it will probably attend Littre's, will not be found associated with the lumbar operation. (See Art. ARTIFICIAL ANUS.)

*After-treatment*—This consists in cleanliness; in protecting the integument around the aperture from the irritating discharge by the application of some oleaginous substance, or of collodion; avoiding any tendency to diarrhoea by a simple and wholesome diet; in aiding the removal of hardened feces by warm-water injections; in preventing a tendency to contraction of the aperture by the use of a suitable plug; in favouring periodical evacuations by the employment of an appropriate plug or truss, and in inducing the patient to acquire the habit of emptying the bowel at stated times. Should prolapsus of the bowel occur, it must be reduced by taxis, and be retained in position by a plug.

*Artificial anus in infants.*—Although in the adult, in whom the ascending and descending colon is fixed to the loin, and usually uncovered by peritoneum to the extent of at least one-third of its circumference, corresponding to the interval between the lateral longitudinal muscular bands, no great difficulty in reaching the bowel is experienced; still, Mr. Curling (*Med. Chir. Trans.* vol. xliii. p. 311) has shown that such facility does not

always attend the operation in infants, either from the occasional existence of a loose mesocolon, or from the presence of the kidney, which, being large at this period of life, may overlie the bowel; while the depth at which the bowel lies from the surface renders a larger incision necessary. Unless the sigmoid flexure be abnormally placed, Littre's operation should therefore have the preference with infants.] *C. F. Muunder.*

[Case of *Bird & Hilton*, *Med. Chir. Trans.* vol. xxx. p. 51. Croonian Lecture, *Lancet*, April 30, 1859. *Guy's Hosp. Reports*, series 2, vol. ii. *Guy's Hosp. Reports*, series 2, vol. ii. p. 389. *Lancet*, Dec. 1861. *Med. Times*, Nov. 22, 1856, p. 515. *Mém. de l'Acad. de Chirurg.* 4to, t. iv. p. 222. *Morbid Anatomy*, 2nd edit. p. 162. *Beirzil*, *De Intestinis se intussusceptibus*, &c., Helmst, 1769. *Lettson's Case in Phil. Trans.* vol. lxxvi; and *Langstaff*, in *Edin. Med. and Surg. Journ.* No. XI. *Med. and Physical Journal*, No. XI. *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i. *Phil. Trans.* vol. lxxvi. p. 305. *Med. Times*, Nov. 3, 1855, p. 456. *Med. Chir. Trans.* vol. i. p. 170. *Duncan's Commentaries*, vol. ix. p. 278. *Physical and Literary Essays*, vol. ii. p. 861. *Duncan's Annals*, vol. vi. p. 298. *Med. Chir. Trans.* vol. ii. *Langstaff* in *Edin. Med. and Surg. Journal*. *Mr. Bush*, 1823, *Med. and Phys. Journal*. *Bibl. für die Chir.* b. iii. p. 756, Gott. 1811. *T. Blizard*, *Med. Chir. Trans.* vol. i. p. 170. *Erichsen*, *Science and Art of Surgery*, 3rd edit. p. 945. *Haller*, *Phys. Corporis Humani*, tom. vii. p. 95. Case by *E. Cousins*, *Brit. Med. Journ.* June 21, 1862. *Simpson's* *Edin. Med. Essays*, vol. vi. *Hevin's* 4th Obs. *Malcolm's Physical and Lit. Essays*, vol. ii. p. 360. *Hunter*, *Med. and Chir. Trans.* *Semmering* in *Trans. of Baillie's Morb. Anat.* *Semmering*. *T. Blizard*, Case in *Med. Chir. Trans.* vol. i. p. 170. *Dr. J. R. Wilson*, *Transylvanian Journal of Medicine*. *Portal*, *Cours d'Anatomie Médicale*, vol. v. p. 247. *Guy*, *Trans. Med. Soc. London*, vol. i. Part III. *Meckel*, *Manuel d'Anatomie*, vol. iii. p. 431. *Struther's Anat. and Phys. Observ.* Part I. p. 137, &c. *Carpenter*, *Human Physiol.* p. 1030. *Watson*, *Principles and Practice of Physic*, vol. ii. p. 465. *Adams*, *Med. Chir. Trans.* vol. xxxv. p. 59. *Galvanism successfully employed*; *Med. Times*, Feb. 7, 1863, p. 137. *C. F. Muunder*. *Dr. Waller*, *Trans. Lond. Med. Soc.* new series, vol. i. p. 130. *Mr. J. Long*, *Med. Times*, 1856. *Guy's Reports*, 2nd series, vol. ii. p. 286. *Trousseau*, in *Nélaton's*, *Elémens de Path. Chirurgicale*, tom. iv. p. 479. *Med. Times*, Nov. 22, 1856, p. 514. *Phillips*, *Med. Chir. Trans.* vol. xxxi. p. 16. *Hevin*, *Mémoire de l'Académie de Chirurg.* tom. iv. p. 211. *Watson*, *Principles and Practice of Physic*, vol. ii. p. 468. Cases of *Gastrotomy*, *Hilton*, two cases, *Med. Chir. Trans.* vol. xxx. xxxi. *Druitt*, *Med. Chir. Trans.* vol. xxxi. *Ferguson*, two cases, *Lancet*, January, 1850. *Prov. Med. Surg. Journ.* May, 1863. *Gay*, *Med. Gazette*, Aug. 29, 1851. *Lawson*, *Trans. Path. Soc. vol. xii.* *Nélaton*, *Elém. de Pathol. Chir.* tom. iv. p. 482. *Callisen*, *Systema Chirurg.* vol. ii. p. 688. *Amussat*, *Mémoire sur l'Anus Artificiel*, Paris, 1839. *Guy's Hospital Reports*, vol. xviii. 1853, p. 189. *Caspar Hawkins*, *Med. Chir. Trans.* vol. xxxv. *Luke*, *Med. Chir. Trans.* vol. xxxiv. p. 274. *Hilton*, *Guy's Hosp. Reports*, vol. viii. p. 479. *Curling*, *Med. Chir. Trans.* vol. xliii. p. 311. Case of *Internal Strang.* by band associated with incarcerated hernia, *T. Bryant*, *Lancet*, Feb. 25, 1860. Obstruction by foreign bodies, *Poland*, *Guy's Hosp. Reports*, vol. ix. 3rd series.]

INTESTINES, WOUNDS OF. (See WOUNDS OF THE ABDOMEN.)

INTROSUSCEPTION, or INTUSSUSCEPTION. (See INTESTINAL OBSTRUCTIONS.)

IRIS, INFLAMMATION OF, IRITIS.

[The forms of inflammation may be grouped under the heads of idiopathic, syphilitic, traumatic, strumous, and rheumatic iritis. It would involve useless repetition to describe each of these varieties separately, as they have many symptoms in common. The better plan seems to be, to select the best type of the disease for general description, briefly noting, subsequently, the other forms.]

By far the best marked specimens of iritis owe their origin to the poison of syphilis. Syphilitic iritis may be either acute or chronic; the chronic condition may form a sequel of the acute, or it may present this type from its commencement. Between the two extremes we have every shade of variety. The disease may exhibit all its characteristic symptoms in a few days, or work its effects gradually during a period of many months. The commencement and progress of this disease are usually unattended with anything like severe pain; some slight feeling of fulness and uneasiness in the globes is all that is complained of. This absence of suffering may be regarded as one of the characteristics of the specific form of this disease, although striking exceptions occur, in which there is considerable pain, lachrymation, and intolerance of light. The degree in which vision is interfered with cannot always be measured by the amount of change in the iris, but depends, to a certain extent, upon the degree in which the deeper structures are involved in the disease. If there is an opportunity of tracing the objective symptoms from the commencement, the surface of the iris is observed to lose its natural brilliancy and to change its colour. This is particularly noticeable if it be blue, in which case it assumes a yellowish green shade; if hazel, the alteration of tint is less obvious; the movements of the pupil are at first sluggish, and soon cease altogether; the sclerotic vessels are slightly injected, particularly round the cornea, causing a pink tinge; but the vascularity, though similar in kind, is much less marked than in rheumatic iritis. As the disease progresses, the structure of the iris can no longer be traced; the irregularities of its surface are filled in and coated over with a layer of fibrine: this deposit is usually thickish, and much marked at the pupillary margin. In the next stage, at one or more points, a distinct roundish elevation, of a reddish brown colour, or of a deep yellow, may be seen, forming a tubercle, which becomes organised with new and distinct vessels. This may gradually increase in size, and may even in some rare instances develop an abscess in its interior. These tubercles vary very much in colour, size, situation, and amount of organisation; in very acute cases, and particularly when recurring in very feeble persons, they are of a light colour—viz. a yellow or pale brown, of a large size and numerous, without much trace of organisation. In other instances, when the disease is less acute, the powers of the system in better preservation, and the syphilitic origin well marked, there is often only one tubercle, of a reddish brown colour, round and clearly defined, highly organized, and usually near the pupillary margin. More rarely a tubercle forms near the ciliary attachment of the iris, and may thrust itself against the cornea and sclerotic, producing prominence and thickening in that situation. Sometimes it is difficult to trace any distinct tubercle, and there seems an elevation and thickening of the proper tissue rather than any deposition superadded. At an early stage of the disease, adhesions form between the pupillary margin and the capsule of the lens; so that if the pupil is dilated by belladonna, it presents a peculiarly irregular and scalloped form, tied down at some points and drawn out at others, and varied according to the number and position of the adhesions. Later in the disease, the adhesions become so firm

and numerous, and even continuous, around the pupil, that dilatation is no longer possible; at the same time the circle of the pupil is much diminished, and a thin coating of fibrine covers the capsule of the lens more or less completely, so as to cause, in extreme cases, a closed pupil. This deposit on the capsule has usually a whitish and spotted appearance. This change seems to be rather due to an altered condition in the lens within the capsule itself than to any deposit upon its surface: hence it is, that when once this takes place, it never quite recovers its transparency. Sometimes patches of uvea adhere to and obstruct the pupillary opening. This to a cursory observer has the appearance of a portion of clear pupil; the extent to which the pupil is closed and the lens loses its transparency, depends upon the severity of the attack. When the disease has thus far run its course, the tubercles of lymph become absorbed, but the iris does not resume its natural condition; its colour is permanently changed, and its tissue has lost its healthy aspect and its normal structure, and is found to be thinned and softened and inelastic, so as to tear through with the greatest ease, and to offer no resistance to the passage of a needle or a hook through it. This becomes an embarrassing circumstance in the formation of an artificial pupil. Sometimes the surface of the iris is found convex and bulged forwards, with the exception of the pupillary margin, which is drawn in and cupped; this appears to be due to an accumulation of fluid behind it in the posterior chamber.

If in addition to the uniform coating of lymph upon the surface, distinct raised tubercles of a roundish form and of a reddish brown colour are seen, such a case may be taken as the type of the more usual form of syphilitic iritis, and is generally accompanied by other constitutional signs of secondary syphilis.

Wherever the disease arises idiopathically or from injury or struma or rheumatism, the effusion is more uniform on the surface and does not present the round, elevated, organized, and defined tubercle, and is accompanied with more evidence of sclerotic vascularity, in proportion to the results in the iris, than in the syphilitic form. In some exceptional cases the entire texture of the iris is not involved in the disease, although the surface is overlaid with lymph, the proper tissue of the iris retains some of its natural structure and function, as evidenced by the fact, that it moves on the application of the stimulus of light, though to a very limited extent, as if struggling underneath the superimposed deposit.

During the progress of iritis, the deeper textures of the eye are more or less involved; even in the early stage of the disease there is considerable dimness of vision and muscæ abundantly floating before the sight. This dimness is usually greater than the mechanical change and deposits in the pupil will account for, which seems to prove that the choroid coat and retina and the media are impaired by an extension of the disease to these parts; and in the latter stages there is often abundant proof that all these structures have been damaged, and the balance between the humours and their containing case has been lost, the result of which is softening of the globe, a result by no means uncommon when iritis has been allowed to pursue its course unchecked. The cornea is generally unaffected, except in the congenitally



syphilitic form of the disease, but it is very common to observe minute dots on the inner surface of the cornea in iritis, showing that the delicate structure lining this part is involved, though in a remote and slight degree, in the disease. Iritis is sometimes found in a chronic form from its commencement, in which case it presents a peculiar and well-marked train of symptoms. It is insidious in its origin and slow in its progress; the pain is very slight, and the patient's attention is chiefly attracted by the dimness of vision that attends it. Both eyes are usually attacked, not simultaneously, but in succession, the first being more seriously involved than the other. In this modification of the disease, the surface of the iris presents a peculiar, thickened, raised, velvety aspect, the villous appearance not being quite uniform, but rather more distinct at one part than another. The pupil is rather small and irregular, and adherent all around to the capsule, which is more or less opaque, presenting white patches and black uveal deposits, forming tags to hold down the margin of the pupil to the surface of the capsule, and often giving the impression of a more impaired state of vision than is found to exist, upon putting the matter to the test of experiment. It is always necessary to use caution in expressing an opinion to a patient on this point, as confidence is impaired by making an assertion which the patient's experience of his own powers falsifies. Although the iris is so extensively coated with lymph, and the pupil is adherent throughout to the capsule, a slight movement may be seen to occur on the application of the stimulus of light, not to such an extent as to influence the pupil, but simply appearing as if moved by its own inherent elasticity. This form of iritis may generally be traced to some syphilitic taint of a remote date, and groups with a train of symptoms usually described as belonging to the tertiary form of syphilis.

The prognosis of iritis is favourable as a general rule. There are few diseases of so marked a character that yield to suitable treatment so readily and frequently when seen at an early stage, and no special and unfavourable complication exists.

*Treatment of Iritis.*—We have here two important objects in view, (a) to arrest the deposit of fibrine that is threatening the integrity and utility of the organ; (b) to obtain the absorption of such as already exists. As a means of effecting these objects there is no agent that can be compared in rapidity, efficiency, and certainty with mercury. The simple and almost single object you have in view in the treatment of an ordinary case of iritis, in which no constitutional peculiarity exists, is to get your patient fully and quickly under the influence of mercury. For this purpose, calomel, in doses of either one or two grains, combined with a quarter of a grain of opium, is perhaps the readiest and best method. The mercurial treatment requires careful watching, on the one hand, to ensure the effect of the medicine, and, on the other, to limit it so as not to carry the influence too far and induce profuse salivation. Evidence of mercurial action upon the mouth is required, but nothing is gained by carrying it beyond this point; for, though the restoration of such a valuable organ as the eye justifies the active employment of this drug, we must not lose sight of the constitution of our patient, and of the permanent evil that may result from its rash and imprudent exhibition.

There seems no reason to suppose that traumatic, that suppurative, and that ulcerative inflammations in general yield to mercury. In cases where the constitutional powers are at low ebb, we must adhere to two important practical points: the one is, that adhesive inflammation produces its worst results and its most rapid and extensive effects in feeble and broken constitutions; and the other, that mercury may and frequently does act rather as a poison to the system than as an antidote to the disease, and may thus actually aggravate that condition which it was administered to remove, and which with a less debilitated frame it would have cured. Our first effort, then, must be to build up the powers in every available manner. In the face of this acute disease we must administer tonics, stimulants, and a liberal diet, and as our patient regains strength, mercury may be carefully insinuated into the system, in such a way as to produce the least possible amount of irritation, for which mercurial inunction will be found the best remedy. As it begins to affect the gums, it will be seen that the constitution now bears that which before irritated and depressed it.

The chronic form of iritis is a far less satisfactory form to treat. It usually comes before the notice of the surgeon when the surface of the iris is materially changed, when the pupil is small and more or less adherent, and when the capsule of the lens is somewhat impaired in its transparency. Such a state of things seriously interferes with vision, and it is seldom we can succeed in restoring the parts to their state of health. This modification of iritis occurs almost invariably in persons whose constitutions are enfeebled by a long course of disease, and, in some cases, by injudicious treatment and insufficient nourishment, and who are very intolerant of mercury. Every available means must be had recourse to, with a view of improving the general health, and, at a subsequent period, small doses of the bichloride of mercury, about one-twentieth of a grain, combined with sarsaparilla, two or three times a day, will be useful. Cases sometimes occur in which even this small dose of mercury cannot be borne. Under these circumstances, the iodide of potassium occupies the next rank in value, in doses of five grains, three times a day. Sometimes sarsaparilla alone appears very useful, combined with medical treatment; a change of air, particularly to the seaside, and, above all, a sea voyage, are powerful auxiliaries.

The traumatic and strumous forms of iritis differ from the specific in the absence of any distinct tubercles, and in being far less under the control of mercury. In the former, where it is recent and acute, it is chiefly to be relieved by the internal use of opium, and by soothing applications and depletions: in the latter, the progress of the case is generally very tedious, the evidences of the disease very limited, consisting chiefly in one or two points of adhesion and a slight dimness of the capsule and some thickening and dullness of the iris. Mercury cannot usually be well borne, and reliance must chiefly be placed in such constitutional treatment as may be indicated by the strumous diathesis. Iritis is occasionally met with in infancy, and very readily yields to mercury.

As regards the local treatment of iritis, depletion, either by leeching or cupping, is usually unnecessary in any but the rheumatic forms. Cases, however, of specific iritis are sometimes attended

by a very loaded condition of the vessels, and a full, strong pulse, in which the local abstraction of blood is very useful, and very much assists the action of mercury. All local applications should be of a warm and soothing character; cold in every shape is decidedly contra-indicated; all astringents or stimulating collyria are worse than useless. The extract of belladonna, applied to the brow with a view of preventing or removing adhesions, is recommended by most writers: it may be applied at the commencement and towards the close of the disease.

*Rheumatic Iritis.*—It most commonly attacks persons about the middle period of life, in whom some constitutional tendency to rheumatism exists; the symptoms are of a severe and distressing character; the attack is ushered in by a feeling of fullness and tenderness about the eyeball, soon followed by profuse lachrymation and some intolerance of light; the pain is intermittent, and is chiefly referred to the eyebrow and temple, and even to the cheek and side of the nose; these symptoms, and especially the pain, are usually much aggravated towards night; after a short time vision becomes cloudy and dim. This disease usually attacks one eye at a time, although both are sooner or later involved. On examining the eye it is highly injected, and on looking more minutely, the vessels are found to be situated in the sclerotic coat; they are deep-seated, numerous, but small, and finely pencilled of a pink colour, and pursuing a straight course towards the cornea, around which they form a capillary plexus; the conjunctiva is usually but slightly involved, a few large loose returning veins being chiefly visible, and being readily distinguishable from the sclerotic vascularity, which is a main feature of the disease. On examining the iris, the pupil is found contracted and immovable, the colour changed usually to a greenish tinge, the surface is dull, and the healthy texture of the iris is no longer visible, the little irregularities being coated over by a thin film that uniformly pervades it, and does not present any tubercle, or even any thickening deposit at the pupillary margin, as we observe in ordinary iritis. In severe cases, and especially after repeated relapses or fresh attacks, the capsule becomes cloudy, and, as a result of this, the sight is impaired. A thin, white line around the margin of the cornea, and a frothy character of the secretion, also indicate this form of inflammation, but their absence by no means contra-indicates it. Combined with these local signs, we usually find some constitutional evidences of rheumatic diathesis; the powers of the system are at a low ebb, the various secretions are in a vitiated state, the tongue is foul, of a whitey-brown colour, and coated over its entire surface; the urine is high coloured, turbid, and scanty; the skin is usually moist, with a tendency to night perspirations; the pulse is rather weak, quick, and irritable. The more immediate and exciting cause of the attack is generally to be found in a prolonged exposure of the eye to a stream of cold air, to a humid state of the atmosphere, and to the injudicious use of cold applications to the eyelids. This form of inflammation often follows injuries of the eye, and operations performed upon this organ in persons prone to rheumatism, and subjected to premature exposure or prolonged use of cold lotions. A favourable prognosis may generally be given if the disease is seen in the early

stage, and if it is a first attack; that which we have particularly to fear is a relapse during treatment, and a return after treatment, which is very discouraging.

The treatment must be constitutional and local. In the constitutional treatment the secretions must be acted upon; drastic purgatives are useful combined with diuretics, and if the rheumatic diathesis is strong, colchicum is very valuable, if the general powers admit of its administration. If the system is feeble, iodide of potassium is a useful substitute, and if the iris is much affected, it may be necessary to exhibit mercury; but though it may clear the surface of the iris, it will not control the inflammation of the fibrous tissue, which is the texture primarily and chiefly implicated. In cases that are very protracted, when the vessels are considerably congested, when the sight is a good deal impaired, and the various medicines seem to fail, turpentine has been strongly recommended. It may be given in doses varying from a scruple to half a drachm, in a mixture, three times a day, carefully watching its effect in the latter stages of the disease; and sometimes combined with more active treatment. If the system be feeble, if the skin act freely, and if the pain assumes an intermittent and periodic type, steel, quinine, and bark may be given. When the pain is very intense and protracted, and after the secretions have been freely acted upon, opiates may be given with great advantage.

We may now consider the local treatment. In severer cases, and in the early stage, local bleeding by means of leeches, or, what is still better, by cupping on the temple, is highly useful, and sometimes cuts short the attack. The effect may be kept up by the application of a blister, either to the temple or forehead; the pain over the brow may be often relieved by rubbing in mercurial ointment combined with opium, in the strength of one drachm to an ounce, to the seat of pain each night and morning, for five or ten minutes; if the surface is blistered it may be dressed with this ointment. Warm applications are usually the most agreeable to the patient, and the most suitable for the disease; but even here exceptions occur in which cold gives relief, and then it is better to allow it. As to the propriety of using belladonna, it may be remarked, that in the early stage, when the iris is but slightly affected, it is useful to enlarge the pupil; and when the disease is subsiding, the same effect may be produced with advantage; but during the active and fully developed stages of the disease, when the iris is thoroughly involved, belladonna often gives great pain, and does not influence the size of the pupil.

The disease now described may be complicated with a catarrhal affection of the conjunctiva. This has been termed catarrho-rheumatic ophthalmia.

(See *Lectures on Diseases of the Eye*, by Mr. Critchett. *Lancet*, September, 1854.)

Consult also the works mentioned under the article *Conjunctivitis*. C. Bader.

[IRIS, CONGENITAL DEFECTS OF THE.—The irides are sometimes wholly absent, a condition which has been termed *Irideremia*; but in most of the cases which are so denominated, there really exists a slight rudiment of iris, which, on close observation, may be traced as a very narrow, coloured ring—or more commonly as a



cornea—skirting some portion of the margin of the cornea.

*Coloboma* is the name given to a congenital malformation of the iris, whereby the border of the pupil is left incomplete at one part, the aperture therefore assuming a pyriform figure, lengthened out to the margin of the cornea. The cleft most frequently exists at the lower part of the iris, but occasionally it extends upwards or in a lateral direction. It usually coexists in both eyes. Sometimes the pupil, retaining its rounded form, is placed close to the margin, instead of opposite to the centre of the cornea.

It is said that in rare instances the "pupillary membrane" which exists in the foetus is not wholly absorbed at birth; and its persistence may give rise to a belief that the infant is the subject of congenital cataract." (*Dixon, Diseases of the Eye*, 1855, p. 117-119.)] *C. Bader.*

IRIS, INJURIES OF. (See Art. EYE, INJURIES OF.)

IRIS, PROLAPSUS OF. A small tumour, formed by the protrusion of a portion of the iris through an opening in the cornea. It is sometimes named *staphyloma of the iris*. The protrusion of the whole iris, after the destruction of the entire cornea by sloughing, is termed *staphyloma racemosum*. A small prolapsus, forming a brownish tumour, compared to a fly's head, is called *myocephalon*.

The causes of this complaint are such wounds and ulcers of the cornea as make an opening of a certain extent into the anterior chamber of the aqueous humour, and violent contusions of the eyeball, occasioning a rupture of the cornea. If the edges of a wound in this situation, whether accidental, or made for the purpose of extracting a cataract, or evacuating the matter of hypopyum, be not brought immediately afterwards into reciprocal contact, or continue not sufficiently agglutinated together to prevent the escape of the aqueous humour from the anterior chamber, regularly as this fluid is reproduced, the iris, drawn by its continual flux towards the cornea, glides between the lips of the wound, becomes elongated, and a portion of it gradually protrudes beyond the cornea, in the form of a small tumour. The same thing takes place whenever the eyeball unfortunately receives a blow, or is too much compressed by bandages, during the existence of a recent wound of the cornea. Also if the patient should be affected, in this circumstance, with a spasm of the muscles of the eye, with violent and repeated vomiting, or with strong and frequent coughing, a prolapsus of the iris may be caused. When an ulcer of the cornea penetrates the anterior chamber, the same inconvenience happens more frequently than when there is a recent wound of that membrane; for the solution of continuity in the cornea, arising from an ulcer, is attended with loss of substance, and, in a membrane so tense and compact as this is, the edges of an ulcer do not admit of being brought into mutual contact.

In purulent and scrofulous ophthalmia, where a minute ulceration of the cornea often occurs, the extensive implication of the iris, and consequent strabismus, Mr. R. Welbank conceives, might be prevented by the early application of belladonna; and "perhaps (he adds) where the ulceration is remote from the circumference of the

cornea, and very small, the iris may be kept wholly disengaged, till processes of reparation prevent the risk of protrusion." (*Note in Frick's Treatise on Diseases of the Eye*, ed. 2, p. 11, 6.)

The little tumour is of the same colour as the iris, viz. brown or greyish, being surrounded at its base by an opaque circle of the cornea, on which membrane there is an ulcer, or a wound of not a very recent description.

As it usually happens that the cornea is only penetrated at one part of its circumference by a wound or ulcer, only one prolapsus of the iris is commonly met with in the same eye. But if the cornea should happen to be wounded, or ulcerated, at several distinct points, the iris may protrude at several different places in the same eye, forming an equal number of small projecting tumours on the surface of the cornea. Scarpa saw a patient who had three very distinct protrusions of the iris on the same cornea, in consequence of three separate ulcers penetrating the anterior chamber, one in the upper, and two in the lower segment of the cornea.

In the incipient state of the disease, the patient complains of a pain, similar to what would arise from a pin penetrating the eye; next he begins to experience, at the same time, an oppressive sensation of tightness, or constriction, over the whole eyeball. Inflammation of the conjunctiva and eyelids, a burning effusion of tears, and an absolute inability to endure the light, successively take place. As the protruded portion of the iris drags after it all the rest of this membrane, the pupil assumes an oval shape, and deviates from the centre of the iris towards the seat of the prolapsus. The intensity of the pain, produced by the inflammation and other symptoms, do not, however, always continue to increase. Indeed, old protrusions of the iris are often noticed, where, after the disease has been left to itself, the pain and inflammation spontaneously subside, and the tumour becomes nearly insensible. But where the prolapsus of the iris remains, as a consequence of previous inflammation of the eye, Beer confesses that it cannot be cured, without a partial adhesion of the iris to the cornea being left, and a dense scar on the latter membrane in the situation of the protruded iris.

As Dr. Mackenzie says, it is often impossible to effect the replacement; indeed, Mr. Lawrence states, that he has never seen it accomplished. "We may, however, occasionally succeed by the following means, if they be employed within an hour or two after the accident, and especially if it is the pupillary portion of the iris which is prolapsed. We find the eye already inflamed, intolerant of light, and probably acutely painful. The cornea will in general be more or less flaccid, and, on attempting to fix the eye, a farther discharge of aqueous humour is apt to follow. The first means to be had recourse to, is gentle friction of the eye through the eyelid, continued for the space of about half a minute, and then sudden exposure of the eye to a bright light. If this does not succeed, we may endeavour with a small blunt probe to lift one edge of the wound, and push the iris into the anterior chamber; and then, whether we succeed or not with the probe, repeat the friction of the eye and the exposure to bright light. If the wound is so situated between the centre and

the edge of the cornea, that it is the pupillary portion of the iris which is prolapsed, we ought to lose no time in smearing the extract of belladonna on the eyebrow and lids, and dropping a solution of atropine upon the eyeball. (See Art. ATROPIA and BELLADONNA.) In the course of from fifteen to thirty minutes, the belladonna will have probably operated on the unprolapsed portion of the iris, so as to dilate the pupil, and perhaps to drag back into its natural place the prolapsed portion. But if the wound is close to the edge of the cornea, belladonna ought not to be employed, as it only tends, in this case, to produce a greater degree of prolapsus. After the belladonna has been applied a sufficient length of time, our attempts by friction, and with the probe, are to be renewed. If we are successful, the wound ought to be touched with a sharp pencil of lunar caustic, which serves to prevent any further discharge of the aqueous humour.

"If the prolapsus of the iris still continue unreduced, it ought to be punctured, or a snip made in it with scissors. This allows the aqueous humour which lies behind the prolapsed portion to escape, and favours the return of the iris to its natural situation; which we must now endeavour to accomplish by the means already indicated." (See *Mackenzie On Diseases of the Eye*, p. 359, ed. 2; *Macfarlane, in Glasgow Med. Journ.* vol. i. p. 104; and *Gibson on Artificial Pupil*, p. 42.)

In conformity with Scarpa's principles, there are two principal indications in the treatment of recent prolapsus of the iris. The first is, to diminish, as speedily as possible, the exquisite sensibility in the protruded part of the iris; the other is gradually to destroy the projecting portion of this membrane to such a depth as shall be sufficient to prevent the little tumour from keeping the edges of the wound or ulcer of the cornea asunder. The adhesion, however, which connects the iris with the inside of the cornea must not be destroyed.

For fulfilling these indications, Scarpa preferred the use of the nitrate of silver.

While the assistant gently raises the upper eyelid, the surgeon depresses the lower one, with the index and middle fingers of his left hand; and, with the right, he touches the little prominence formed by the iris with the nitrate of silver, scraped to a point like a pencil. This is to be applied to the centre of the little tumour, until an eschar of sufficient depth is formed. The pain which the patient experiences at this moment is very acute; but it subsides as soon as the eye has been bathed with warm water. The caustic, in destroying the projecting portion of the iris, destroys the principal organ of sensibility, by covering it with an eschar, of sufficient depth to protect the part affected from the effect of the friction of the eyelids.

These advantages only last while the eschar remains adherent to the little tumour formed by the iris; when it falls off, as it usually does two or three days after the use of the caustic, all the pain, inflammation, &c., are rekindled, with this difference, that they are less intense and acute than they were previously, and the tumour of the iris is not so prominent as it was before the caustic was applied. When these symptoms make their appearance, the surgeon must once more have recourse to the nitrate of silver, and employ it a third and even a fourth time, as occasion may

require, until the prominent portion of the iris is sufficiently reduced.

There is a certain period, beyond which the application of caustic becomes improper. This is the case whenever the surgeon continues to employ the caustic after the little tumour of the iris has been destroyed to a level with the external edges of the wound, or ulcer of the cornea, and the application begins to destroy the granulations just as they are originating. He must now discontinue the caustic.

The adhesion, which the projecting part of the iris contracts to the internal margin of the wound, or ulcer of the cornea, during the treatment, continues during the rest of the patient's life. Hence, even after the most successful treatment, the pupil remains a little inclined towards the place of the scar, and of an oval figure. The change in the situation and shape of the pupil, however, causes little or no diminution of the patient's faculty of discerning the smallest objects; and is much less detrimental to the sight than one inexperienced in these matters might conceive; provided the scar on the cornea be not too extensive nor situated exactly in its centre. If the prolapsus be considerable, Mr. Middlemore prefers dropping into the eye a solution of from one to four grains of nitrate of silver in an ounce of distilled water, or touching the protruded part of the iris with a fine camel-hair pencil, dipped in the solution, and occasionally bathing the eye with the common alum or zinc lotion. He also recommends applying the extract of belladonna every twenty-four hours to the forehead and eyebrow. But, when acute inflammation prevails, he enjoins caution with respect to stimulants, until such inflammation has been subdued. (See *R. Middlemore on Dis. of the Eye*, vol. i. p. 714.)

According to Scarpa the excision of the protrusion with scissors can only be practised with success when the iris has contracted a firm adhesion to the internal edge of the wound or ulcer of the cornea; and, more especially, in that old prolapsus of the iris, in which the projecting portion of the iris has become with time almost insensible, hard, and callous, with its base strangulated between the edges of the wound or ulcer of the cornea, and, besides being adherent to them, has also a slender pedicle. Scarpa, indeed, has seen an incarcerated one fall off of itself.

In such circumstances the excision of the old prolapsus of the iris is not attended with the least danger; for, after removing, with a stroke of the scissors, that prominent portion of the iris which has already contracted internal adhesions to the ulcerated margin of the cornea, so as to reduce it to a level with the external edges of the ulcer, there is no hazard of renewing the effusion of the aqueous humour, or giving an opportunity for another piece of the iris to be protruded. One or two applications of the nitrate of silver suffice afterwards for the production of granulations on the ulcer of the cornea and the formation of a cicatrix. But it is not so in the treatment of the recent prolapsus of the iris, which has no adhesions to the internal edges of the wound or ulcer of the cornea.

In four subjects, affected with recent prolapsus of the iris, after Scarpa had removed, with a pair of convex-edged scissors, a portion of that membrane projecting beyond the cornea, of about the



size of a fly's head, he found, on the ensuing day, that a new portion of the iris, not less than the first, had made its way through the ulcer of the cornea, and that the pupil was very much contracted, and drawn considerably further towards the ulcer of the cornea. The advantage of caustic in the recent sensible prolapsus of the iris, and the use of scissors only in old callous cases, agree also with the directions given by Beer and Travers. (*Lehre von den Augenkr.* b. ii. p. 68.; and *Synopsis*, p. 280.)

There is a particular species of prolapsus, much less frequent, indeed, than that of the iris, but which does occur, and, in Scarpa's opinion, is very improperly termed by modern oculists, "*prolapsus of the tunic of the aqueous humour*." (*Janin, Pellier, Guérin, Gleize, &c.*) Neither do his sentiments upon this subject agree with those of Beer, who terms the case *ceratocoele*, and describes it as arising from a yielding of the inner layers of the cornea. And in his second volume, p. 59, he has given a description of the same kind of disease from the support of the outer layers of the cornea being destroyed by ulceration. This is a point, on which the most experienced men differ so much, that it is difficult to reconcile their statements. Dr. Vetch seems to have full reliance upon the accuracy of the accounts of a protrusion of the membrane of the aqueous humour. (*On Diseases of the Eye*, p. 54, &c.) Mr. Travers inclines to Beer's view of the subject, and details reasons for doubting that the vesicle is a distinct texture: "its appearance corresponds accurately to that of the innermost lamella of the cornea." (*Synopsis*, &c. p. 116.)

It is, says Scarpa, a transparent vesicle, filled with an aqueous fluid, and composed of a very delicate membrane, projecting from a wound or ulcer of the cornea, much in the same way as the iris does under similar circumstances. Scarpa has several times seen this transparent vesicle full of water, elongating itself beyond the cornea, shortly after the operation for the extraction of cataract, and sometimes, also, in consequence of an ulcer of the cornea, especially after rescinding a prolapsed portion of the iris.

Scarpa believed this pretended prolapsus of the tunic of the aqueous humour to be a protrusion of a portion of the vitreous humour, which, from too much pressure being made on the eye, either at the time of the operation, or afterwards, or from a spasm of the muscles of the eye, insinuates itself between the edges of the wound after the extraction of the lens, and projects in the form of a transparent vesicle. The same thing also happens after ulcers of the cornea, whenever the aqueous humour has escaped, and a portion of the vitreous humour is urged by forcible pressure towards the ulcer facing the pupil; or whenever an elongated piece of the vitreous humour, after the excision of a prolapsed portion of the iris, passes by a shorter route than through the pupil, between the lips of the ulcer of the cornea. At length, we understand why, in both these instances, a transparent vesicle forms, even after the excision of the tunic of the aqueous humour, or ulceration of the cornea; and why it very often reappears in the same place, though it has been cut away to a level with the cornea. It is because one or more cells of the vitreous humour, constituting the transparent vesicle, are succeeded after their removal by other

cells of the same humour, which glide between the lips of the wound or ulcer of the cornea into the same situation.

The treatment consists in removing the transparent vesicle projecting from the wound or ulcer by means of a pair of curved scissors, and bringing the edges of the wound of the cornea immediately afterwards into perfect apposition, in order that they may unite together as exactly as possible. But, when there is an ulcer, as soon as the vesicle is removed, the sore must be touched with the nitrate of silver, so that the eschar may resist any new prolapsus.

If, in some particular cases, the vesicle should not project sufficiently from the wound or ulcer to be included in the scissors, the same object may be accomplished by puncturing the tumour with a lancet or couching needle; for when the limpid fluid which it contains is discharged, the membrane forming it shrinks within the edges of the wound or ulcer, and no longer hinders the union of the former or the cicatrization of the latter.

Scarpa saw a prolapsus of the choroid coat, two lines from the union of the cornea with the sclerotic, in the inferior hemisphere of the eye. It was preceded by a small abscess, the consequence of severe ophthalmia. The treatment consisted in applying the nitrate of silver severaltimes to the projecting part, until it was reduced to a level with the bottom of the ulcer of the cornea. The part then healed. The eye remained, however, considerably weakened, and the pupil afterwards became nearly closed. C. Bader.

Scarpa, sulle Principali Malattie degli Occhi, Venezia, 1802. Richter's Anfangs. der Wundarzneikunst, b. iii. Pellier, Obs. sur l'Œil, p. 350. C. J. Beer, Lehre von den Augenkrankheiten, b. i. § 402, 518, and 592, and b. ii. § 58, 62, &c. 8vo. Wein, 1813—1817. J. Wardrop, On the Morbid Anatomy of the Human Eye, vol. ii. p. 51, 8vo. Lond. 1818. J. Vetch, On the Dis. of the Eye, p. 53, &c. Lond. 8vo. 1820. B. Travers, Synopsis of the Dis. of the Eye, p. 116, 280, &c. 8vo. 1820. Weller, On Dis. of the Eye, Transl. by Dr. Monteith, 8vo. Glasgow, 1821. Frick, On Dis. of the Eye, ed. 2, by R. Weibank, 8vo. Lond. 1826. W. Lawrence, On Dis. of the Eye, 8vo. Lond. 1833. R. Middlemore, On Dis. of the Eye, vol. i. 8vo. Lond. 1835. Wm. Mackenzie, On Dis. of the Eye, ed. 2, 8vo. Lond. 1835. [Mackenzie: On the Dis. of the Eye; 4th edition, 1854. Desmarres, Traité Théorique et Pratique des Maladies des Yeux, &c. Paris, 1855.]

For a description of the manner of dividing the iris, in order to make an artificial pupil, when the natural one is closed, refer to *Pupil, Closure of*.

IRIS; effects of certain narcotics upon the. See ATROPIA, BELLADONNA, and CATARACT.

IRITIS. See IRIS, INFLAMMATION OF.

ISSUE. See SETON.

JAW-BONES, REMOVAL OF. See BONES, EXCISION OF.

JOINTS, DISEASES OF.—The joints are subject to numerous diseases, which are more or less serious according to their particular nature. Like all other parts, they are liable to inflammation and abscesses; their capsules frequently become distended with an aqueous secretion, and the disease termed *hydrops articuli* is produced; but the most important of all their morbid affections are the cases which, a few years ago, were indiscriminately called *white swelling*, *scrofulous joints*, and the *disease of the hip-joint*. Here, as Sir Benjamin Brodie remarks, the same name has been frequently applied to different diseases, and the

same disease has received different appellations. And confusion, with respect to the diagnosis, always gives rise to a corresponding confusion with respect to the employment of remedies. Although, says he, diseases in their advanced stage extend to all the dissimilar parts of which the joints are composed, such is not the case in the beginning. Here, as elsewhere, the morbid actions commence, sometimes in one, and sometimes in another texture, differing in their nature, and of course requiring to be differently treated, according to the mechanical organisation and vital properties of the part in which they originate. (See *Pathological and Surgical Obs. on Dis. of the Joints*, p. 2, 8vo. Lond. 1818.) It was this idea which led Sir B. Brodie to trace by dissection the exact parts in which several of the principal diseases of the joints commence; and how much light and discrimination his successful investigations have produced it is needless to insist upon, as his merit will be appreciated by every surgeon who recollects the perplexity and ignorance which prevailed only a few years ago in this very interesting branch of surgery.

**Wounds.**—By the wound of a joint surgeons mean a case where the capsular ligament and synovial membrane are penetrated or divided. The injury is often accompanied with a division of the lateral or other ligaments, and sometimes also with that of the cartilages and bones. [The fact of penetration is made known to us by the escape of a transparent viscid discharge, called the synovia; or the interior of the articulation itself may be exposed. If there is any doubt as to the wound penetrating the synovial membrane, it is strongly recommended by surgeons not to probe or use any other means to ascertain the fact, for the reason that the very occurrence that is dreaded may be induced by the surgeon. The fact of the wound penetrating the joint will speedily be cleared up by the symptoms that supervene.] As a discharge very much resembling synovia may proceed from mere wounds of the bursæ mucosæ, we might form an erroneous judgment were we unacquainted with the situation of these little synovial bags. In Aug. 1829 I attended a man whose leg was attacked with erysipelas in consequence of a superficial laceration of the skin of the knee by a fall. A small abscess formed below the patella, and afterwards a considerable quantity of fluid, resembling white of egg, and evidently secreted by the neighbouring bursa, was daily discharged with the pus. Boyer met with several cases in which a fluid resembling synovia was discharged from the wounds of the sheaths of tendons. (*Mal. Chir.* t. iv. p. 408.)

[The severity of the wound of a joint will depend upon the size of the articulation itself, and also upon the nature of the wound, whether it be a puncture, an incision, or an extensive laceration. In small joints like those of the fingers a recovery will often ensue without destruction of the articulation. On the other hand, when a large joint is punctured or incised, the inflammation and constitutional disturbance may be so great as not only to lead to the loss of the limb, but also of the patient's life. "When the wound is large, lacerated, or contused, with fracture of the articular ends of the bones, one or other of these consequences certainly results. It is especially in grown-up persons that these unfavourable conse-

quences ensue; in children extensive injuries of large joints may heal favourably, though, if the child be of a strumous habit of body, destructive action is apt to be set up. (See *Erichsen's Science and Art of Surgery*, ed. 3, p. 256.) Simple wounds, however, even of large joints, often heal favourably; we have seen the knee and elbow joint laid open, and recovery with a moderate amount of temporary stiffness of the joint, the cure having mainly depended upon keeping the limb in the most perfect state of rest, and using proper means to avert inflammation.] Boyer relates two cases of punctured wounds of the elbow-joint, which healed up in a few days without any unfavourable symptom. I have seen others. In the hospitals of this metropolis cases of punctured wounds of the knee and other joints frequently present themselves, and, if well treated, often have a favourable termination. The records of surgery, again, furnish many examples, in which the most alarming and fatal consequences have ensued. (See *Hunter's Commentaries*, part i. p. 69.) When properly treated, punctured wounds of the joints (says Boyer) are not in general attended with danger; but as some of them, which were apparently quite simple, have been followed by bad symptoms, and even death, we should always be extremely circumspect in the prognosis. (*Op. cit.* t. ix. p. 409.)

[In wounds of the joints, the local symptoms and state of the parts are the same as in the most violent forms of synovitis, and the source of the danger is the inflammation set up (*traumatic arthritis*). "A few hours after the infliction of the injury the joint swells, becomes hot, painful, and throbs. The pain increases, becoming tense and extremely severe. If the aperture be large, synovia freely escapes, which soon becomes mixed with pus. If it be small, but little more than a puncture, the joint swells and fills with purulent fluid, which will either escape through the original wound, or find an outlet for itself through a new situation. There are startings of the limb, with excessive pain in any attempts at moving it. The constitutional disturbance becomes very severe, the patient being occasionally carried off by the violence of the irritative fever. In other cases symptoms of purulent absorption come on, and death results from pyæmia." (See *Erichsen, op. cit.* p. 257.) Should the patient survive the acute symptoms, abscesses form around and above the articulation, burrowing in various directions, and the discharge both from them and the joint induces irritative fever and hectic. It is to the admission of air into the joint that suppuration is attributed; and this is beyond dispute an undoubted fact, when it is remembered that very extensive wounds, in and around joints, involving ruptures and lacerations of tissues, as occur in dislocations and fractures, go on without any bad symptoms, if air is excluded. At any rate suppuration rarely takes place. The air in communication with an open joint causes the pus to become acrid and putrescent, thus rendering it a source of irritation in the depths of the articulation, which severely tells upon the constitutional powers. The essential difference between *traumatic arthritis* and other forms of idiopathic inflammation of a destructive or disorganising character, is that in the first the synovial membrane is the part primarily affected, and if the cartilages are involved, they become so secondarily, the articular ends of



the bones not participating in the morbid action. This is reversed in disorganising idiopathic inflammation; the mischief then usually commences in the osseous articular ends, or in the cartilage, the synovial membrane being often the last affected. "In the traumatic form the disease may be said to radiate from the circumference of the joint; in the idiopathic from the centre."

In the *treatment* of wounded joints, the first point to be determined is whether amputation should be performed, or an attempt made to save the limb. Without here going into this question, we may remark that the former must be discarded if the joint is not extensively opened, if the soft parts are not much contused and torn, and if there is no dislocation or extensive fracture of the bones. If the wound is a puncture or a clear incised wound, an effort must be made to heal it by the first intention, by bringing the edges together, and "placing a piece of lint soaked in collodion upon it, or a strip of plaster washed over with resin-varnish, the inflammatory action being subdued by continuous irrigation with cold water: no poulticing or warm fomentations should ever be allowed during this stage." (*Erichsen*, op. cit.)]

When the edges of an incised wound of a joint are immediately brought together, the cavity of the joint has not been long exposed, and blood is not extravasated into it, the prognosis is mostly favourable. This last source of danger is also exaggerated, as will be noticed in speaking of collections of blood in joints. With these exceptions the wound may heal as readily as if the joints were not opened. In a sabre, or cut wound, the principal object is to heal the wound by the first intention. The rest of the treatment consists in using every possible means for the prevention of inflammation, as perfect quietude of the part, the use of cold applications, leeches, &c.

[If suppuration supervene, it has been recommended to make free incisions into the joint so as to procure an early outlet for the pus; the part must now be well poulticed, and an attempt made at procuring ankylosis by the granulation and cohesion, through fibrous tissue, of the articular surfaces. The decomposition of the pus, and its absorption into the system, are no doubt greatly lessened by free and early incisions into the joint after suppuration has once been set up. The constitutional irritation produced by the tension of the parts is likewise at once removed.]

The experienced Mr. Hey has noticed wounds of the joints, and made some pertinent remarks on them. He states that, in these cases, the utmost care should be taken to *prevent* inflammation. "Upon this circumstance chiefly depends a successful termination. I have seen (says he) many large wounds of the great joints healed without the supervision of any dangerous symptoms where due care has been taken to prevent inflammation in the joints after a wound, and to arrest its progress when once begun. I speak now of inflammation affecting the capsular ligament. A slight degree of redness and tenderness in the integuments only is of little consequence; but when the capsular ligament becomes inflamed, the formation of abscesses, attended with a high degree of fever, and ultimately a stiffness of the joint, are the common consequences, if the life of the patient is preserved." (See *Practical Obs. in Surgery*, p. 354, edit. 2.)

In speaking of cartilaginous substances in the joints, I shall have occasion to advert again to the danger attendant on wounds of these parts; and the same fact is still further considered in the articles *Amputation*, *Dislocations*, *Fractures*, and *Gun-shot Wounds*, in which last part of the Dictionary the sentiments of Baron Larrey, and other writers on military surgery, are laid before the reader.

*Inflammation of Joints, or Synovitis.* [This is the most common perhaps of all the articular affections, and may be acute, subacute, or chronic in its characters. Whatever form it assumes, synovitis usually results from exposure to cold, especially in rheumatic constitutions. In these cases it commonly happens that more joints than one are implicated at the same time; and the affected articulations are most frequently those that are most exposed by the thinnest covering of soft parts, and by being especially subjected to transitions of temperature; such as the knee and ankle. Injuries of joints, as blows, bruises, wounds, or sprains, will also frequently occasion this inflammation; but when arising from such causes, it is seldom of an unmixed kind, being usually associated with inflammation of the other textures that enter into the composition of the articulation. (See *Erichsen, Science and Art of Surgery*, p. 678, ed. 3.)] No cause, however, is so frequent as the application of cold; and hence Sir Benjamin Brodie explains the frequency of synovial inflammation in the knee, and its rarity in the hip and shoulder, which are covered by a thick mass of flesh. [Mr. Coulson has known long-continued pressure to give rise to it; thus it has been caused by kneeling for a long time on damp earth.]

The synovial membranes are naturally not very sensible; but, like many other parts similarly circumstanced, they often become acutely painful when inflamed. The complaint is accompanied with an increased secretion of the synovia, which becomes of a more aqueous and of a less albuminous quality than it is in the healthy state. Hence it is not so well calculated for lubricating the articular surfaces and preventing the effects of friction, as it is in the natural condition of the joint; a circumstance which may explain why a grating sensation is often perceived on moving the patella.

It has been explained by Sir Benjamin Brodie, that the usual consequences of inflammation of the synovial membrane, are: 1. A preternatural secretion of synovia; 2. An effusion of coagulated lymph into the cavity of the joint; 3. A thickening of the synovial membrane, and conversion of it into a substance resembling gristle, and an effusion of coagulated lymph, and probably of serum, into the cellular texture, by which it is connected to the external parts; 4. In some instances, adhesion, more or less extensive, of the opposite surfaces of the reflected membrane to each other. "These effects of inflammation of the synovial very much resemble those of inflammation of the serous membranes. There are, however, some points of difference. In the former, I have reason to believe that suppuration rarely takes place independently of ulceration; but this is a frequent occurrence in the latter. Inflammation of the peritoneum or pleura, though very slight in degree, and of very short duration, terminates in the effusion of coagulable lymph; but it is only violent,

or long-continued inflammation, which has this termination in the membranes of joints." (*Med. Chir. Trans.* vol. iv. p. 216.)

When coagulable lymph is effused, the whole of it does not always adhere to the inflamed surface, but some of it forms flakes which float in the fluid within the joint, in masses large enough to be felt through the capsular ligament. In other instances, the lymph becomes solid, adheres to the inside of the synovial membrane, and becomes vascular. The surface of this adventitious coating is sometimes smooth; but occasionally it forms thick projecting masses of different degrees of thickness and length, and so numerous as to conceal every part of the original smooth surface of the synovial membrane. (See *Wilson, On the Skeleton, &c.*, p. 319.)

[As uncomplicated acute synovitis is never a fatal affection, it is seldom that we have an opportunity of studying its pathology. It would, however, appear from the result of the examination of joints in cases of synovitis from injury, as well as from the result of experiments of Richet, Bonnet, and others, who have induced traumatic synovitis in animals, that there is in the first instance an inflammatory congestion and vascularity of the membrane, attended by a loss of its peculiar satiny polish. The synovia is then increased in quantity, as well as altered in quality, becoming thin and serous, and after a time intermixed with plastic matters, which are poured out with it. If the disease progress favourably, these products are more or less completely absorbed. If, however, as is more rarely the case, the inflammation go on to an unfavourable termination, the vascularity and swelling of the synovial membrane increase, until at last it becomes so turgid and distended with blood and effused fluids that a kind of chemosis of it results; a thin, purulent-looking fluid, composed of granular corpuscles floating in a serous liquid, is poured out, and disintegration, with thinning and erosion of the cartilage, and probably complete destruction of the joint, ensues. In other cases, granulations are thrown out on the looser portions of the membrane, which, becoming supplied with blood-vessels, constitute fringed and villous membranous expansions, lying upon the subjacent disintegrated and eroded cartilage. (See *Erichsen's Science of Surgery*, ed. 3. p. 678.)]

When the inflammation attains a high pitch, an abscess may occur in the cavity of the joint; the synovial membrane and capsular ligament at length ulcerate; the pus makes its way beneath the skin, and is sooner or later discharged through ulcerated openings.

An abscess rarely takes place in an important articulation, in consequence of acute inflammation, without the system being greatly deranged. Severe febrile symptoms always afflict the patient, and occasionally, delirium and coma taking place, death itself ensues. Two rapidly fatal cases of ulceration of the synovial membrane, where matter had formed within it from a sprain of the hip and a contusion of the shoulder, are recorded by Sir Benjamin Brodie. (See *Path. and Surg. Obs.*, ed. v. 65.)

[In some of these cases, the inflammatory fever is quickly converted into hectic fever, and generally hectic symptoms almost immediately begin to show themselves when an abscess has taken place in a large joint. The cartilages now become

affected, and are either absorbed or ulcerated, denuding the surface of the bones. At length the heads of the latter inflame, and become carious; or the result may be ankylosis. Sir Benjamin Brodie believes that in most cases of caries of the joints the disease begins in the harder textures, subsequently extending to the cartilage or synovial membrane. The same surgeon has also noticed the occasional termination of acute synovitis in suppuration, without its having produced ulceration in the soft or hard textures of the joint. In many cases of pyæmia and phlebitis, pus is found in the joints, as an effect of synovial inflammation without the presence of ulceration. Ordinary synovitis is a disease that seldom attacks young children, but is frequent in adult persons; this is the reverse of what happens in some of the other diseases of the joints.]

The following are the chief symptoms of the acute form of the complaint, described by Sir Benjamin Brodie:—

There is pain in the joint, sometimes referred, in the first instance, to a particular spot, afterwards to the joint generally, and it is not at its height before the end of a week or ten days. Sometimes even at this period the pain is trifling, but sometimes it is considerable, and every motion of the joint is distressing. In a day or two after the commencement of the pain, the joint is affected with swelling, which at first arises entirely from a collection of fluid in its cavity; and in the superficial joints an undulation may be distinguished. However, after the inflammation has prevailed for some time, the fluid is rendered less perceptible, either in consequence of the synovial membrane being thickened, or the effusion of lymph; and the more solid the swelling is, the more is the mobility of the joint impaired. The form of the diseased joint does not correspond to that of the heads of the bones; but as the swelling is chiefly caused by the distension of the synovial membrane, its figure depends in a great measure on the situation of the ligaments and tendons, which resist it in certain directions, and allow it to take place in others. Thus, when the knee is affected, the swelling is principally observable on the anterior and lower part of the thigh, where there is only a yielding cellular structure between the extensor muscles and the bone. It is also often considerable in the spaces between the ligament of the patella and the lateral ligaments; because at these points the fatty substance is propelled outward by the collection of fluid. In the elbow, the swelling occurs principally above the olecranon, under the extensor muscles of the fore-arm; and in the ankle it is between the lateral ligaments and the tendons in front of the joint. In the hip and shoulder, where the disease is less frequent, the fluid cannot be felt, but the swelling is perceptible through the muscles. In the beginning of this disease in the hip, a fulness is remarked in the groin, and sometimes also in the nates. The pain is referred, not to the knee, as in cases of ulceration of the cartilages, but to the upper and inner part of the thigh. The pain is aggravated when the patient stands erect, and allows the limb to hang without the foot resting on the ground. It is also increased by motion, but not by pressing the articular surfaces against each other. The pain is often very severe, yet not equal to that which occurs when ulceration of the cartilages has taken place. From



some cases which have fallen under the observation of Sir Benjamin Brodie, he cannot doubt that inflammation of the hip occasionally terminates in dislocation of that joint. Indeed he has recorded one example of this occurrence. The pain is usually confined to the hip, but Sir Benjamin Brodie has seen cases in which it was also referred to the knee. It may be discriminated from the case in which the cartilages of the hip are ulcerated, by observing that *the pain is more severe in the beginning than in the advanced stage of the disease.*

After the inflammation has subsided the fluid is absorbed, and the joint frequently regains its natural figure and mobility; but in the majority of cases stiffness and swelling remain, and the patient continues very liable to relapse, the pain returning and the swelling being augmented whenever the patient exposes himself to cold, or exercises the limb a great deal. In cases where the synovial membrane is thickened, a slow kind of inflammation sometimes continues in the part, notwithstanding the fluid has been absorbed, and the principal swelling has subsided, the disease at length extending to the cartilages, suppuration taking place, and the articular surfaces being completely destroyed. According to Sir Benjamin Brodie, in this advanced stage, the history of the disease, and not its present appearance, is the only thing by which we can learn whether the primary affection was inflammation of the synovial membrane, or ulceration of the cartilages.

Though such is the most common character of inflammation of the synovial membrane, it is admitted that its nature is sometimes more acute, exhibiting the symptoms mentioned at the beginning of this section. In venereal cases synovitis rarely affects more than one or two joints at the same time. In rheumatism several joints are frequently affected, either at the same time or in succession, and the bursæ mucosæ and sheaths of tendons often participate in the disease. There is usually a good deal of pain and swelling, and the joints are often left stiff and enlarged. When the inflammation is connected with gout, the pain is usually out of all proportion to the other symptoms of inflammation. (See *Path. and Surg. Obs.* p. 28—34, &c., ed. v.)

[When the synovitis is chronic or subacute it may be characterised by all the symptoms of the acute variety of the disease, but in a less severe degree. The swelling and uneasiness of the joint are the most conspicuous local conditions. In some cases the swelling from accumulated serous fluid is so considerable as to constitute a true dropsy of the joint—*Hydrarthrosis*. This accumulation of fluid, partaking in various degrees of the characters of serum and synovia, is usually preceded or accompanied by evidence of synovial inflammation; but though this generally happens, it is not invariably the case. Richet, in particular, has recorded instances from which it would appear that inflammation is not a necessary or invariable accompaniment of the affection, the synovial membrane being, indeed, preternaturally white, and looking as if it had been washed or soddened; and though these cases are rare, those that commonly present themselves to the surgeon being of a decidedly inflammatory character, yet their occasional occurrence is sufficient to establish the existence of a passive as well as of an inflammatory form of the

disease. The presence of an abnormal quantity of fluid in the joint is always readily perceived by its *fluctuation* and *undulation*, and by the *peculiar shape* that it communicates to the part. The distinctive signs of *hydrops articuli* in the different articulations are described further on. In some cases of chronic synovitis distinct *crackling* will be felt in the interior of the joint on laying the hand over the articulation whilst it is freely moved. This has been attributed by Mr. Erichsen to the existence of plastic bands or deposits in the interior of the joint through which the fluid is pressed on the articular movements, and this occasions the sensation which is met with under other but similar circumstances, in enlargements of the bursæ, and in fluid effusions in the sheaths of tendons. (See *Erichsen, Science and Art of Surgery*, ed. 3, p. 681–2.)

The termination of synovitis will depend mainly on its cause. When of a simple uncomplicated character, arising as the result perhaps of rheumatic influences, it will in most cases terminate in complete resolution. In other instances, however, plastic matter may be thrown out, which either assumes the form of warty vegetation or concretions within the joints, or of bands stretching across its interior or incorporated with its capsule, occasioning more or less permanent stiffness. When synovitis arises from a wound, it usually goes on to suppuration within the joint, with superficial erosion or disintegration of the cartilage, and eventually, if the limb be not removed, to complete disorganisation of the interior of the articulation, and to more or less complete ankylosis. The same happens in the puerperal inflammation of joints, and in those that arise from pyæmia (presently to be considered); in which cases the marked action, commencing on the synovial membrane, extends downwards to the cartilages, eventually leading to their destructive disorganisation. The chronic or subacute synovitis and hydrarthrosis usually terminate favourably; but occasionally, more particularly in strumous constitutions, the disease runs on to suppurative destruction of the joint. This, however, is rare; yet its occurrence, in some instances, should make the surgeon careful not to confound the fluctuation of the serous accumulation with that of the purulent collection. In the latter instances there will always have been the precursory symptoms of inflammation. (See *Op. cit.*)]

The *treatment* of synovitis will depend partly on the severity of the symptoms, and partly on the cause of the disease.

When the disorder is connected with rheumatism, the medicines advised are opium, with ipecacuanha, diaphoretics, or preparations of colchicum or mercury; of the two latter Sir Benjamin Brodie prefers colchicum, where several joints, and the bursæ mucosæ and sheaths of tendons are implicated. In such cases he prescribes the wine of the root of colchicum in doses varying from fifteen to thirty minims, three times a day, or the acetous extract in doses of two or three grains every night. On the other hand, he considers calomel joined with opium best, where only one or two joints are affected at a time, and he recommends it to be given so as to affect the gums. In synovial inflammation connected with gout, the relief produced by colchicum is still more remarkable. In cases from syphilis, a well-regulated course of

mercury may be tried; and in others, from the protracted or injudicious use of mercury, the iodide of potassium, and sarsaparilla. Sir Benjamin Brodie deems the last medicines especially useful where the affection of the joints occurs in combination with diseases of the bones and periosteum. (See *Path. and Surg. Obs. on Joints*, ed. 5.)

[It is in the acute form of synovitis, whether arising idiopathically or from injury, that active measures must be adopted. Thus, if the patient be young and strong, venesection must be employed; but in all instances the free and repeated application of leeches to the inflamed articulation must be carried out. Many surgeons prefer cupping-glasses to leeches. Where the knee is affected, Mr. Coulson recommends the blood to be drawn from the lower part of the thigh, immediately above the swelling, as the application of cupping-glasses over the swelling itself gives rise to too much pain. When the leeches fall off, or when the cupping-glasses are removed, the bleeding is to be promoted by fomenting the part. This line of practice must be persisted in for some days, until the acute symptoms have subsided. In some cases no amount of abstraction of blood will have any effect in diminishing the amount of pain by which the patient is tormented. "I cannot say on what this depends, but it often occurs: perhaps it may be connected with some faulty position of the limb, giving rise to pressure of one inflamed surface against the other." (See *Coulson, Lectures on Diseases of the Joints. The Lancet*, vol. i. 1855, p. 380.) The local blood-letting must be followed by the use of warm fomentations or emollient poultices, with the addition of some narcotic to relieve the pain. Some surgeons employ poppy fomentations. Others again the lotio plumbi acetatis. In addition to these, the most perfect rest must be maintained with the limb on a splint, or on pillows properly arranged. In some instances cold irrigation will be found of essential service, more particularly if the synovitis has followed a wound of the articulation. At the same time calomel or other purgatives, followed by saline medicines, with antimony, may be given, and the patient kept on a low diet. Should these means fail, recourse must be had to mercury, which should be given so as to bring the system speedily under its influence.]

When the acute symptoms have subsided, and the disease has assumed a *subacute or chronic* form, the same principles of treatment must be adopted, modified according to the intensity of the affection. Repeated blisterings applied over the whole surface of the joint will now be found most useful, as recommended by Sir Benjamin Brodie. And if the joint be deep-seated, they may be applied as near to it as possible; but otherwise, at a little distance. Thus, when the synovial membrane of the hip is affected, they may be placed on the groin and nates; but when that of the wrist is inflamed, they should be applied to the lower part of the fore-arm. Sir Benjamin Brodie thinks blisters have more effect than any other means in removing the swelling; but, excepting in very slight cases, he condemns their use, unpreceded by the abstraction of blood.

[The most important element in the treatment of the chronic form of the disease is rest, everything else proving nugatory until this be attended to; the limb is usually best fixed by leather splints,

buckled on so that they may be removed in order to make the necessary applications to it. Counter-irritation by means of stimulating embrocations will now be serviceable, together with douches, either of warm sea-water, or of some of the sulphurous springs, such as those of Harrogate, Aix, or Barèges.]

In this stage of the disease, I find the tincture of iodine possesses considerable efficacy, particularly when blended with the soap liniment in the proportion of ʒj. to ʒij. Mr. Buchanan applies the tincture of iodine to the integuments, and his accounts represent it as being rapidly absorbed from the surface of the skin, and acting very powerfully in dispersing the thickening and induration of various diseases and abscesses of the joints. Indeed, he prefers such application of iodine to its internal exhibition, and states that its effects are produced without the aid of friction, so that it admits of being employed with advantage even when inflammation is present. (*On Diseased Joints, &c.*, Lond. 1828.) Mercurial or iodine ointment is preferred by some surgeons; or brushing over the joint a strong solution of nitrate of silver; or, after having damped the skin with water, rubbing it very gently with the solid nitrate. Sir Benjamin Brodie speaks favourably of the antimonial ointment in the proportion of ʒj. of the antim. tart. to ʒj. ung. cetacei. Issues and setons are never serviceable, unless ulceration of the cartilages has begun. After all inflammation has subsided, passive motion and friction, conjoined with some of the foregoing modes of treatment, will, in the course of time, restore the motion of the joint, and the use of the limb.

I have met with several instances, in which lotions containing vinegar and muriate of ammonia sufficed for the removal of the chronic complaints, left after the acute stage of the disorder. The tincture and ointment of iodine are also valuable applications, and they may be blended with other liniments, which will thus be rendered more efficient.

[Amongst the internal remedies likely to be of most service, may be mentioned the iodide of potassium, either alone, or in some bitter infusion.]

When the knee-joint has been much distended, Sir Benjamin Brodie has sometimes discharged the fluid by puncture. The following were the results:—1. In a thin person, if a few punctures be made with an instrument a very little broader than a couching-needle, a large quantity of fluid may be abstracted by means of a cupping-glass, with no inconsiderable relief to the patient. But while inflammation exists the benefit is not permanent, the fluid being rapidly regenerated. If, however, the inflammation has been already subdued, the absorption of the fluid usually goes on so rapidly that any more expeditious method of removing it is unnecessary. 2. If suppuration has taken place in the joint, not in consequence of ulceration, but from the surface of the synovial membrane, a free opening into it, made with a lancet, will often be the best practice. The most prudent plan seems to Sir Benjamin Brodie to be that of first making a puncture with a needle, and ascertaining the nature of the discharge; if it be not simply turbid serum, but actual pus, the lancet may then be employed. (*Op. cit.*)

*Loose cartilages in joints.*—Hard, roundish, or flattened bodies, mostly of a cartilaginous nature,



are sometimes formed within the synovial membrane, occasioning at times more or less pain in the joint, inflammation, and lameness. The disorder, though not noticed by any of the very ancient writers, is far from being uncommon.

Paré is the first who speaks of it: he says, that a *hard, polished, white body, of the size of an almond*, was discharged from the knee of a patient in the year 1558, in which he had made an incision for an *aqueous apostume*, or *hydrops articuli*. (Liv. xxv. chap. 15, p. 772.) A hundred and thirty-three years afterwards, viz. in 1691, Pechlin published the full details of another case, in which a cartilaginous body was successfully extracted from the knee. (*Obs. Physico Med.* obs. 38, p. 306.) Dr. A. Monroe, in 1726, dissected the knee-joint of a woman who had been hung, and found in the articulation a cartilaginous body of the shape and size of a small bean. These were the only examples of the disease known until the year 1736, at which period Mr. Simpson cut out of the knee a similar substance, which he supposed at the time of the operation was only beneath the skin. (See *Edinb. Med. Essays*, vol. iv.) But of late years the disease has been noticed and described by almost every writer.

[They have been referred to under various names, such as loose bodies in joints, inter-articular cartilages, osseous concretions, articular mice, and loose cartilages in joints. Velpeau calls them movable cartilages; and Nélaton strongly objects to the term cartilage, and proposes that they should be named movable or floating bodies in joints. Müller also objects to the term cartilage, for, although they resemble that substance in consistence, they are distinctly fibrous in structure.]

It would appear that all the very movable articulations are subject to the occasional presence of these bodies, although they are more common in some joints than in others. They are generally found in the knee, and produce symptoms that render them the object of surgery. They are rare in the arthrodial joints. Morgagni and B. Bell met with them in the ankle; Haller in the joint of the jaw; Hey and Solly in the elbow; and Laennec in the shoulder. (*Andral, Anat. Pathol.* t. i. p. 29.) They have also been noticed in the articulation between the head of the fibula and the tibia, and in that between the pisiform and cuneiform bones.

They present great varieties in regard to number, size, and shape. Usually there is but one in a single joint, and almost always so when large, but several may be formed in the same joint. Sir E. Home mentions an instance in which there were three. Professor Pirrie found fifteen in the knee of a body he opened in the dissecting room. Morgagni counted twenty-five in the left knee of an old woman who died of apoplexy; and Haller met with no less than twenty in the articulation of the lower jaw. [Robert discovered eighteen in the elbow, and Malgaigne as many as sixty. Philip Boyer saw five in the shoulder-joint, and Bonnet twenty in the same articulation. Dr. Berry of Kentucky removed thirty-eight from the knee of a negro, aged 35, with complete success. Their size in this instance varied from that of a pea up to that of a pullet's egg.] When there are several in a joint, it has been observed that their size is generally small, say from a mustard-seed to a small bean; but they may acquire the volume of

a marble, an almond, and even the patella, or of a pullet's egg just mentioned; but they are very rarely indeed found so large, although a few examples are recorded. When very large, they do not cause so much trouble to the patient as the smaller kind. A soldier of the 56th regiment had one nearly as big as the patella, which occasioned little uneasiness, being too large to insinuate itself into the moving parts of the joint.

[In colour they are whitish, greyish, or of a yellowish white, often of a pearly appearance, and bear a strong resemblance to cartilage. Their surface is perfectly smooth and even polished, and consist of either a single mass or of several lobules, connected together by dense gristly matter. They may be tough and striated, like the ligamentous tissue, or hard, like bone; but in a majority of cases they are distinctly fibro-cartilaginous. When very ancient, they have usually a bony nucleus at the centre. These bodies are invested by a reflection of the synovial membrane, beneath which they are developed, and to which they are originally attached by a slender pedicle, which is ultimately ruptured by the friction of the articular surfaces between which they are situated. (See *Gross, Path. Anat.* ed. 3, p. 274.) In shape they are oval, lenticular, or round, but they present great varieties in this respect. In the knee they are usually compressed and wedge-shaped, sometimes raised on one side and hollowed on the other, and in some cases not unlike the patella; oftentimes angular with numerous facets. Their consistence will vary a good deal, according to their density and composition. They seldom remain long at rest while the limb is in motion, and when they happen to be in situations where they are pressed upon with force by the different parts of the joint, they occasion a sudden attack of violent pain, and materially interfere with its motions.]

Various opinions have been promulgated as to the origin and structure of loose bodies in joints, and at one time the conjectures offered of their mode of formation were by no means of a reliable character. Mr. Hunter believed that they originated from a deposit of coagulated blood upon the end of one of the bones, which had acquired the nature of cartilage, and had afterwards been separated. What lent a show of truth to this opinion was the discovery of small projecting parts, preternaturally formed, as hard as cartilage, in joints which had been violently strained, or otherwise injured, and where death had occurred at different periods after the accident. These protuberances were so situated as to be readily knocked off by any sudden or violent motion of the joint. (*Trans. for the Improvement of Med. Chir. Knowledge*, vol. i.) [Nélaton observes that this opinion of Hunter's was completely abandoned when it was received by Velpeau. It is probable, he asserts, that in some cases such is the origin of these little movable bodies, when a large number of them are found in some articulations. But this explanation is insufficient for the formation of those large bodies which we find only in certain cases. (See *Nélaton, Éléments de Path. Chir.* t. ii. p. 183.)

Mr. South observes, that in the Museum of St. Thomas's Hospital there are several examples of these foreign bodies from joints and ganglions, which support Hunter's notion of their formation. In one there are numerous small flattened discs, not exceeding a pea in diameter, which were evacuated

from a swelling on the back of the hand that had probably been part of a tendon sheath, and had inflamed. They are composed of fibrine of ordinary type, and have hollow centres. In another, in which many little bodies were in the wrist-joint about the size of flattened peas, their surface had a cartilage-like appearance, and, when cut through, their substance was seen to consist of concentric layers of fibrin, with a small central hollow. In other preparations of larger size the central hollow has disappeared, and the whole mass seems homogeneous, and resembles cartilage. There is also a fine example of the result of synovial inflammation of the knee-joint, in which a large portion of the cartilaginous covering of the joint-ends of the bones has been destroyed; but on several parts of the synovial capsule numerous bunches of grape-shaped growths, with more or less thick stems, have formed, and one of these, as big as a bean, has become detached, and is loose in the cavity of the joint. Mr. South does not think, however, that this condition can be fairly taken as an example of the ordinary mode of production of loose cartilages, though it certainly explains the process very well. (See *System of Surgery* by J. M. Chelius, translated with notes by J. F. South, vol. i. p. 708.) There is a preparation of the knee-joint in St. Mary's Hospital Museum, laid open with the patella turned down, in which the synovial membrane is actually studded with melonseed-shaped growths, no doubt the result of former attacks of synovitis. There is also a preparation in the Museum of St. George's Hospital, where seven of these bodies are seen in various stages of growth, attached to the crucial ligaments and synovial membrane. In regard to their origin, Mr. Barwell remarks that "It would be hardly warrantable to assert that all false bodies in joints are of rheumatic origin; but it is certain that they are chiefly found in connection with that diathesis; they are very fully and largely developed in the disease called chronic rheumatic arthritis, and are in that malady frequently bony; moreover, they are found external to the articular cavity, that is, developed and lying among the peri-articular tissues." (See *Diseases of the Joints* by Richard Barwell, p. 206.)

Sir Benjamin Brodie met with two cases, in which the loose bodies were of a different nature, and had a different origin from that referred to by Sir E. Home. Sometimes disease causes a long ridge to be formed, like a small exostosis, round the margin of the cartilaginous surfaces of the joint. In the two examples alluded to, this preternatural growth of bone had taken place, and in consequence of the motion of the parts, portions of it had been broken off, and lay loose in the cavity of the joint. (*Med. Chir. Trans.* vol. iv. p. 276, and *Path. Obs.* ed. v. p. 255.) And in a more recent publication he remarks that, in the majority of cases which he has met with, no inflammation preceded the formation of these preternatural substances, and therefore he thinks it probable that, in some instances, they are generated, like other tumours, by some different process. He further observes, that they appear to be situated originally either on the external surface, or in the substance of the synovial membrane, since, before they become detached, a thin layer of the latter may be traced over them. (*Path. and Surg. Observ.* p. 250, ed. 5.) This statement also agrees with the views formerly

promulgated by Laennec and Bécclard (see *Andral, Anat. Pathol.* t. i. p. 286), and with that of Cruveilhier. (See *Anat. Pathol.*) The latter gentleman indeed has given an engraving, representing some of them as situated not only in the synovial membrane, but also in the cellular tissue external to it. All those which become detached and loose in the joint are covered by synovial membrane, and for some time were adherent by means of a slender pedicle formed of it. (See *Mayo's Outlines of Human Pathology*, p. 108.)

[Rokitansky speaks of these bodies under the name of articular mice. He describes two varieties of them, and believes they have different origins. The first variety, comprehending the fibrous or fibro-cartilaginous, some of which contain bony concretions, he believes to originate either in the cellular tissue external to the synovial membrane, or in the substance of the synovial membrane itself. As they increase in size, they press the membrane into the joint, becoming covered with a replication of it; by-and-by they retain a communication with the membrane only by a small pedicle, a condition not unfrequently revealed by dissection; and eventually, by the pedicle being ruptured, or worn away by friction, they become free in the joint. They have a proper synovial covering, which often bears a trace of this mode of development in being deficient at the spot where they were separated from the pedicle, it is there completed by loose shreds of cellular tissue. Those of the second variety are fibrillated and albuminous coagulations and precipitates, which are believed to take place in consequence of some abnormal products in the synovial fluid. They are distinguished by their uniform smoothness throughout, by a delicate albuminous investing membrane, and frequently by their manifest arrangement in concentric laminae.

Rokitansky therefore agrees with Laennec, Bécclard, Cruveilhier, and Sir B. Brodie in regard to the first variety being formed on the outside of the synovial membrane. (See *Path. Anat.* vol. iii.; *Sydenham Soc. Edit.* p. 41 & 295.) Indeed this is the general opinion of pathologists at the present day. One of the latest and best accounts of their minute structure is by Mr. Rainey, who examined several successfully removed from the elbow-joint by Mr. Solly, eight in number. To recapitulate: These loose bodies in joints may originate—1. In the form of small plastic tumours outside of the articulation (the most common), or within the synovial membrane itself. 2. From some morbid deposit within the joint derived from the synovial fluid, or perhaps in some rare instances from blood. 3. From a fragment of bone or of cartilage detached by violence.]

The symptoms by means of which we recognise this affection are seldom obscure. When the formation of the extraneous substances follows a fall or blow upon the joint, the complaint begins with a swelling of the surrounding soft parts, and upon the subsidence of this swelling the presence of the little cartilaginous tumours is indicated by certain symptoms which are peculiar to them. In persons who have had no blow or fall upon the knee, the disease sometimes commences with a more or less acute pain in the joint, with or without swelling of the surrounding soft parts, and which affection is usually regarded as rheumatism. To these first symptoms, which are



common both in cases of foreign bodies in the joints and other diseases of these parts, are soon added other particular signs, by which the nature of the case is evinced.

["All these loose or pedunculated bodies," Mr. Bryant observes, "give rise to similar symptoms. They are sometimes traced to a previous attack of inflammation of a joint; in other instances they show themselves after a strain. In many cases, however, no cause can be assigned, and it is more than probable that they are new developments, which follow their own laws, and do not depend upon any of these usually assigned causes. They may certainly be discovered after one of them, but it appears more probable that the sprain or inflammation of the joint is the result of the presence of the cartilage and its malposition, the cartilage during walking or some movement of the joint becoming fixed and pinched between the articular surfaces of the bones." (See *Thomas Bryant on the Diseases and Injuries of the Joints*, p. 150.) These bodies are mostly discovered accidentally by the patient, who, in walking or moving the joint, suddenly experiences a severe pain, and is unable to move the articulation; the joint cannot be flexed or straightened completely. The severe pain is often so intense as to cause faintness or sickness, which, however, quickly disappears when the loose body slips from between the bones, which is indicated by a snap. The loss of the power of moving the knee is instantaneous when the extraneous substance glides suddenly between the condyles of the femur and the head of the tibia, and as long as it remains the pain continues to be most acute. Most frequently, when the loose body gets behind the patella, or the ligament of the patella, as the patient is walking, he is compelled to make a sudden stop, and would fall down from the acuteness of the pain, if nothing were at hand to save him. It is to be observed, however, that there are some instances in which no pain is experienced by the patient under these circumstances. Mr. Erichsen says it is difficult to explain the cause of this severe pain. Richet thinks it may be owing to the synovial membrane being pinched between the foreign body and one of the articular surfaces. On the other hand, Reimarus mentions a man who suffered great pain, and could not move his leg when the extraneous body was at the side of the joint; but was immediately relieved by pushing it under the patella. This would show that the mere pinching alone is not the cause of the pain in all cases, although much importance is attached to Richet's opinion. B. Bell has known persons in whom the least motion of the limb would cause such pain as to awake them out of the deepest sleep. The pain has been so violent in some instances when the leg has been placed in certain postures, that patients have preferred remaining quiet in their beds to running any risk of experiencing the pain again. It is quite certain that these bodies remain quiescent for longer or shorter periods of time in particular parts of the joint without producing any inconvenience; and on some occasions, when least expected, they suddenly become jammed again between the articulating surfaces. Indeed patients have imagined themselves cured, from an immunity of all inconvenience for several months, when the symptoms indicating their presence have reappeared.

In the diagnosis of this affection the loose bodies can generally be made out and felt by the surgeon

at the surface of the joint. Some stiffness and slight inflammation may follow the first occurrence of the injury to the loose body, and these subside in a few days by rest and other treatment, again only to be renewed upon a recurrence of the accident.]

In handling the knee, the sufferer feels a hard prominent substance, which slips about under his fingers, and glides under the patella or the ligament of this bone, and sometimes under the tendon of the extensor muscles of the leg, from one side of the joint to the other. The extraneous body may make its appearance either at the inside or the outside of the articulation; but it most frequently presents itself at the former part, which is the broadest and most sloping, while the capsular ligament there is loosest. Desault met with one instance, in which the capsular ligament and soft parts were so loose that the patient could turn the extraneous substance round and round. [Although we have no statistics to illustrate the frequency of cases of loose bodies in joints, they may be considered not very rare. On this point Mr. Bryant observes that the disease is by no means an uncommon one, for about thirteen cases have taken place in Guy's Hospital within the last five years: twelve of these were in the knee, and one in the elbow-joint. In two of these the cartilages were removed without a bad symptom; in a third an attempt was made, but the cartilage slipped away; in the remaining ten palliative treatment was alone employed. (See *Bryant's work already quoted*.)]

If we except making an incision into the joint for the purpose of extracting these cartilaginous formations [or of causing their adhesion at the side of the joint at the seat of puncture], we are not acquainted with any certain means of freeing a patient from the inconvenience of the complaint. To this plan the danger attendant on all wounds of so large an articulation as the knee is a very serious objection. Middleton and Gooch endeavoured to conduct the extraneous body into a situation where it produced no pain, and to retain it in that position a long time by bandages, under the idea that the cartilaginous substance would adhere to the contiguous parts and occasion no future trouble. [This, in fact, is the palliative treatment of the present day, and is adopted by some surgeons in preference to the radical or operative treatment, by means of which the loose body is removed altogether from the joint, or is fixed in an unoffending position. As a rule, Mr. Bryant thinks the palliative treatment is the correct one to be enforced; for, he observes, "knowing how destructive inflammation of a joint following a wound too often becomes, few surgeons would venture upon an operation without an absolute necessity, and such seldom exists. If the movements of the joints are restrained by means of strapping or an elastic bandage, or if the loose body can in any way be fixed by the same means, any injurious effects will seldom be experienced. If the cartilage should be occasionally pinched between the extremities of the bones, and, as a consequence, some slight synovial inflammation should take place, rest, and the application of cold lotions or blisters, with a mild purgative, are generally sufficient to allay it. If these mild measures are enough, any operative interference is certainly not required, as it is not justifiable for any surgeon to submit his patient to the risk of an acute inflammation of a joint by making a wound, whether subcutaneous or otherwise, into

the synovial membrane, unless an absolute necessity exists; and if such palliative measures as just mentioned suffice to prevent any serious inconvenience being felt from the presence of this foreign body, such a necessity is not present." (*Op. cit.* p. 151.)]

Mr. Hey, aware of the dangerous symptoms which have occasionally resulted from the most simple wounds penetrating the knee-joint, was induced to try the efficacy of a laced knee-cap; and the cases which he has adduced clearly demonstrate that the benefit thus obtained is not temporary, at least so long as the patient continues to wear the bandage. In one case the method had been tried for ten years, with all the success which the patient could desire. Boyer also made one patient use a knee-cap for a year; after which it was left off, the patient appearing cured. And in a second instance the same practitioner tried the same plan, which put a stop to the pain, and enabled the patient to walk with ease; but it was not known whether the method answered permanently. (*Mal. Chir.* t. iv. p. 444.)

[Chelius remarks on the subject of bandages, that although in many cases they are of no use, and even increase the pain, yet should they be tried, as in several instances they effect not merely momentary but permanent relief.]

Contemplating the evidence upon this point, and the perilous symptoms sometimes following wounds of the knee-joint, I am decidedly of opinion that the effect of a knee-cap, or of a roller and compress, applied over the loose cartilage, ought generally to be tried before recourse is had to excision. I say generally, because the conduct of the surgeon ought, in such cases, to be adapted to the condition and inclination of the patient. If a man be deprived of his livelihood by not being able to use his knee; if he cannot or will not take the trouble of wearing a bandage; if he be urgently desirous to undergo the operation after the risk and danger have been impartially explained to him; if a bandage should not be productive of sufficient relief; and, lastly, if excessive pain, severe inflammation of the joint, a great deal of symptomatic fever and lameness should frequently be produced by the complaint (see *Brodie's Pathol. and Surg. Obs.* ed. 5, p. 253), I think it would be the duty of a surgeon to operate. Under such circumstances, I lately removed a loose cartilage of considerable size from a gentleman's knee, without the previous trial of pressure; and the result was perfectly successful. It is very certain that success has generally attended the operation; but, small as the chance is of losing limb, and even life, in the attempt to get rid of the disease, since the inconveniences of the complaint are, in most cases, very bearable, and are even capable of palliation by means of a bandage, endangering the limb and life in any degree must seem to many persons contrary to the dictates of prudence. At all events we must agree with Boyer, that as the laced knee-cap can do no harm, we ought always to make trial of it, and never perform the operation except when pressure does not answer, and the return of frequent and violent pain makes the employment of the knife necessary. (*Mal. Chir.* t. iv. p. 445.)

[When it has been determined to adopt operative proceedings, some preliminary steps must be taken before putting them into effect. The patient should be kept quiet in bed for a few days previously; cold lotions may be applied to the knee

during the same time, and a saline purgative may be exhibited. If the joint be painful and inflamed, this state must first be got rid of by strict rest, leeches, cold applications, and the like. No operation should be undertaken for extraction of the loose body so long as the joint is in an irritated state, as the result of a recent attack of pain; this must be first subdued. It should be ascertained by careful examination whether there be not several such bodies in the joint, or only one, and its size should be made out if possible. Sometimes the loose body cannot be found, and we have seen patients removed from the operating-table in consequence. The patient therefore should arrest it when in a favourable situation, and retain it till the surgeon arrives.]

I shall next introduce an account of the plan of operating, as described by various surgeons.

[On the knee-joint it is performed in the following manner:—The patient, being placed on a table in the horizontal posture, the foreign body is pressed to the upper part of the knee-joint, on one or other side,—according to Abernethy, on the inner, but according to Schreger, best on the outer side—towards the condyle of the thigh-bone, and fixed with the fingers of the left hand, so that it cannot escape; if there be several bodies, they must all be fixed in the same way. An assistant now draws the skin as much as possible upwards, and the operator makes, with a convex bistoury, a vertical cut through the skin and capsular ligament, of sufficient size for the loose body to be easily pressed out, or removed with forceps. If the foreign body slip away the very moment the cut is made, which Chelius has seen, it must directly be brought back to the cut, but the wound must be at once closed if this cannot be easily and quickly done. When the loose body has been removed the wound must be cleaned, the parallelism between the internal and external wound got rid of, by letting go the skin which has been drawn up, and then closed most carefully with sticking-plaster. The limb is to be kept strictly at rest. If no inflammatory symptoms come on, the wound unites by the first intention in a few days; but if inflammation should set in, it must be counteracted by active antiphlogistic treatment, as leeches and cold applications. (*Chelius' System of Surgery*, translated by South, vol. i. p. 709.)

"In the cases in which I have operated," Mr. South remarks, "the loose substance was placed most conveniently in the little cleft between the edges of the condyle, and the head of the shin-bone and the margin of the knee-cap; and instead of drawing the skin up, as Chelius recommends, I drew it tightly to one side. I do not know, however, that it is of material consequence in which direction the skin is drawn; and the best rule would seem to be, to draw in that direction in which the skin yields most readily, so as to keep the outer and inner wounds farthest apart. This will principally depend on the size and seat of the loose substance, which will also decide whether its removal shall be effected on the inner or outer side of the knee-cap. The operation applies only to the loose, cartilaginous, or bony bodies, and not to the malignant growths to which Schreger refers, for which amputation is the only remedy."

The operation as performed by Desault, Abernethy, Chelius, South, and many others, is a valvular one; for as the integuments are gently



but firmly drawn over the body to be extracted, in one direction or the other out of their natural situation, the wound is completely covered when they are allowed to regain their normal position. Much of the success of this now called older method depends upon the dexterity of the operator, in getting the loose body to suddenly slip out of the capsule through the incision he has made into it, together with the celerity with which the skin is drawn over the wound thus made.]

I am ready to allow, with M. Brochier, that the danger attendant on wounds of the large joints has always been exaggerated, in consequence of ancient prejudices. (*Desault's Jour.* vol. ii.) But making every allowance for the influence of prejudice, a man must be very sceptical indeed who does not consider the wound of so large a joint as the knee to be attended with real cause for the apprehension of danger. At the end of Ford's case (*Med. Obs. and Inquiries*, vol. v.), we read on the subject of cutting loose cartilages out of the knee:—"The society have been informed of several cases in which the operation has been performed: some, like this, have healed up without any trouble; others have been followed by violent inflammation, fever, and death itself." A case was lately published, in which the patient nearly lost his life from suppuration in the knee-joint after the operation. (See *Kirby's Cases*, p. 75.) In the same work reference is also made to two other cases, which actually had a fatal termination (p. 82); and even in Mr. Kirby's own instance, the recovery was not effected without the entire loss of the motions of the knee. I remember an example, in which the patient died after the operation at St. Bartholomew's Hospital.

"The operation for their extraction produces no ill consequences at all in some instances, while in others the patient loses his life by it, and this even in cases which seemed most favourable for it. Sometimes he dies from the great constitutional disturbance, suppuration, &c., and sometimes he recovers with a stiff joint. The greatest attention to the after treatment will sometimes not prevent either of these results. I once saw a case where hæmorrhage took place from a superficial artery, and we were called to the patient, who, we were told, was dying of the bleeding; the hæmorrhage occurred in two or three hours after our operation, and it not only bled externally, but into the joint; yet this man recovered perfectly." (See *Lectures on Surgery by Abraham Colles*, vol. ii. p. 155.)

The older method, as it is called, is still practised by a few of our modern surgeons, and among others by Mr. Fergusson, who states that he has met with a variety of instances where it has not been advisable to resort to this practice. He has, however, in various cases cut into the knee-joint in the way described, and with perfect success; and in these examples the absence of dangerous inflammation may be attributed, he observes, to the great care which was taken of each patient, both immediately before and after the operation. All the cartilages in these cases have been small, but he has seen much larger extracted with equal success, though he has known alarming inflammation follow such operations. (See *Fergusson's Practical Surgery*, ed. 4, p. 427.)

To obviate the dangers of a large external wound, and the risk of entrance of air into the cavity of the joint, Mr. Syme and M. Goyrand of Aix

simultaneously proposed a method for the removal of these bodies from the knee by means of a subcutaneous incision. The movable body is first fixed in the most convenient position, and steadily maintained there; a narrow knife is then passed under the skin, drawn a little to either side, and a wound is made in the capsule of the joint over the loose body, of sufficient size to allow of its being squeezed out of the articulation into the subcutaneous areolar tissue: this concludes the operation. The parts are then kept from moving in the least degree upon each other for a few minutes, until all oozing of blood has perfectly ceased, after which the integument is allowed to assume its natural position; the wound is closed, the leg carefully fixed upon an easy splint, and all judicious means employed to avert inflammation. The cartilage may be permitted to remain in its new position, or subsequently removed through an incision of proper size in the skin when the parts have all healed up. The advantages of this mode of operation are apparent enough; the articulation in fact is well opened, but it is beneath the skin, and without communication with the atmosphere. The puncture in the skin need not be larger than that made by an ordinary tenotomy knife, and invariably heals by adhesion. Experience has now on numerous occasions shown the advantages of the subcutaneous method over any other, and it has become generally adopted in surgical practice. In but very few instances has this method of operation been followed by any inconvenience. We have practised it with success, and have seen it done by others with good results.

If there be more than one movable body in the joint, they are all to be brought to the same part of the sac, if practicable. The subcutaneous operation is applicable to the elbow and shoulder, or any other joint, as well as to the knee. When occurring in the shoulder, as has happened in the practice of Schreger, it is recommended to press and fix the loose body above and before, or above and without, the long head of the biceps. The operation would be unsafe if performed in the armpit. The arm must be pressed to the trunk; the skin is then as much as possible drawn inwards by an assistant, and the subcutaneous incision is made into the capsule. At the elbow, the most convenient situation to press the loose body is above the inner condyle. Mr. Solly removed eight from the elbow at this situation, and he found it necessary to lay open the articulation till he exposed the loose cartilages, which were readily pressed out of the opening. The wound was healed in forty-eight hours, but the joint was kept at rest for a week; after this the patient could move his limb without pain, and made a good recovery. (See *Monthly Jour. Med. Science*, May 1849.)

It might be a question whether all the bodies should be removed out of the joint at one time, the knee especially; but we imagine this will depend very much upon the facility with which they may be encountered. It is perhaps best not to manipulate much after the first body is removed, for fear of exciting inflammation, and the operation might be renewed some days later. An operation of the older kind was performed thrice upon the same joint with perfect success. The case was published by Dr. Clarke. (See *Med. Chir. Trans.*, vol. v. p. 67.) Sir Benjamin Brodie also extracted five loose cartilages by three different

operations, without any subsequent unpleasant symptoms, although the patient appears to have been previously subject to repeated attacks of severe inflammation of the joint. (*Pathol. and Surg. Obs.*, ed. 5, p. 254.)]

*Hydrops Articulī*—signifies a collection of serous fluid in a joint. The knee is more subject than other joints to dropsical disease, which has been known, however, to affect the wrist, ankle, and shoulder joints. (*Boyer, Mal. Chir.* t. iv. p. 465.)

Mr. Russell adopts the opinion that some of these cases are venereal, and others scrofulous. *Hydrops articuli* generally arises from contusions, rheumatism, sprains, exposure to severe cold, the presence of extraneous cartilaginous bodies in the joint, and in general from anything which irritates the synovial membrane; and, as already explained, it is a common attendant on inflammation of that texture: the complaint also sometimes follows fevers, but in most instances it is purely a local affection, quite independent of general debility. (*Boyer*, t. iv. p. 467.) As Sir Benjamin Brodie has noticed, cases do occur, but not often, in which a joint is swollen from a preternatural quantity of fluid collected in its cavity, without pain or inflammation. The disease may be compared to hydrocele, and depend either upon diminished action of the absorbents, or increased action of the secreting vessels. This is the case sometimes particularly signified by the terms *Hydrarthrus* [*Hydrarthrosis*] and *Hydrops articuli*. Much more frequently the swelling of a joint, from an accumulation of fluid in it, is attended with pain and inflammation. Then it may be presumed that the synovial membrane is or has been inflamed, and the secretion from it augmented. (See *Brodie's Pathol. and Surg. Obs. on Joints*, p. 7, ed. 3.)

*Hydrops articuli* presents itself in the form of a soft tumour, circumscribed by the attachments of the capsular ligament, without change of colour in the skin, accompanied with fluctuation; it is indolent, and but little painful, causing hardly any impediment to the motion of the joint, yielding to the pressure of the finger, but not retaining any impression, as in œdema. The swelling does not occupy every side of the joint, being most conspicuous where the capsular ligament is loose and superficial. In the wrist it occurs at the anterior and posterior parts of the joint, but especially in the former situation, while it is scarcely perceptible at the sides. In the ankle it is more apparent in front of the malleoli than anywhere else; and in the shoulder it does not surround the joint, but is almost always confined to the fore-part of it, and can only be seen in the interspace between the deltoid and great pectoral muscles.

In the knee-joint, which is the most common situation of *hydrops articuli*, the tumour does not occur behind the articulation, but at the front and sides. Behind, the capsular ligament is too narrow and resisting to admit of being much distended with the synovia, while in front and laterally it is broad, so that it can there yield considerably in proportion as the quantity of fluid increases. The swelling is at first circumscribed by the attachments of the capsular ligament; but in consequence of the accumulation of fluid, it afterwards exceeds these limits above, and distends the capsule more

or less upward between the thigh-bone and the extensor muscles of the leg, which are lifted up by the swelling. Boyer has seen it reach to the upper third of the thigh. The swelling is irregular in shape; it is most prominent where the capsular ligament is wide and loose; and it is in some measure divided longitudinally into two lateral portions by the patella, the ligament of the patella, and the tendon of the extensor muscles of the leg; all which parts the synovia raises and pushes forward, though in a much less degree than on either side, where the capsule is less protected. Of these lateral portions the internal is broadest and most prominent, because the part of the capsule between the patella and edge of the internal condyle, being larger than that situated between the patella and edge of the external condyle, yields in a greater degree to the distending fluid. The motions of the leg, which are generally little interrupted by this disease, make a difference in the shape and consistence of the swelling. In flexion the tumour becomes harder, tenser, and broader, and more prominent at the sides of the knee-pan, which is somewhat depressed by its ligament. In extension the tumour is softer, and the fluctuation plainer.

In order to feel distinctly the fluctuation, which is one of the best symptoms of the disease, the ends of two or three fingers should be placed on one side of the swelling, while the opposite side is to be struck with the end of the middle finger of the other hand.

The patella, being pushed forward, away from the articular pulley, is very movable, and, as it were, floating. When it is pressed backward, while the leg is extended, it can be felt to move a certain way before it meets with the resistance of the articular pulley; and, on the pressure being discontinued, it immediately separates from this part again.

By such symptoms *hydrops articuli* may easily be distinguished from other diseases of the joints; from tumours of the bursa mucosa under the extensor tendons of the leg, or in front of the knee-pan; from rheumatism, œdema, &c.

[The nature of the fluid varies; ordinarily it is unctuous and viscid, like synovia, of a yellowish colour, and as it flows through the canula, it presents the density of oil. Sometimes, however, it is reddish, or even altogether red. Occasionally the fluid is serous. But this last is the rarest,—a fact that was verified during the period when puncture had become the method of treating *hydrarthrosis*. Rarely this fluid, in recent cases of *hydrarthrosis*, is mixed with albuminous flakes, or of hordeiform grains; in such examples we can suppose, with some amount of certainty, that the cause of the malady has been either an active inflammation or external violence. (*Nélaton, Path. Chir.* t. ii. p. 170.) Of seven cases tapped by Dr. Macdonnell previous to injection with iodine, the fluid was found to be mostly of a straw or yellow colour, clear, and resembling the fluid of hydroceles. It coagulated by heat, and varied in quantity from a few up to 16 or 18 ounces. (See *Montreal Medical Chronicle*, June and November, 1857.) The nature of the fluid after withdrawal will oftentimes give a clear idea of the state of the synovial membrane itself: thus, a viscous thick liquid, drawing into long threads rather than dropping, shows a considerable structural change, and



it is probable that no means whatever will be able to restore perfect health to the synovial membrane of the joint for months, if at all. A fluid, whether thick or otherwise, which is opalescent and turbid,—in fact puriform,—shows that the cartilages have more or less yielded to disease, and therefore that repair is barely possible. A fluid thinner than synovia, clear, yellow, like the liquor of hydrocele, denotes that very little or no morbid change, according to the more or less watery condition, has taken place. (*Barwell, Dis. of Joints*, p. 198.)]

The prognosis is therefore most favourable when the swelling is recent and small, and has been quick in its progress. On the contrary, when the tumour is of long standing and large, the effused fluid thick and viscid, and the synovial membrane thickened, the removal of the fluid by absorption, and the restoration of the parts to their natural state, will be more slow and difficult. The worst case is that which is complicated with disease of the synovial membrane, cartilages, and bones.

[Dropsy of a joint is also very liable to a relapse, and, when long-continued, can produce organic changes of the joint, which build up new structures. Cases are related by Nélaton, in which the synovial membrane has become ruptured by the enormous accumulation of fluid which then was infiltrated in the surrounding tissues. This rare termination has been observed several times in the knee, either from accident, or spontaneously, by the excessive dilatation alone of the capsule. Bretonneau of Tours has observed rupture of the capsule of the elbow, the shoulder, and of the hip.]

The cure depends upon the absorption of the effused fluid. And when the case is combined with acute and chronic inflammation of the synovial membrane, the treatment is the same as that already recommended for those particular forms of disease. When inflammation subsides, the absorption of the fluid is sometimes altogether spontaneous, and it may always be promoted by friction, by rubbing the joint with camphorated mercurial ointment, the ointment of tincture of iodine, the soap liniment, containing ℥j. of the tincture of iodine in every two oz. of it, and particularly by the employment of blisters.

Boyer, Marjolin, and Velpeau recommend the application of small flying blisters around various parts of the joint, frequently repeated. After the use of blisters, the absorption of the effused fluid may be materially assisted with a moderately tight bandage. Among other effectual means of cure, we may enumerate frictions with flannel impregnated with the fumes of vinegar; electricity; and the exhibition of mercurial purgatives. When hydrops articuli occurs during the debility consequent on typhoid and other fevers, the complaint can hardly be expected to get well before the patient regains some degree of strength.

[Gimelle has recommended repeated doses of tartar emetic as especially efficient, and these have been found serviceable in some cases by Nélaton and other surgeons. Gimelle reports its efficacy in twenty-eight cases, commencing with half a grain every three hours, and increased by degrees, until twelve grains are taken in the twenty-four hours. (*Mémoires de l'Académie de Médecine*, July, 1840.) This plan has met with more attention amongst German surgeons than in France or Eng-

land. Mr. Barwell considers iodide of potassium, guaiacum, James's powder, ipecacuanha, and diaphoretics as the chief means at our disposal. He would exclude, however, mercury and colchicum nearly, or altogether, from this list.

If the absorption of the collected fluid be not brought about by the treatment recommended, and the quantity increase, so that great pain and inability to use the limb is produced, or if there be a foreign body in the cavity of the joint, the collected fluid must be so discharged as to prevent the entrance of the air. This is effected by a subcutaneous section of the synovial membrane as recommended by Goyrand, and the greater part of the liquid infiltrates the areolar tissue and soon becomes absorbed. The safest plan of discharging the fluid would be by means of punctures made with an instrument not much broader than a couching-needle, and then applying a cupping-glass, as suggested by Sir Benjamin Brodie, or the fluid might be allowed to escape subcutaneously, as in Goyrand's plan. Simple puncture, however, of a dropsical joint rarely produces a radical cure, and thus resembles the same operation in hydrocele. The fluid re-collects more or less quickly, and sometimes severe symptoms and suppurative inflammation ensue. Guérin punctured a joint on two occasions, and the results of the second rendered it necessary to perform amputation.

To effect a radical cure, injections have been employed within the dropsical joint after its liquid has been evacuated. This is certainly one of the most powerful means at our disposal, and is, says Barlow, even though it be not always curative, so very slightly dangerous, and so seldom followed by too violent an inflammation, that it may be used without fear. The first person who resorted to this mode of practice was Mr. Gay, of the Cape Hospital, at the Cape of Good Hope, in 1789. He injected a mixture of the diacetate of lead and rum into the knee-joint of a negress affected with hydrarthrosis; this produced a cure. In 1830 Jobert submitted three cases of hydrarthrosis of the knee to injections of barley-water and spirit, with no positive results. Eleven years later (1841) Bonnet and Velpeau called attention to this operation, and proposed to treat hydrarthrosis by injections of iodine. The process they recommended was exceedingly simple: the limb being placed in a position of extension, the surgeon plunges a small trocar and canula above the patella, either at the internal or external side of the knee, whilst the opposite side of the swelling is compressed with the hand, so as to render it more prominent. It is essential to push up a fold of the skin, and to make the puncture beneath this, so that the opening in the synovial membrane may afterwards be covered by the integuments when the canula is withdrawn. As the liquid flows through the canula it must be held vertically, so as to prevent the introduction of air; and it is not necessary to evacuate all of the synovial fluid contained in the articulation. The solution of iodine—one part of tincture to two or three of water—is then injected by means of a syringe, and the joint is gently pressed with the hand in every direction during the sojourn of the injection, so that every part of the membrane may come into contact with it, and in two or three minutes the whole of the fluid is allowed to escape, and the external cutaneous wound is carefully closed. After

the operation the limb must be retained in a completely immovable position, and such general and local measures employed as tend to prevent suppurative inflammation. (See *Bulletin de Therapeutique*, 1842, and *Annales de Chirurgie*, 1843, and also *Nélaton, Path. Chir.* t. ii. p. 178.)

The testimony of Bonnet, Velpeau, Jobert, Dieulafoy, Leriche, Bérard, and other French surgeons in favour of this mode of treatment, is of the greatest value, for it shows a very large amount of success. In this country this practice has not had a fair trial, for surgeons were afraid of practising it, from the fear of throwing an irritating fluid into a large joint, and of ankylosis taking place even in case of success. Now both of these dangers are imaginary. There is no previous incision made, but a simple puncture. Up to the year 1853 there were more than one hundred cases related by Bérard, Jobert, Malgaigne, and other French surgeons, in which these joints were treated by the iodine injection, and none of the patients had any unfavourable symptom. The swelling, with slight redness, which appears after the operation, only shows that a natural process is going on, such as takes place in a hydrocele, and is resolved without the application of leeches, &c. As to the danger of ankylosis, it is equally imaginary. Velpeau has seen patients long after the operation, and in all the movements of the joints were preserved. It is, in fact, in these cases, as in hydrocele, — the cure can be effected without obliteration of the serous sac; or if adhesions do take place, they yield after a time, and the function of the joint is restored. If the iodine injection fails, it will not prevent the employment of other accessory means of cure. (*Ranking's Abstract*, v. 17.)

Chelius says that the consequence of the injection is an acute inflammation, the running on of which to suppuration must be carefully prevented. In very great and painful swellings of the joint, from the excessive collection of fluid, it may be necessary to discharge part of the fluid by puncture, so as to lessen the symptoms. In regard to the strength of the iodine injection of Bonnet which Chelius quotes (half a drachm of iodine and one drachm of iodide of potassium in four ounces of water), Mr. South remarks that if there be no mistake in the proportions it must be highly caustic, and such as no English surgeon would, he thinks, dare to throw into a joint, though a French surgeon might. (*Op. cit.* vol. i. p. 463.) Experience has proved, however, that no bad results follow from this mode of practice, notwithstanding the doubts and fears of many English surgeons. Mr. Barwell thus expresses himself on the use of iodine as an injection fluid: — "This material is valuable, inasmuch as it does not tend to produce suppuration; and although several cases have occurred in which an undesirable amount of inflammation has followed, I have not found any reported cases whose results were disastrous, although both in England and on the continent its employment has become pretty general. The mixture commonly used in this country is from a drachm and a half to two drachms of the tincture of iodine, with an ounce of water." (*Dis. of Joints*, p. 200.) Whilst Mr. Barlow acknowledges this to be the most powerful means at our disposal for the reduction of hydrarthrosis, he says it does not always cure the complaint. It will almost invariably greatly diminish the amount of fluid in the joint;

but its effect upon the hypertrophied synovial fringes is less marked.

On the other hand, many surgeons condemn the proceeding, who have not had any experience of its application. Professor Pirrie, of Aberdeen, observes that, "it is quite certain, however, that other surgeons have seen cases in which this treatment gave rise to inflammation, which endangered both life and limb, and the dread of uncontrollable inflammation has hitherto prevented surgeons in these islands from venturing on this proceeding — a proceeding which, apart altogether from the question of whether or not it be justifiable on account of the danger of a wound of a joint, is really not necessary, as these cases always get well, unless there be disorganisation of the synovial membrane." (See *Prin. and Pract. of Surgery*, ed. 2, p. 417.) Professor Miller, of Edinburgh, thinks the practice much more likely to effect disorganisation of a joint than its cure.

Mr. Erichsen approves of this mode of treatment, and considers that, when other means fail, we have a very powerful means of cure at our command in the injection of the joint with tincture of iodine. He treated a case, in a man aged 61, of hydrarthrosis of the knee, which had resisted other modes of treatment, by the injection plan with complete success; some slight inflammation was perceived, which was carefully watched, and when the patient left the hospital he had complete power of the joint, although it felt weak. (See *The Lancet*, vol. i. 1858, p. 189.) On this mode of treatment Mr. Fergusson thus expresses himself: "In accordance with modern fashion iodine has been injected in some of these cases by Bonnet, Velpeau, Jobert, and others. I have no personal experience in such practice; but, judging from the observations of Dr. Macdonnell of Montreal, lately published in connection with some cases of the kind occurring in his own practice, the treatment is probably worth greater attention than it has had in this country." (See *Pract. Surgery*, ed. 4, p. 428.)

The success which has been attained by Dr. Macdonnell in curing hydrarthrosis of the knee-joint by puncture and injection of iodine, has to some extent led to its adoption in this country, and in Canada and the United States. The almost universal condemnation of this method of treatment by many British writers on surgery, has, he says, done much to retard, if not to prevent, its adoption by their countrymen. He was not deterred by the prohibition of authors, who had no personal experience of the treatment they condemned, in applying it to cases of hydrarthrosis which had resisted all other plans of treatment. In 1853 he published the details of seven cases, all treated successfully, and followed by a complete cure, without any untoward complication, even such as ankylosis. These cases were witnessed by his medical brethren. It is quite true that many surgeons have objected to this plan of treatment under an erroneous idea of the disease for which it is recommended, and also of the results that are expected to be derived from it. Thus some surgeons have confounded the affection under consideration with a white swelling, and have objected to the treatment because it did not cure the latter. "Now, I wish it to be distinctly understood," Macdonnell observes, "that it is to *pure uncomplicated chronic hydrops* of the knee-joint that my suggestions as yet apply; for I have not employed the treatment



in any other joint; and though I do not believe that injection of iodine would do any harm to a joint already destroyed by ulceration, yet I wish the point to be clearly understood, that it is not in such affections I recommend it." (See *Montreal Med. Chron.* vol. v. pp. 6 and 242.) The object of the operation is not to produce an acute arthritis, as Bonnet endeavoured to do, but a modification of diseased secreting action, as in hydrocele. Macdonnell injects only two drachms of strong tincture of iodine, mixed with an equal quantity of lukewarm water, and this is allowed to remain, first drawing off the dropsical fluid. The limb is then kept perfectly motionless on a straight splint, and the patient is kept on a cooling diet. In the employment of this mode of practice surgeons will do well to remember the following rules laid down by Macdonnell:—"1st. The necessity of a careful diagnosis. It is in chronic hydrarthrosis alone that I recommend iodine injections. 2nd. Puncture the sac above the level of the patella and on the front of the femur, having first made the tumour tense by a bandage carried round its lower portion. 3rd. Inject two drachms of tincture of iodine with two drachms of lukewarm water. 4th. Having injected that amount of the fluid, manipulate the joint, so as to bring all its surface into contact with the fluid, which is then to be allowed to remain. 5th. Close the external wound, and surround the joint with a wet bandage, which should be carried upwards from the ankle to above the knee. 6th. Keep the limb in a straight position on a padded splint. 7th. Do not allow any motion to take place for at least a week after the operation. 8th. When the patient is allowed to leave his bed, take off the wet bandage, and surround the joint with a starched bandage."

Several other successful cases have occurred in Macdonnell's practice since his memoir appeared.

After the cure of hydrarthrosis, by whatever means obtained, some surgeons have observed a stiffness of the joint, more or less great, with difficulty of movement. To obviate this, various means have been recommended, and, among others, frictions, douches, and baths.]

*Collections of Blood in Joints.*—Most systematic writers speak of this affection, though it must be uncommon. Tumours about the joints, composed of blood, and set down in numerous surgical works as extravasations within the capsular ligament, are generally on the outside of them.

Were blood known to be undoubtedly effused into a large articulation, however, no man would be justified in making an opening for its discharge. No bad symptoms are likely to result from its mere presence, and the absorbents will, in the end, take it away. If an incision were made into the joint, the coagulated state of the extravasated blood would not allow such blood to be easily discharged. The best plan is to apply discutient remedies; as the lotion of vinegar, spirits of wine, and muriate of ammonia, for a week or two, and afterwards friction with camphorated liniments may be adopted.

[Mr. Colles recommends for effusion of blood into the joint, when the wound is small, gentle compression with the hand, to get out as much as possible without giving pain, and immediately closing the wound. When it occurs from a contusion, without any penetrating wound, the blood

may be absorbed, he says, and the case do very well, assisting this process by light compresses of lint steeped in cold water. We have already referred to the occurrence of this accident, when considering loose cartilages in joints, and noticed a case of Mr. Colles' wherein a superficial vessel was wounded on removing a loose body, which ended in a good recovery.]

Mr. Hey relates a case in which the knee-joint was wounded, and blood insinuated itself into the capsular ligament; though the occurrence could not be hindered, yet no harm resulted from the extravasation, which was absorbed without having created the smallest inconvenience. (*Pract. Obs. in Surgery*, p. 354.)

[Hæmorrhage is more liable to occur in wounds of the elbow, knee, and ankle, than in those of any other articulation, because of the presence of a considerable number of arterial vessels. The danger of this complication is in the event of the blood not becoming absorbed; it gives rise, as Boyer and Richet have noticed, to the most dangerous form of destructive inflammation, which soon destroys the joint.]

[*Arthritis.*—The term white swelling was at one time indiscriminately applied to a number of different affections of the joints, in which some or all of the structures were involved in disease. This led to much confusion and embarrassment, one disease was confounded with another, and at last surgeons were content to apply the term to two forms of white swelling, namely, the *rheumatic* and *scrofulous*. These are worthy of consideration under another name. And, with a view of bringing the subject up to a level with the science and pathology of the diseases of joints as understood at the present day, we purpose embodying all the destructive diseases of joints under the head of *Arthritis*. Of this we shall firstly describe the simple, acute, and chronic forms; and after entering into their pathology, and into the nature of the changes which cartilage undergoes, we shall describe Chronic Rheumatic Arthritis, and Chronic Strumous Arthritis. The last will include the affection white swelling, properly so called, which is now recognised as a scrofulous disease of the joints. Although some difference of opinion still exists among modern surgeons as to the precise classification of diseases of joints, yet the majority agree in the general principles of classification, which to some extent are founded upon the admirable labours and researches of Sir Benjamin Brodie.

In the details of the arrangement of the subject of arthritis in its different forms, we follow that laid down by Mr. Erichsen, and we do this the more willingly, as it is the one now adopted in the teachings of most of the great schools of surgery. (See *Science and Art of Surgery*, ed. 3, 1861.)

By *Arthritis* in its simple form is meant an inflammatory disease of an acute or chronic kind, affecting the whole or greater part of the structures that enter into the formation of a joint. This affection may commence in the *synovial membranes*, and then spread to the other articular tissues, as has been previously mentioned; or it may begin in the *cartilages* or *bones*.

Diseased action is very seldom primarily set up in the *ligaments* of the joints; although these structures commonly become elongated, softened, and

destroyed, as a consequence of other forms of articular disease. But, though primary inflammation of the ligaments is so rare an affection as to be denied by many, yet it certainly does occasionally occur. This has been particularly noticed in the hip-joint, where the inflammatory action may commence in the ligamentum teres. Inflammation may commence also in the *fibrous capsule* of the joint: this we find more particularly to be the case when the affection is of a rheumatic character; in these cases inflammation, running into suppuration and slough of this structure, will commonly spread to the internal parts. In some cases this form of disease gives rise to the deposition of masses and layers of bone in the cellular structures outside of the articulation.

Among the *causes* of arthritis may be mentioned *acute necrosis of the shaft* of one of the long bones, as of the tibia in some instances. This will run on to destructive action in the terminal articulations, the cartilages becoming undermined, softened, and perforated. Occasionally the arthritic disease is the result of a *morbid condition of the articular ends* of the long bones, or of those short bones that enter into the formation of the joint; this is especially observed in diseases of the foot, the elbow, knee, and hip; but it is a condition which Mr. Erichsen believes may occur in any joint.

"The bones usually become, in the first instance, the seat of tuberculous infiltration; this runs into unhealthy suppuration, which gives rise to caries and limited necrosis; as the diseased action approaches the articular surface, the incrusting cartilage becomes loosened, detaches, and at the same time gradually disintegrates, and becomes perforated, nutrition in it being arrested or modified by the morbid state of the subjacent bone. When once the cartilage becomes affected, the whole of the interior of the joint speedily suppurates, and is destroyed. In other cases, inflammatory congestion, but without the formation of tuberculous matter, takes place in the articular ends, which become somewhat expanded, and then, without any suppuration occurring in the osseous structure, the cartilage gradually separates or peels off, and becomes softened and necrosed. This condition is often met with in diseases of the tarsal articulations." (*Erichsen, op. cit.*)

Arthritis commonly arises as the result of *wounds of joints*, or *injuries*, such as sprains and fractures in their vicinity, especially in young people, and in those of a lymphatic constitution. It also occurs as an accompaniment of *pyæmia* (see PYÆMIA), and of some of the morbid conditions of the *puerperal state*. The puerperal inflammation of joints is of a very destructive character, most generally speedily terminating in suppurative disorganisation. One or several joints may be affected, and the knee is the one that is most frequently and seriously involved. Arthritis not unfrequently occurs as a consequence of *scarlatina*; and Mr. Erichsen has seen the knee-joint especially affected in a destructive manner after this disease. In some forms of *albuminuria* there is a great tendency to inflammation of the joints; and the same surgeon has so often seen that form of renal dropsy which follows scarlet fever accompanied by severe inflammation of some joint, as to lead him to look upon one condition almost as the sequence of the other.

The following are the symptoms of arthritis:—Pain frequently so severe, tense, and throbbing,

that sometimes the patient screams in agony; the slightest movement of the bed, shaking of the room, or of the limb, or, again, an attempt to examine the joint, gives rise to insupportable agony. At night the pain is increased, and is usually referred with especial severity to one particular spot in the joint,—commonly at the inner or under side of the knee-joint, and at the outer aspect of the hip. The joint is *hot* and more or less red superficially. The *swelling* is uniform, involving the whole of the articulation, and not projecting at certain parts of it, as when the synovial membrane alone is affected; it is generally not very considerable, and has a soft doughy, rather than a fluctuating, feel. "As the disease advances, however, the swelling usually increases suddenly, and to a considerable extent, either in consequence of the irritation of the synovial membrane, or of the accumulation of pus within or around the joint. In many cases the synovial membrane gives way, and the pus from the interior of the joint becomes widely diffused through the muscular interspaces of the limb, forming enormous abscesses and long sinuous tracts." The *position* of the affected limb is peculiar, and such as affords the greatest ease; the knee is semi-flexed and turned outwards; in the hip the thigh is adducted; and the elbow is bent. *Spasms* or *startings* of the limb, often of a sharp and painful character, occur, at night especially. And the *constitutional disturbance* is not only very severe, but associated with much fever.

As the disease progresses the following phenomena will be noticed: *suppuration* (or pyarthrosis) within the joint, which is hot and painful, throbbing pain, and at last fluctuation, where the coverings are thinnest. It has been remarked that occasionally suppuration occurs very rapidly, and the head of the bone is luxated. Sometimes an abscess forms external to the joint, and pus is diffused throughout the limb. As the ligaments are destroyed, so does the joint become loose, the bones movable; they grate against one another where the incrusting cartilage has been removed, and thus give rise to severe suffering. Grating is by no means always to be observed, although the cartilages may be extensively destroyed; this is attributed to the limitation of the destructive action to the edge of the incrusting cartilage, the opposing surfaces being sound; or else to the filling up of the joint with plastic matter after the cartilages have been removed. It sometimes happens that the symptoms of erosion of cartilage may be present, such as painful starting of the limb, grating, and preternatural mobility, without the formation of an abscess. Under such circumstances, if proper treatment is adopted, the joint may recover itself, but with some amount of ankylosis present. When matter does form, the constitutional disturbance is of an irritative type; the patient suffers severe pain, and becomes worn out for want of rest. If hectic fever occurs, in addition to these aggravated symptoms, death will ensue from exhaustion and irritation, unless the diseased part be removed; in other cases the joint falls into a state of chronic thickening, with perhaps fistulous openings leading to the diseased structures; and in some of the more favourable instances the patient may recover with a permanently rigid joint. (*See Erichsen, op. cit.*)

If attention be paid to the general symptoms,



the disease described cannot be confounded with any other ; but the formation of an abscess external to the joint, yet close upon its capsule, may closely simulate disease of the articulation. Such cases have occurred, and have puzzled able surgeons : one in particular in a patient of Mr. Stanley's we would refer to. A large abscess formed external to the knee-joint of a young man, a shoemaker, aged 22, who was well a fortnight before its appearance. It existed irregularly on either side of the joint ; the patella was not prominent, and the joint could be flexed and straightened without any assistance, or any pain. The position of the leg was natural, lying on its posterior surface, and not on its side. Flexion and extension had been perfect throughout the disease ; fluctuation was very distinct, and it did not occupy the usual situation of the fluid of synovitis. It was looked upon as an exceptional case, and four gentlemen believed the matter proceeded from the interior of the joint, whilst three pronounced it outside. An exploratory opening was made and a little pus let out ; a free incision was now made by Mr. Stanley, and the abscess evacuated itself, and was found to be wholly external to the articulation. (*The Lancet*, vol. ii. 1856, p. 162.) The absence of serious constitutional disturbance, the irregularity of the swelling, greater on one side than the other, its extension over bony points, as the patella or olecranon, the superficial character of the fluctuation, the absence of all rigidity about the joint, and of other severe local symptoms, such as pain, starting, looseness, or grating, and more particularly the occurrence of easy flexion, as in the above case, will enable the surgeon to effect a correct diagnosis.

In the *Pathology* of arthritis, when acute, such appearances are noticed as might be anticipated from the nature of the inflammation : thus the cartilages will be found in a state of ulceration and erosion, in disseminated patches ; the bone is exposed and found to be rough and vascular. What cartilage is left is soft, inelastic, opaque, and thickened, and can be readily detached from the rough and grating subjacent bone. The synovial membrane is generally thicker than natural, and very vascular, the latter condition being more distinct about those parts where the erosions and grooves in the cartilage are deepest, and the membrane often assumes a fringed or dentated appearance. About the circumference and other parts of the joint masses of plastic matter are deposited underneath, and upon the synovial membrane ; these masses are smooth and semi-transparent, possessing a somewhat fatty or gelatinous look ; the ligaments are relaxed, vascular, and softened, and the interior of the joint is filled with thin, flaky, and light-coloured pus. The capsule and the various areolar and other surrounding structures are thickened, and infiltrated with pus, or clogged with the same kind of plastic matter that is seen in the interior of the joint. The articular end of the bone is enlarged, soft, and vascular ; and in strumous cases may be the seat of tuberculous infiltration. (*Erichsen, op. cit.*)

As the principal changes in arthritis are found to take place in the cartilages, we purpose inquiring into the nature of these ; but it may here be mentioned that the various changes which are noticed in them are not always the result of inflammation, for erosion and absorption may take

place independent of that process. This is believed sometimes to arise from disuse of a joint. In old people, again, on the articular ends of the bones a porcellaneous or ivory-like deposit is commonly met with, which allows motion, associated with stiffness and pain. Mr. Quekett has shown this porcellaneous deposit to be of two kinds : one consisting of unorganised earthy matter, the other of true bone, the Haversian canals being filled with phosphate of lime.

*Nature of the changes in cartilage.*—The conflicting opinions which have long prevailed upon this subject, constitute the chief reason of the difficulty in classifying many of the diseases of joints. The doctrine held by many persons, that cartilage is extra-vascular, and therefore that the changes which take place in it are secondary to disease in the synovial membrane or bone, is disproved by the researches of many of our most accurate and careful observers. We therefore adopt the conclusion of Mr. Erichsen, that disease of cartilage may arise in three ways : 1, through the medium of the synovial membrane ; 2, through the medium of the subjacent bone ; and 3, by means of changes taking place in the cartilage itself. The correctness of this will be shown by the observations which now follow :—]

1. Disease of cartilage through the medium of the *synovial membrane*.—Whilst acknowledging that ulceration of cartilage proceeds from disease in the subjacent bone, extending to the under surface of the cartilage, and that it is occasionally a primary affection independent of other textures of the joint, Mr. Aston Key was led to believe, from the examination of many diseased joints, and the history of the cases, that inflammation of the synovial membrane is the most frequent cause of ulceration of the cartilage. After noticing the symptoms of the acute, chronic, and subacute forms of synovial inflammation, as a cause of ulceration of cartilage, he describes the different degrees of the latter as observed on opening the joint. His statement agrees with that of Cruveilhier, in representing the inner part of the knee-joint as usually exhibiting the most extensive ulceration, "on account of the oblique bearing of the femur, and its consequently unequal pressure on the inner part of the head of the tibia. We therefore find the inner semi-lunar cartilage more often destroyed than the outer, and a corresponding destruction of the cartilage covering the inner condyle of the femur, and inner part of the head of the tibia." Of the patella, the first part that ulcerates is commonly the margin of the cartilage, where the synovial membrane is reflected from it. "At this point sulci, of different depths are formed, which cannot be always distinguished until the thickened edge of the synovial membrane is raised. The ulcerated surface sometimes exhibits parallel vascular lines, verging towards the centre, and having their origin from the synovial membrane. The synovial membrane at this part, if the vessels are well filled with fine injection, appears highly vascular, and fringed or villous, like a mucous membrane. This increased vascularity is particularly noticeable at the edge of the membrane, and in those portions of the fringed margin that correspond to the ulcerated surface of the cartilage ; the other parts of the synovial membrane have their vascularity but slightly increased. This highly vascular fringe of membrane is a newly-organised substance, and will be found in

some parts to be a superadded structure, for the purpose of producing ulceration of the contiguous cartilage."

It appears, therefore, to Mr. Key that the process by which the ulceration of cartilage is in this case effected, is through the medium of the newly-organised synovial membrane, the cartilage itself being indisposed to ulceration by the low degree of its organisation. It is acted upon by the newly-organised surface of the membrane, which is rendered highly vascular, and by means of its villous processes forms a groove in the edge of the cartilage, thus commencing the work of destruction. The cartilage at the edge is sometimes entirely destroyed, so as to lay bare the bone, in which case vascular granulations also arise from the surface of the exposed bone, and assist the membrane in the work of absorption. This, however, is more usually observed in the most acute form of inflammation. In the more chronic form, the vascular fringe of synovial membrane contracts adhesion to the surface of the cartilage in which ulceration is going on, and gives rise to the formation of a new membrane, which gradually spreads over the surface of the cartilage.

The second mode referred to by Mr. Key, in which nature seems to him to effect the ulceration of cartilage without the agency of its own vessels, may be seen in the rapid process of disorganisation that follows a wound of the synovial membrane. Here the latter undergoes a change which enables it to perform its new function. The surface becomes highly vascular, and in most parts covered with a new deposit of adhesive matter, which adheres firmly to the synovial membrane. The new surface is irregular, wanting the polish of the original membrane, and appears in many parts villous, or furnished with vascular fringed projections. "In a joint (says Mr. Key) thus far advanced in disease, the only mode of arresting the disease, or of repairing the mischief occasioned by inflammation, consists in the production of ankylosis. To this end the removal of the cartilage is an essential step; and it would appear that the office of removing it devolves on the inflamed synovial membrane."

[The best example to illustrate the destruction of cartilage, as the result of synovial disease, is a wounded joint before disorganisation has ensued. In such a case, it has been found that the diseased action spreads from the synovial membrane, where it is most intense, downwards into the substance of the cartilage, which, superficially diseased, appears more healthy the deeper the examination of it is carried. Immediately under the swollen, gelatinous-looking, brightly-injected synovial membrane, the cartilage will be found to be reddened, roughened, and softened. On examining a thin slice of this, it will be found to be composed of granular matter and nuclei of cells whose walls have disappeared. At a little greater depth than this, it will present an opaque matrix with cells, some perfect; others imperfect or disintegrating; and below this level we come to healthy white cartilage, with clear matrix, and well-formed cells. The disorganisation of the cartilage will eventually go on to its complete removal, and to the exposure of bare and roughened bone. It is in this way that destruction of joints, as the result of punctured wounds, of pyæmia, or of puerperal inflammation, takes place. (*Erichsen, op. cit.*)

The appearances described by Mr. Key are of common occurrence. Mr. Goodsir considers that Mr. Key is in error in attributing the disintegration of the cartilage to the disease set up in the synovial membrane; for he states that a fibrous tissue forms in a diseased joint as the result of the disintegration of the cartilage, and that this, which is connected either with the synovial or osseous surfaces, speedily becomes vascular. So far, therefore, from being the organ by which the cartilage is removed, it is the result of prior disease in this structure. At the same time, Mr. Erichsen thinks that it cannot be doubted that a villous injected state of the synovial membrane will modify the nutrition of the subjacent cartilage in such a way that disintegration, erosion, and apparent ulceration of it will ensue.

2. Disease of cartilage, primarily depending on *morbid action in the subjacent bone*.—This Mr. Erichsen believes to be one of the most frequent modes of disorganisation of joints in strumous subjects, and most certainly leads to those rapidly destructive affections of joints in which amputation or excision is required. In these cases, either as the result of violence, or from constitutional causes, the articular ends of a bone, or the whole of a bone if it be one of the tarsal, become congested, inflamed, carious, or necrosed, sometimes infiltrated with tubercle. In consequence of this disorganisation of the osseous tissues, the incrusting cartilage becomes detached, its under or attached surface softened, and at last perforation takes place. This process of disintegration, and at last perforation and erosion of the cartilage, takes place in a direction from below upwards. So soon as perforation occurs, the whole of the interior of the joint becomes acutely inflamed, and suppuration is set up in it, the ligaments loosen, and complete disorganisation ensues. On examining the diseased patch of cartilage in cases of this kind, it will be found to correspond to the carious or tuberculous bone, from which it is separated by some bloody fluid; it will also be seen that the under edges of the erosion or perforation in the cartilage are separated to some extent from the subjacent bone, from which they readily peel off, and that they are bevelled off towards the aperture. (*Erichsen, op. cit.*)

"When the primary attack is in osteitis, the cartilage undergoes the process both of degeneration and inflammation. In articular diseases thus commencing (says Mr. Barwell) it is to be remembered, that generally only one of the bones forming the joint is primarily affected; moreover, it is seldom so extensively diseased that the whole surface, whereon the cartilage rests, undergoes morbid action at the same time. Now, the first effect of an osteitis upon the cartilage is, in most instances, a cessation of its supply of nutriment, hence a rapid degeneration and detachment, with its articular lamella, from the inflamed portion of the bone. Around the spots where such degeneration takes place, the cartilage will not thus be killed, as it were, by starvation, but will become inflamed and ulcerated. The cartilages covering the bone which still remains normal, will, when the other joint textures become inflamed, participate in the inflammation, just as they do in synovitis. Thus, in articular diseases, commencing in one of the bones, there are two sorts of action going on in the cartilages—inflammation and degeneration. The latter occurs over that portion of the bone whose



inflammation has been so violent as to cut off the nutrient supply; the latter over those portions less powerfully affected, and in that cartilage covering the yet normal bone, to which the action spreads in the same way as it does to the synovial membrane. The cartilage which has suffered degeneration, and which lies over the focus of inflammation, is detached with the articular lamella by the osteitis itself, and is frequently pushed by a collection of pus, or a growth of granulations into the joint-cavity, in which it is found lying loose and fatty, its formerly attached surface feeling gritty, like sand-paper, from the adherence of osseous matter." (See *Barwell, Treatise on the Joints*, p. 294.)

3. Disease of cartilage primarily commencing in itself, of the nature of inflammation and ulceration. —This primary change is attributed to the action of its own vessels; this is the opinion of Sir B. Brodie, Liston, and Mayo, all of whom have observed true vascularisation of cartilage. This condition, however, is considered to be extremely rare, and according to Mr. Erichsen is certainly not one of the more common forms of joint disease, seldom occurring except in the more chronic stages of arthritis. Indeed, some writers altogether deny that any change whatever commences in the cartilages as a primary stage of disease. On this point Mr. Barwell observes,—"Most works on diseases of the joints contain a part devoted to those maladies which have their especial seat in the cartilages; and yet nothing can be more sure than that, of all the joint diseases which fall under the surgeon's notice, not one originates in the cartilage. It has been seen that an inflammatory action commencing in the synovial membrane, or in the bone, will spread to the cartilage and set up an ulceration of that structure; it is also well known that in the dead-house and dissecting-room we frequently find breaches of continuity in various articular cartilages which were accompanied by no symptom during life. The joints in which such conditions are found have been perfectly free from any pain or any diminution of mobility, and the neighbouring tissues have been perfectly untouched by any disease whatever. Thus we come to the inevitable conclusion, that disease confined to the cartilage gives rise to no symptoms; and we must ask whether disease, which has commenced elsewhere and passes to the cartilage, may give any sign whereby we can tell whether or no the cartilage be diseased." (*Barwell, op. cit.*) The subject is further discussed by Mr. Barwell, but we think his question will be best answered by the following observations of Mr. Pirrie:—

"Destruction of the substance of cartilage may take place without the slightest trace of disease in other structures, and as the result of actions confined to the cartilage itself; in which circumstances it is said to be *original* or *primary*; or it may be the consequence of acute, chronic, or scrofulous synovitis, or of inflammation of the portion of bone to which the cartilage adheres, or of scrofulous degeneration of the joint-ends of bone; when it is called *secondary*. The destruction may thus be either original or secondary; it may be extremely rapid or very slow, constituting acute or chronic destruction; it may be limited or extensive; it may be superficial and limited, or superficial and extensive; or it may go through the whole thickness of part of the cartilage, and thus penetrate to the bone. Though it most frequently commences on the free

surface, it may commence in the middle of the substance of the cartilage, or, if it proceed from disease of the bone, on the attached surface. It may be unattended with the slightest vestige of disease of the synovial membrane or bone; it may even be cured by the unassisted efforts of nature, without the occurrence of any exudation, by the formation of a fibro-nucleated membrane from the substance of the cartilage itself; or it may be an accompaniment of disease of the synovial membrane or bone, ending in total destruction of the joint. It is very remarkable that in all these varieties, the structural changes in the cartilage are found, on microscopical examination, to be similar, consisting in changes in the structure and arrangement of the cells, and alterations in the hyaline substance." (See *Prin. and Prac. of Surgery*, ed. 2, p. 426.)

The investigations of Rainey, of Goodsir, and of Redfern, have proved that cartilage, like other extravascular tissues, is subject to other transformations, independent of the prolongation of vessels into it. As was first pointed out by Goodsir, destruction of cartilage is always accompanied by enlargement, change of form, and irregular arrangement of the cells. They become larger, rounded, or oviform; and instead of two or three nucleated cells in their interior, contain a mass of them. The enlarged corpuscles at the surface burst and discharge their contents, so that the disintegrated surface presents a series of cavities. The matrix of the cartilage now softens, and, according to Redfern, splits up into fibres or bands, which become nucleated. The nuclei become elongated and incorporated with the fibres of the split-up hyaline substance; and this is one of the most remarkable transformations of the nuclei which have as yet been observed. A species of fatty degeneration also takes place in the nuclei, as pointed out by Rainey; they become converted into fatty granules and into fat-globules. Their conversion into drops of oil was first described by Mr. William Adams, in 1846, in Mr. South's translation of *Chelius' Surgery*. (See *Trans. Path. Soc.* vol. ii.) This fatty degeneration of cartilage is justly considered a result of defect of nutrition, and helps to soften and break down the structure of the cartilage. Sometimes the cartilage is infiltrated by amorphous animal mineral matter, chiefly salts of lime, and these are occasionally seen in the cell walls. In more advanced stages of disease of cartilage, masses of porcellaneous deposit are found attached to the ends of the bones in plates and layers, taking the place of the eroded cartilage. Such, then, are the changes which cartilage undergoes; and for further information on the subject we must refer to the writings of the authors whose names we have quoted.

We now come to speak of another set of changes which produce a soft, pulpy, and vascular fibro-plastic deposit of a greyish, ashy, or reddish-brown colour, with whitish streaks of a firmer material running through it in various directions, and which takes the place of the cartilage that has been removed, or that has undergone fibro-cellular degeneration. On examination under the microscope this will be found to be composed of plastic material, with cartilage cells intermixed, and with the subjacent bone in a state of disintegration and softening. This condition of joints Mr. Erichsen believes to be analogous to the "pulpy degeneration of the synovial membrane" of Sir Benjamin Brodie,—an

opinion in which we, in common with many others, are fully disposed to concur. This material has been carefully examined by Mr. Erichsen, in an elbow-joint which he excised, and the morbid appearances were so characteristic that, he observes, they may be taken as the type of this peculiar morbid condition, which he has since repeatedly met with in other articulations besides the elbow, more particularly those of the fingers and the knee, and which always, he believes, constitute an incurable form of disease. He has met with this condition only in instances in which the articular affection has been of very old standing, and has fallen into a truly chronic state.

In the following account of the pulpy degeneration of the synovial membrane of Sir B. Brodie, it will, of course, now be understood that the disease occasionally commences in the cartilage itself primarily, as already mentioned, but we will not alter Sir Benjamin's account of it.]

"The disease originates in the synovial membrane, which loses its natural organisation, and becomes converted into a thick pulpy substance, of a light brown, and sometimes of a reddish-brown, colour, intersected by white membranous lines, and from  $\frac{1}{4}$  to  $\frac{1}{2}$  of an inch, or even more than an inch, in thickness. As this disease advances, it involves all the parts of which the joint is composed, producing ulceration of the cartilages, caries of the bones, wasting of the ligaments, and abscesses in different places. The complaint has invariably proved slow in its progress, and sometimes has remained nearly in an indolent state for many months, or even for one or two years; but" (says Sir Benjamin Brodie) "I have never met with an instance in which a real amendment was produced; much less have I known any in which a cure was effected." (See *Med. Chir. Trans.* vol. iv. p. 220, &c.) The whole, or nearly the whole, of the synovial membrane has always been found affected; though if a very early examination were made, Sir B. Brodie conceives that this might not be the case; and in one example he found only a half of the membrane thus altered, while the rest was of its natural structure. (*Path. and Surg. Obs.* p. 94.) This gentleman further acquaints us, that the preceding affection of the synovial membrane is rarely met with except in the knee; that he has never known an example of it in the hip or shoulder; that it is peculiar to the synovial membrane of the joints; that he has never known an instance of it in other serous membranes, nor even in the synovial membranes, which constitute the bursæ mucosæ and sheaths of tendons; and that it generally takes place in young persons, under or not much above the age of puberty. In fact, Sir B. Brodie has not met with more than one instance in which it occurred after the middle period of life. Mr. Hodgson, of Birmingham, met with one example of it in the ankle, and another in one of the joints of the fingers. [Mr. Pirrie, of Aberdeen, possesses a well-marked example of the disease affecting the synovial membrane of the shoulder-joint, which he took from a male subject in the anatomical rooms of the university. (See *Prin. and Prac. of Surgery*, ed. 2, p. 422.)] "In the origin of this disease there is a slight degree of stiffness and tumefaction, without pain, and producing only the most trifling inconvenience. These symptoms gradually increase: at last the joint

scarcely admits of the smallest motion, the stiffness being greater than where it is the consequence of simple inflammation. The form of the swelling bears some resemblance to that in cases of inflammation of the synovial membrane, but it is less regular. The swelling is soft and elastic, and gives to the hand a sensation as if it contained fluid. If only one hand be employed in making the examination, the deception may be complete, and the most experienced surgeon may be led to suppose there is a fluid in the joint when there is none; but if both hands be employed, one on each side, the absence of fluid is distinguished by the want of fluctuation.

"The patient experiences little or no pain, until abscesses begin to form and the cartilages ulcerate, and even then the pain is not so severe as where the ulceration of the cartilages occurs as a primary disease; and the abscesses heal more readily and discharge a smaller quantity of pus than in cases of this last description. At this period the patient becomes affected with hectic fever, loses his flesh, and gradually sinks, unless the limb be removed by an operation." (*Med. Chir. Trans.* vol. v. p. 251—2.) In the majority of cases Sir Benjamin Brodie believes, that the gradual progress of the enlargement, the stiffness of the joint without pain, and the soft elastic swelling without fluctuation, will enable the practitioner readily to distinguish this from all other diseases of the joints. However, when the diseased synovial membrane happens to be distended with a quantity of turbid serum and flakes of coagulable lymph, the complaint somewhat resembles, in its feel and appearance, that stage of common inflammation of the synovial membrane, where this part is left thickened, and more or less distended with coagulable lymph; but the impossibility of relieving the former case by the same means which cure the latter, and due attention to the history of the disease, will prove the difference between them. (*Path. and Surg. Obs.* p. 87, ed. 3.)

In its early stage, by means of rest, attention to the general health, and cold lotions, the disease may be stayed, but Sir Benjamin Brodie has never known it to be cured. After dwelling upon the partial benefit of treatment, he says:—"But no method with which I am acquainted is capable of doing more than somewhat checking the progress, and somewhat relieving the symptoms of the complaint. In every case of which I have had an opportunity of seeing the termination, the ulceration of the cartilages, the formation of abscesses in the cavity of the joint, and the consequent disturbance of the patient's general health, have ultimately rendered the amputation of the limb necessary in order to preserve the patient's life. At this period, therefore, the surgeon is called upon to recommend and urge an operation; but at an earlier period it is a matter of choice with the patient, whether he will live with the incumbrance of a useless limb till the advanced stage of the disease renders its removal imperative, or whether he will submit to the loss of it before the absolute necessity for losing it exists." (*Path. and Surg. Obs.* ed. 5.)

In speaking of this form of disease of the joints, Mr. Pirrie observes that he has found it necessary to amputate in every instance which has come under his observation; he agrees with Sir Benjamin Brodie, therefore, in considering it incurable,



—an opinion which is now the prevalent one amongst surgeons generally. It is this peculiar form of disease of the joints in which some surgeons advocate the practice of excision,—an operation that shall be noticed further on. (See EXCISION OF JOINTS.) We may here again refer to the researches of Mr. Aston Key on the ulceration of cartilage as an independent disease from osseous or synovial inflammation.]

After briefly adverting to the removal of the cartilage from the heads of the bones in old persons, and the frequent substitution of an ivory deposit for it, Mr. Key notices that form of ulceration of cartilage which commences on the surface of it attached to the bone. According to his researches, there are two varieties in which this secondary absorption of cartilage takes place,—one chronic, the other acute; but he remarks, that in the process of ulceration the same passive condition of the cartilage may be observed as in that which commences within the cavity of the joint. When the cartilage begins to give way, vessels, he says, may be seen shooting towards it, and they accumulate in sufficient number to form a vascular tissue, covering the attached surface of the cartilage. He has never examined a joint in which disease appeared to have begun in the cancelli, and in which ulceration commenced on the surface of the cartilage within the joint. The ulceration having at length opened, or nearly so, on that surface, the synovial membrane becomes inflamed, and the ulceration is then forwarded by a similar process commencing at the edge of the cartilage, by means of the synovial membrane, and a newly developed vascular structure. (See *C. Aston Key in Med. Chir. Trans.* vol. xviii. art. 9.)

In the nineteenth volume of the same work, Mr. Key endeavours to point out the difference between the foregoing process, by which the absorption of cartilage is accomplished in certain forms of disease, and ulceration of the same texture. The latter is described as commencing in the cartilage itself, which becomes broken up and converted into a purulent mass, that mixes with the synovia, and irritates the synovial membrane, so as to excite inflammation, and ultimately suppuration and ulceration. It appeared to Mr. Key that ulceration of cartilage is a much less frequent occurrence than absorption through the intervention of the membrane. He does not remember to have examined a joint that had been the subject of ordinary chronic inflammation, in which this membrane was not found more or less developed. Nor has he seen an instance of chronic inflammation in the early stage of strumous disease, in which degeneration or ulceration of the cartilage existed as the primary action. Nature seems to him to endeavour as long as she can to remove the cartilage by absorption, in order to prevent the necessity of suppuration; for primary ulceration of cartilage leads to the formation of abscess. The breaking up of the tissue of the cartilages is equivalent to the suppurative process in softer tissue. It creates a product that must be got rid of. The synovial membrane is irritated, and ulceration, with abscess, is the result. In absorption of the cartilage through the intervention of the membrane, suppuration is not a necessary attendant, and we sometimes find the whole process completed without abscess. But when the membrane is wanting, suppuration follows sooner or later.

It further appeared to Mr. Key that the diseases in which the texture of cartilage primarily undergoes ulceration, are, for the most part, acute from their commencement. Thus, the inflammation that follows wounds of joints often leads to rapid ulceration of the cartilage, and burrowing abscess. The cartilage is often found to be extensively destroyed, and the bone laid bare, without any appearance of a membrane for the purpose of absorption. The remaining cartilage sometimes exhibits different stages of approaching disorganisation; in some parts retaining its natural form, consistence, and appearance; in others being soft and spongy, or even pulpy; and in those parts most advanced towards ulceration, the fibres of the cartilage can be seen to separate, and here and there flakes appear to be almost detached. Not unfrequently chronic inflammation of the synovial membrane, attended with absorption of the cartilage, becomes acute, and leads to the ulceration and quick disorganisation of the joint. Here both ulceration and absorption are seen to operate.

In chronic affection of the semi-lunar cartilages, the softening of the fibro-cartilaginous texture, and its gradual conversion into a puriform mass, may be observed in every stage.

Another form of inflammation, attended with primary ulceration of cartilage, occurs in cachectic subjects, and assumes the character of acute rheumatism. It often follows subacute abscesses in different parts, and attacks more than one joint. (*C. Aston Key, in Med. Chir. Trans.* vol. xix. p. 134, *et seq.*) [This form of disease is the peculiar Inflammation of Joints of Mr. Coulson, described further on, the result of pyæmia. (See PYÆMIA.)]

Notwithstanding the results of Mr. Key's investigations, Sir Benjamin Brodie still finds abundant evidence that the explanation of the former gentleman will not admit of a general application; and "that the absorption of the cartilage, commencing on the surface towards the cavity of a joint, may take place under such circumstances that it cannot be supposed to be the result of any other agency than that of the vessels of the cartilage itself." For the facts in confirmation of this statement I must refer to Sir Benjamin Brodie's publications. (See *Path. and Surg. Obs. on the Joints*, ed. 3. And a paper by Mr. Mayo, *Med. Chir. Trans.* vol. xi.)

[*Repair of cartilage.*—The subject of the diseases of articular cartilage, and their mode of repair, has received much attention at the hands of Mr. Redfern. His researches have been devoted to the consideration of the healthy and morbid nutrition of these structures, and to the mode of healing of wounds in articular cartilage (which we have previously adverted to), and on the analogy which exists between diseases of this tissue and inflammation and ulceration of other textures.

It will be sufficient for our purpose to give Mr. Redfern's conclusions on this interesting subject. He thinks that the demonstration has been fully made, that every morbid action which takes place in the structure of cartilage is referable to an abnormal nutrition of its texture, and in so far all these morbid actions resemble inflammation. They differ from it,—1st, in not being attended with exudation, because the texture in which they occur contains no blood-vessels; and 2nd, in not giving rise to pain on account of the absence of nerves.

If, therefore, inflammation be merely a process

of abnormal nutrition, it takes place in cartilaginous as well as in other textures; but if we include *exudation* as an essential phenomenon of inflammation, it never affects the human articular cartilage, which contains no blood-vessels and presents no exudation in disease.

So with ulceration: if we are to separate the softening, degeneration, and ejection of tissue in the formation of an ulcer, from the exudation, — which is an almost constant attendant on this process in vascular tissues, and forms cicatrices in them, — then ulceration in cartilage and in other tissues is identical, though the method by which ulcers heal in the two forms of texture is altogether different; if, on the other hand, we include in the term ulceration the production of exudation and its transformation into the tissue of the cicatrix, then it is equally clear that ulceration in cartilage and in vascular tissues differs in the occurrence of those phenomena in the latter case and not in the former.

Finally, Mr. Redfern calls attention to the following conclusions: — 1st. Wounds in articular cartilages heal perfectly by the formation of fibrous tissue out of the cut surfaces. 2nd. The fibrous cicatrix consists of white and yellow fibres, which are formed out of the inter-cellular substance of the cartilage, and out of the nuclei of its cells respectively. 3rd. Articular cartilages disappear after amputation at the joints, either by being transformed into fibrous tissue, which is mixed with that of the cicatrix, or by slow ejection of their tissue into a newly-completed synovial sac. 4th. Ulceration in articular cartilages differs from that in other tissues, in neither being accompanied by exudation nor attended with pain, — differences which depend on the absence of vessels and nerves. 5th. Ulcers in articular cartilages heal by transformation of the surrounding cartilage tissue into fibre, but those occurring in other textures are cured by the formation of a cicatrix and of newly-exuded blood plasma. 6th. Inflammation, regarded as a process of abnormal nutrition, attended with changes in the blood and blood-vessels, including exudation as an essential phenomenon, does not occur in articular cartilages in man, simply because these textures contain no blood-vessels. 7th. The whole diseased states of cartilage are referable to a changed or abnormal nutrition of the texture, and to this alone; when unaccompanied by disease in other textures, they produce no pain or other symptoms by which they can be recognised, and have much less surgical importance than they have for many years been supposed to possess. (See *Redfern, in Edin. Monthly Jour.* Sept. 1851.)

When the cartilages are eroded or destroyed, the joint may become ankylosed by connection of the articular ends of the bones, the intervening spaces becoming filled up with fibro-cellular material, which forms a kind of cicatricial adhering medium. In other instances the eroded cartilage is replaced by porcellaneous deposit, and now and then the exposed or osseous surfaces unite by bone, becoming fused, as it were, into one another. This constitutes the bony or immovable ankylosis of some writers. Pathologists now assert that in no instance does cartilage become regenerated when once it has been destroyed.

The treatment of acute arthritis must be commenced by the adoption of the most perfect and complete rest, for experience has proved that

unless this be adopted all subsequent treatment will prove of little avail. The limb, therefore, should be supported in an easy position upon pillows, or laid upon a well made and softly padded splint; at the same time blood should be freely taken away by cupping or leeching the affected part, and this local depletion must be followed by assiduous fomentations. The choice of these will be left to the surgeon. In the acute stage of the disease it is recommended to give, internally, the remedy from which it is believed that the most essential service may be derived, namely, calomel and opium (grs. ij. and gr.  $\frac{1}{2}$ ) every four or six hours, whilst at the same time a strict antiphlogistic regimen is persevered in. After the violence of the symptoms has been subdued, and the disease has assumed a *chronic subacute* form, the joint may be repeatedly blistered; but in many instances most benefit will be derived by the application of the actual cautery. This agent, when properly applied, according to the experience of Mr. Erichsen and others, yields much more certain and successful results than any other form of counter-irritation. We have seen it applied on numerous occasions, and it has been extensively employed in France for many years. The patient being placed under the influence of chloroform, a cauterising iron heated to a white red heat should be rapidly drawn over the diseased articulation in a series of parallel lines, across which an equal number of cross bars are again drawn, so as to char, but not destroy, the true skin. A good deal of inflammatory action is thus set up, followed by slight suppuration. When this has subsided, the application of the hot iron may, if necessary, be repeated; in this way the deep, enduring pain will usually be readily removed, and suppuration of the joint may be averted. For counter-irritants to be of any use, it is recommended to employ them before suppuration has set in; Mr. Erichsen believes that it is only torturing the patient unnecessarily to have recourse to these agents when once pus has formed in the articulation. In order, however, that full benefit should be derived from this plan of treatment, it must be persevered in steadily for a considerable length of time, and should be conjoined with a moderately antiphlogistic and alterative treatment. With this view, the bichloride of mercury, in doses of one-twelfth to one-eighth of a grain, may be advantageously given with the compound decoction of sarsaparilla, or, if there be much debility, with the compound tincture of bark; nourishment, and even stimulants, being conjoined with it, in proportion to the advance of the debility. When suppuration has taken place in the joint, more particularly if the skin covering it be reddened at any one part, the abscess should be freely opened by one or two lateral incisions, extending fairly into the joint, so as to afford a free exit for the pus. In some cases, even when abscess has formed, the joint being perfectly loose and grating, by perseverance in proper treatment, both local and constitutional, a good and useful limb may be left; and although there be mobility and grating, provided there be no sign of abscess the surgeon should never despair of obtaining a satisfactory result. (See *Erichsen, Science and Art of Surgery*, ed. 2, p. 688.)

The prognosis is more unfavourable when an abscess has formed in such large joints as the knee or hip, or in those which are important to life,



such as the articulations of the vertebræ. When the articular ends of the long bones are affected, and caries and necrosis are complicating and keeping up the disease, it is seldom that the joint can recover itself. When the articulation is very sinuous, as in the carpus, or when a number of small joints communicate with one another, if not directly by synovial membrane, at all events indirectly through the medium of ligament and fibrous tissue, as in the tarsus, a cure can scarcely be anticipated. In all these cases, hectic and great constitutional irritation usually come on; or, the joint becoming useless or cumbersome, its removal must be practised either by excision or amputation. The result will at last, in a great measure, depend upon the state of the bones that enter into the conformation of the joint. If these be sound, or not primarily affected, and the patient's constitution have got over the effect of suppuration in the joint, ankylosis more or less complete may be confidently looked for. But if the articular ends of the bones be primarily or deeply implicated, then excision or amputation will be the only alleviation.

When an inflamed joint appears to be disposed to undergo a cure, its repair by ankylosis must be facilitated by keeping it in a proper position, such as will be most useful to the patient in after-life,—the straight one for the knee and hip, and the semi-flexed for the elbow. Should it have assumed a faulty position in consequence of the surgeon neglecting to support it properly in splints in the early acute stage, the patient may be anæsthetised, and the limb slowly and gently placed in such a position as will be most conducive to the patient's after-comfort. At the same time it may be useful to strap the joint firmly in the proper position, in the way recommended by Mr. Scott, when it is the knee that is affected, or when the hip or elbow are implicated, fixing it well by means of starched bandages. Scott's plan of treatment consists in spreading on pieces of lint the strong mercurial ointment, to every ounce of which a drachm of camphor has been added; strips of soap-plaster spread upon leather are then cut of a proper length and breadth, and the joint is firmly and accurately strapped up, the limb having previously been bandaged as high as the joint that is strapped. This dressing may be left on for a week or two until it loosens or gives rise to irritation; over the whole a starched bandage may be applied. In many cases Mr. Erichsen has found it advantageous to strap up the joint with a plaster composed of equal parts of emp. ammon. cum hydrarg., and the emp. saponis or belladonnæ. These applications not only fix the joint and promote the absorption of the plastic matter that is deposited around it, but, by acting as gentle counter-irritants, remove the remains of the inflammation that may be going on within it.]

[*Chronic Rheumatic Arthritis*.—This disease has been alluded to by many writers, and among others by Sir Benjamin Brodie, Mr. Aston Key, Lobstein, and Benjamin Bell, but no systematic treatise appeared upon it before Dr. Robert Adams, of Dublin, published his work in 1847. (*Treatise on Rheumatic Gout, or Chronic Rheumatic Arthritis of all the Joints*.) From it we learn that Dr. Haygarth, of Bath, described one of its appearances as “Nodosity of the Joints,” deriving his ideas from the hard swellings which he observed among

several of the smaller joints. Cruveilhier was the next writer who specially called attention to it, and pointed out the propriety of studying, with reference to each other, its symptoms in the living subject, and its anatomical characters in the dead. The difficulty of adapting some special name was felt by Dr. Adams, equally with Haygarth and Cruveilhier. “Its symptoms,” Dr. Adams observes, “like those of chronic rheumatism, are slow in their progress, and of a sub-inflammatory nature, and the joints, large and small, are the principal seats of it; it is therefore a ‘Chronic Arthritis,’ or ‘Chronic inflammation of the joints,’ partaking more of the rheumatic character than of any other with which I am acquainted. With such ideas I have long since ventured to name the disease ‘*Chronic Rheumatic Arthritis*,’ and under this head have communicated to the Pathological Society (of Dublin) many facts and observations on the malady; and indeed, in this city at least, I may say that the term is now current with the profession.” (*Op. cit.* p. 4.) This disease has been carefully described as occurring in the hip by Dr. R. W. Smith of Dublin, and some valuable Notes on the Morbid Anatomy of the same disease in the shoulder and other joints have been published by Mr. Edwin Canton. (*Path. and Surg. Obs.* pp. 1 to 33.) We would here also refer to the minute examination of the articular extremities in this disease, made by Mr. Wm. Adams, published in the 3rd volume of the *Transactions of the Pathological Society of London*.

The disease in the majority of cases has been preceded by an attack of rheumatic fever, from the lingering remains of which the chronic rheumatic arthritis has evidently sprung. Exposure to cold and humidity, or to night air; gouty diathesis; uterine disorder; are causes of it. Sir B. Brodie observed it among the upper servants, hall-porters, and tall footmen of large London houses; and Dr. Adams among the damply-lodged and potato-fed peasants of Ireland. It is asserted by Dr. Adams to be a very common disease in Holland, and he observes that, so far as he is aware, it does not exist in hot dry climates. It usually affects several joints, rarely a single one, unless at the hip, and is commonly noticed to affect the joints symmetrically—thus, the two knees, or both hips may be involved. Dr. Todd stated that it is to be observed more among the labouring poor than among the higher classes. (*On Gout and Rheumatism*.)

Chronic rheumatic arthritis is an active disease of the bones and fibrous expansions about the joint: it is especially characterised by considerable increase in the size and by alteration in the shape of the osseous structures, which become porous in some parts, porcellaneous in others; by thickening of the fibrous capsule of the joint, with deposition of masses or plates of bone in it, and ultimate destruction of the cartilages and synovial membranes. The suffering is considerable: the disease greatly cripples the utility of the joint, at last produces incomplete ankylosis of it, and is incurable.

The investigations into the disease made by Dr. Adams, show that the affection in its early stages is a chronic inflammation of the fibro-synovial capsules, which, besides being thickened, are distended with synovial fluid. This is the condition formerly called hydrops articuli. The synovial membrane internally is of a red colour; vascular tufts, red and hypertrophied synovial fimbriæ, will

be seen in the joint. As the disease advances the redundant fluid is absorbed; and the capsular membranes of the joints acquire a preternatural density. That in the hip-joint is sometimes one and a quarter inches thick, and not a vestige of the round ligament will be seen; nor of the long tendon of the biceps or glenoid ligament in the shoulder-joint; and all the articulations, great or small, which have been long affected, are usually divested of their cartilages of incrustation. The inter-articular fibro-cartilages are also, with very few exceptions, absorbed when the disease has existed long in any joint normally possessing them. This Dr. Adams has proved in the lower jaw, the sterno-clavicular joints, and also in the wrist. This observation also applies to the knee-joint; in every well marked case of this disease he has observed absorption of the semi-lunar cartilages, as completely as of the cartilages of incrustation of the heads of the bones. The fibrous brim of the glenoid cavity of the scapula, and of the cup of the acetabulum, are altogether removed by the disease.

The lateral ligaments of the ginglymoid joints are elongated, from the primary distention of the capsules by effusion; and this accounts for a certain degree of abnormal motion afterwards sometimes present. This mobility is not always observed in advanced cases, because of the semi-flexed state of the limbs and spastic condition of the muscles. In the smaller ginglymoid joints, however, the ligaments become so lax as to permit of partial or even complete dislocation. The capsular ligament of the arthrodial and enarthrodial joints are also very slow to recover the effects of the over distension they, too, had undergone in the early periods of this disease; and these capsules, thus elongated and relaxed, also admit of dislocations of the bones. These observations, Dr. Adams further remarks, relative to the displacements of the bones he has noticed to occur as the result of chronic rheumatic arthritis of long standing, do justice to the sagacity of the following observation of Haygarth:—"As the disease increases, the joint becomes distorted, and probably, in bad inveterate cases, dislocated."

Dr. Adams describes the presence of loose bodies, which, he says, are generally to be found in the joints of patients who have suffered for a long time, and severely, under this disease. He describes one instance in which no fewer than forty-five of these were found in the elbow-joint; Haller observed twenty in the lower jaw; and Morgagni twenty-five in the knee-joint. We would refer the reader to a previous consideration of this subject under the head of loose cartilages.

When the disease has been of long standing, the removed cartilage is replaced by an ivory-like enamel, remarkable for its fine polish and hardness. "In the first class joints, such as those of the hip and shoulder, the surface of the head of the femur or humerus becomes, in whole or part, as smooth as an ivory ball. In the ginglymoid joints, such as the knee and elbow, the place of the removed cartilage is supplied by means of patches of ivory or porcelain, like enamel, marked by parallel grooves hollowed out in the direction of the movements of flexion and extension.

The denuded bony surfaces, left by the absorption of the cartilages, become partially worn away by friction and attrition, and a smooth enamel is formed by the mutual action of the bones on each

other. "Around the articular surfaces thus acted upon, bony vegetations arise. The heads of the bones, thus enlarged, and sometimes flattened, get the appearance as if they had been crushed down. The necks of the humerus and femur become gradually shorter, from a species of interstitial absorption they undergo; and under such circumstances we can easily imagine that any one not familiar with these anatomical characters of this peculiar disease, might be led to infer, when they met with them, that they had before them specimens of fractures of the anatomical neck of the humerus, or even of an intra-capsular fracture of the cervix of the femur which had been united by bone." Dr. Adams also points out, that as the heads of the bones are greatly enlarged by this disease, the cavities for their reception are found to be proportionably expanded. In many cases, these sockets are rendered much deeper than natural, and in others they are found shallower and otherwise deformed. It appears, moreover, that the peculiar irritation of the disease is not confined merely to the wearing away of the cartilage, or the enlargement of the articular heads of the bones; but that, in some cases, the shafts and centres of the bones themselves become hypertrophied. (See *Dr. Adams's Treatise*, p. 25 to 40.)

Mr. Barwell believes that the morbid action in this disease begins in the bones—that it is in reality a rheumatic osteitis. Mr. William Adams observes that the cartilage seems to take the first step in the morbid process, becoming greatly hypertrophied, and afterwards ossifying. A good description of the ultimate structure of this disease is given by Mr. Barwell, and also by Mr. William Adams, but for which we must refer the reader to their separate works; and also to Mr. Paget's and Mr. Canton's writings for further information upon this subject. We shall now make a few observations upon this disease, as it occurs in the various articulations.

In the hip, the symptoms generally partake somewhat of the ordinary characters of rheumatism; there is some pain and stiffness about the joint, increased at night, especially in damp or cold weather; as the disease advances the pain is increased by walking or standing, and the movements of the joints gradually become impaired. There is much difficulty in bending the body forwards from the hips; the patient therefore cannot stoop or sit comfortably, and is obliged to keep the limb straightened in nearly a direct line with the trunk. All these symptoms increase; and as the changes already described take place in the head of the bone, shortening of the limb occurs to the extent of an inch or more. The pelvis also becomes oblique, and the shortening looks greater than it is. The knee and foot are everted, the heel raised, the hip is flattened posteriorly, the folds of the nates disappear; but the trochanter projects, and seems to be larger and thicker than natural. Rotation of the limb is extremely limited, and crackling or osseous crepitation will be felt around the joint. Dr. R. W. Smith observes that the lumbar vertebrae acquire great mobility; the thigh on the affected side is wasted, but the calf retains its natural size and firmness. In the shoulder the symptoms are very similar to those in the hip: stiffness and crackling felt by the patient; at first effusion, and after its absorption the shoulder seems wasted.



The head of the bone is a little elevated and advanced, and posteriorly a depression is seen over the posterior edge of the glenoid cavity and head of the humerus. The elbow cannot be moved upwards, except by the rotation of the scapula on the trunk. All movements of the shoulder are effected through the medium of the scapula; the whole arm becomes wasted and weak.

When occurring in the lower jaw, Dr. R. W. Smith describes the disease as mostly symmetrical, and gives rise to an enlargement of the condyles, which can be felt under the zygoma, attended with much pain in opening the mouth, a sensation of crackling or grating in the joint, and some enlargement of the lymphatic glands by the side of the neck. There is much distortion of the face, if one side only is affected, the affected side projecting considerably; if both joints are involved the chin projects, and the entire jaw is drawn forwards.

The knee is more frequently affected than any other joint, the ankle very rarely so. When seated in the knee, the tibia gets a peculiar outward tendency making the knee fall inwards, and at the same time it is rotated outwards. The patella is turned outwards and lies on the outer condyle. The toes turn inwards, excepting the great toe, which is usually the first affected; it lies crossed over, and on the back of the others.

In the treatment of this affection, but little indeed can be done to effect a cure. Rest and the habitual application of warm or stimulating plasters will afford relief; and in many instances the administration of the iodide of potassium, with sarsaparilla, will lessen the nocturnal pain. When it fails, the bichloride of mercury has been recommended, either alone, or combined with the iodide of potassium. Dr. R. W. Smith recommends an electuary composed of guaiacum, sulphur, the bitartrate and carbonate of potass, and ginger, with a small quantity of rhubarb; and Mr. Erichsen offers his testimony in favour of this in some cases. When the disease, however, is once fairly established, and has assumed a very chronic character, nothing can be done except to mitigate the pain by some such means as those recommended, conjoined with rest and careful attention to the general health.]

[*Chronic Strumous Arthritis: white swelling*, or scrofulous disease of the joints.—The signification of the expression of *white swelling* is a very chronic form of arthritis, occurring in scrofulous subjects. This condition has not in many cases any definitive starting-point, but appears slowly to supervene upon some slight injury, as a twist, or a blow, or strain; at other times it commences with a sub-acute synovitis, assuming its peculiar characters by occurring in a strumous constitution, and is especially liable to happen in children and females.

The bones are sometimes, but not always, primarily affected, and when this is the case, as a consequence ulceration takes place in the cartilages covering the articular extremities.]

By Mr. Lloyd, scrofulous white-swellings are divided into three stages; the first being that in which the affection is confined to the bone; the second, that in which the external parts become thickened and swelled; and the third being what he names the suppurative stage, attended with ulceration of the cartilages, inflammation of the

synovial membrane, and abscesses. (*On Scrofula*, p. 121.) It was formerly a common notion that, in white swellings, the heads of the bones were always enlarged. Mr. Russell, I believe, is the first writer who expresses an opposite sentiment, and he distinctly declares that he has never heard or known of an instance in which the tibia was enlarged from an attack of white swelling (p. 37). The inaccuracy of the opinion was afterwards pointed out by Mr. Lawrence to the late Mr. Crowther, and the subject was mentioned in the earliest edition of the *First Lines of the Practice of Surgery*.

Deceived by the feel of many diseased joints, and influenced by general opinion, I once supposed that there was generally a regular expansion of the heads of scrofulous bones; but, excepting an occasional enlargement, which arises from spicula of bony matter, deposited on the outside of the tibia, ulna, &c., and which alteration cannot be called an expansion of those bones, for a long time I never met with the head of a bone enlarged in consequence of the disease known by the name of white swelling. I was formerly much in the habit of inspecting the state of the numerous diseased joints which were every year amputated at St. Bartholomew's Hospital; and though I was long attentive to this point, my searches after a really enlarged scrofulous bone always proved in vain. Nor was there at that period any specimen of an expanded head of a scrofulous bone in Mr. Abernethy's museum. Some years ago, however, a specimen of an enlargement of the upper end of the ulna was found and shown to me by Mr. Stanley. Mr. Langstaff also had in his possession a knee-joint in which the femur and tibia are much expanded, "the external laminæ of the bones not being thicker than when the bones are of their natural size, and the cancelli healthy, though of rather greater solidity than natural." (*Lloyd on Scrofula*, p. 148.) However, this last form of disease evidently does not resemble the common scrofulous affection of the heads of the bones. I may add that Mr. Wilson, whose dissections were very numerous, concurs with the best modern writers concerning the rarity of an actual expansion of the substance of the heads of the bones. (*On the Skeleton*, &c. p. 336.) I have also heard of a few other instances in which the heads of the bones were actually enlarged in cases of white swelling. However, I believe the occurrence is far from being usual.

A cursory examination of a diseased joint, even when it is cut open, will not suffice to show that the heads of the bones have not acquired an increase of size. In making a dissection of this kind in the presence of a medical friend, I found that even after the joint had been opened, the swelling had every appearance of arising from an actual expansion of the bones. The gentleman with me felt the ends of the bones after the integuments had been removed, and he coincided with me that the feel which was even now communicated seemed to be caused by a swelling of the bones themselves; but, on cleaning them, the enlargement was demonstrated to arise entirely from a thickening of the soft parts. So unusual, indeed, is the expansion of the heads of the bones, that the late Mr. Crowther, who paid great attention to these cases, joined Mr. Russell in believing that such a change never happened,—a conclusion

not entirely correct. (See *Practical Obs. on White Swelling*, &c. edit. 2, p. 14, 1808.)

Mr. Russell has particularly noticed how much the soft parts frequently contribute to the swelling. He describes the appearances on dissection thus: "The great mass of the swelling appears to arise from an affection of the parts exterior to the cavity of the joint, and which, besides an enlargement in size, seem also to have undergone a material change in structure. There is a larger than natural proportion of a viscid fluid, intermixed with the cellular substance; and the cellular substance itself has become thicker, softer, and of a less firm consistence than in a state of health. (*On the Morbid Affections of the Knee*, p. 30.)

In this disease, the change which the head of the tibia undergoes, in many cases, is first a partial absorption of the phosphate of lime throughout its texture, while at first a transparent fluid, and afterwards a yellow cheesy substance, are deposited in the cancelli. In a more advanced stage, and, indeed, in that stage which most frequently takes place before a joint is amputated, the head of the bone has deep excavations in consequence of caries, and its structure is now so softened that, when an instrument is pushed against the carious part, it easily penetrates deeply into the bone. Occasionally, as Mr. Lloyd has observed, all the bones of a joint are affected in this way, but frequently only one of them. (*On Scrofula*, p. 120.)

According to Sir Benjamin Brodie—"The morbid affection appears to have its origin in the bones, which become preternaturally vascular, and contain a less than usual quantity of earthy matter; while at first a transparent fluid, and afterwards a yellow, cheesy substance, is deposited in their cancelli. From the diseased bone, vessels, carrying red blood, shoot into the cartilage, which afterwards ulcerates in spots, the ulceration beginning on that surface which is connected to the bone. The ulceration of the cartilage often proceeds very slowly. I have known a knee amputated on account of this disease in which the cartilage was absorbed for not more than the extent of a sixpence. Occasionally, a portion of the carious bone dies and exfoliates. As the caries of the bones advances, inflammation takes place of the cellular membrane external to the joint. Serum, and afterwards coagulated lymph, are effused, and hence arises a puffy and elastic swelling in the early, and an oedematous swelling in the advanced, stage of the disease. Abscess having formed in the joint, makes its way by ulceration through the ligaments and synovial membrane, and afterwards bursts externally, having caused the formation of numerous and circuitous sinuses in the neighbouring soft parts." In some instances, in the advanced stage, we find nearly the whole of the cartilage forming an exfoliation, instead of being ulcerated. In one of the cases related by Sir B. Brodie, these layers of cartilage were found lying on the ulcerated surface of the bone, apparently unconnected with it. (*Med. Chir. Trans.* vol. iv. p. 272, and *Path. Obs.* p. 193, ed. 3.) The above-described alteration of the structure of the bones the author has never seen in the cranium, nor in the middle of the cylindrical bones; but it is asserted by another late writer that the cheesy matter sometimes pervades the cancelli of the whole bone, and is deposited in innumerable portions of the most minute size. (*E. A. Lloyd on Scrofula*, p. 120.)

Also, with respect to the increased vascularity of the diseased part of the bone, although Mr. Lloyd assents to the truth of this statement, as applied to the early stage of the disorder, he represents the vascularity as afterwards being diminished in proportion as the quantity of cheese-like deposit increases. (*Op. cit.* p. 122 and 123.)

"Scrofula attacks not only those bones, or portions of bones, which have a spongy texture, as the extremities of the cylindrical bones, and the bones of the carpus and tarsus; and hence the joints become affected from their contiguity to the parts which are the original seat of the disease." (See *Med. Chir. Trans.* vol. iv. p. 273.)

Sir B. Brodie observes, however, that sometimes the effects of these morbid changes may be traced even in the shaft of a cylindrical bone, so that the middle of the femur or tibia is converted into a thin shell, enclosing a medullary cavity of unusual magnitude. (*Path. and Surg. Obs.* p. 195, ed. 3.)

In the cavity of the joint we sometimes find a quantity of curd-like matter, and the cartilages absorbed in various places, but more particularly round the edges of the articular surface.

[Mr. Erichsen mentions that—"The bones undergo important changes in this disease, the articular ends becoming expanded and enlarged; and though this was denied by Crowther, Russell, and others, it is affirmed by more modern surgeons, and I have had repeated opportunities of determining the fact. In all the cases that I have examined, the osseous tissue has undergone important changes, the compact structure having become thin and expanded, and the cells of the cancellated portion filled with a bloody and fatty serous fluid. The bone is softened, often cutting readily with the knife, and, owing to the deposit of fat, presents a more homogeneous section than healthy bone. In many cases, tuberculous matter is deposited in it. From this it would appear that the principal changes that take place in a joint affected with white swelling consist in a kind of fatty degeneration of the tissues that enter into the formation of the articulation, associated with an unhealthy strumous inflammation of the parts, and in the consequent deposition of considerable quantities of semi-transparent and lowly organised plastic matter, which, in its turn, has a tendency to undergo the same structural change, or to run into unhealthy suppuration." (*Science and Art of Surgery*, ed. 2, p. 692.) Mr. Pirrie coincides with the previous writer when he states that more recent observers have met with examples, and he has seen a good many specimens which prove incontestably the existence of the expansion of bone. "That the head of a bone is occasionally enlarged in other diseases it is impossible to deny; but the cases I refer to were examples of expansion of the shell, combined with tubercular deposit in the bone, and no doubt the inflammatory process that co-existed with the deposit led to the expansion." (*Prin. and Pract. of Surgery*, ed. 2, p. 434.)

The occurrence of true tuberculous deposit in bone is acknowledged to be rare; indeed, some pathologists actually deny its occurrence in that structure. Mr. Barwell observes that, when it does occur, it is as a result, and not a cause, of osteitis. "Dr. Cornelius Black has published some observations on what he terms 'tuberculous bone;' (*Edin. Med. Jour.* vol. iv.) but he has described under that name what I believe to be the filling of the



cancelli by granulations from their lining membrane, the gradual thinning of their walls, and enlargement of their cavities, with just that sort of generation of bone which we find in a not very far advanced degree of caries." There is no proof, Mr. Barwell goes on to observe, that the material which he found stuffing the cancellous cavities was tubercle. (See *Barwell, Dis. of the Joints*, p. 228.) Mr. P. C. Price, in his work on *Excision of the Knee*, refuses to discuss the tuberculous or non-tuberculous nature of the deposit in spongy bone; but he assumes a peculiar nature for the deposit, "under the character of a morbid material, which partakes more or less of the nature of struma, as developed in other localities of the body."]

In white swelling, as the name of the disease implies, the skin is not at all altered in colour. According to Mr. Lloyd, the first decided symptom of disease in the articulating extremity of a bone is an occasional deep-seated, dull, heavy pain, unattended by swelling, and not increased by motion; and if it be the hip, knee, or ankle which is affected, the patient keeps the knee rather bent, and never fully extends it in progression. (*On Scrofula*, p. 138.) In some instances the swelling yields in a certain degree to pressure; but it never pits, and is almost always sufficiently firm to make an uninformed examiner believe that the bones contribute to the tumour. It is remarked by Sir B. Brodie, that while the disease is going on in the cancellous structure of the bones, before its effects have extended to the other textures, and while there is still no evident swelling, the patient experiences some degree of pain, which, however, is never very severe, and often is so slight that it is scarcely noticed. After a time, varying from a few weeks to several months, the external parts begin to swell, and serum and coagulated lymph to be effused in the cellular membrane, so as to form a puffy elastic swelling. (*Path. Obs.* p. 197, ed. 3.) In the majority of scrofulous white swellings of the knee, let the pain be trivial or more severe, it is particularly situated in one part of the joint, viz. either the centre of the articulation, or the head of the tibia. Sometimes the pain continues without interruption; sometimes there are intermissions; and in other instances the pain recurs at regular times, so as to have been called by some writers periodical. Almost all authors describe the patient as suffering more uneasiness in the diseased part when he is warm, and particularly when he is in this condition in bed.

In the early stage of the disease, the swelling is mostly very inconsiderable, or there is even no visible enlargement whatever, excepting perhaps after exercise. In the little depressions naturally situated on each side of the patella, a fulness generally first shows itself, and gradually spreads all over the affected joint. According to Mr. Lloyd, however, when the soft parts on the outside of the knee-joint permanently swell, the swelling often commences on each side, just behind the condyles, so that the joint appears wider; and he says that he has often seen the enlargement commence by the swelling of a gland immediately above the inner condyle. He observes that there is no part of the joint where the swelling may not begin. (*Op. cit.* p. 139.)

The patient, unable to bear the weight of his body on the disordered joint, in consequence of the great increase of pain thus created, gets into the

habit of only touching the ground with his toes, and the knee, being generally kept a little bent in this manner, soon loses the capacity of being completely extended again. When the disease has lasted a good while, the knee is almost always found in a permanent state of flexion. In scrofulous cases the pain constantly precedes any appearance of swelling; but the interval between the two symptoms differs very much in different subjects.

The morbid joint in the course of time acquires a vast magnitude. Still the integuments retain their natural colour and remain unaffected. The enlargement, however, always seems greater than it really is, in consequence of the emaciation of the limb, both above and below the disease.

An appearance of blue distended veins, and a shining smoothness, are the only alterations to be noticed in the skin covering the enlarged joint. The shining smoothness seems attributable to the distension, which obliterates the natural furrows and wrinkles of the cutis. When the joint is thus swollen, the integuments cannot be pinched up into a fold, as they could in the state of health, and even in the beginning of the disease.

As the disease advances the cartilages ulcerate, and collections of matter form around the part, and at length burst. Their progress, as Sir Benjamin Brodie has stated, is slow, and when they burst or are opened they discharge a thin pus, with portions of a curd-like substance floating in it. The discharge afterwards becomes less copious and thicker. (*Path. Obs.* p. 199, ed. 3.) The ulcerated openings sometimes heal up; but such abscesses are generally followed by other collections, which pursue the same course. In some cases these abscesses form a few months after the first affection of the joint; on other occasions several years elapse, and no suppuration of this kind makes its appearance. They sometimes communicate with the cavity of the diseased joint, or lead down to diseased bone, portions of which occasionally exfoliate. In the generality of cases several abscesses take place in succession, some healing up, and others ending in sinuses.

As the cartilages continue to ulcerate, Sir B. Brodie has observed that the pain becomes aggravated, though not in a very great degree; and he says that it is not severe until an abscess has formed, and the parts over it are distended and inflamed.

The local mischief must necessarily produce more or less constitutional disturbance. The patient's health becomes gradually impaired; he loses his appetite and natural rest and sleep; his pulse is small and frequent; an obstinate and debilitating diarrhoea, and profuse nocturnal sweats, ensue. These complaints are, sooner or later, followed by dissolution, unless the constitution be relieved in time, either by the amendment or removal of the diseased part. In different patients, however, the cause of the disease and its effects upon the system vary considerably, in relation to the rapidity with which they occur.

Rheumatic arthritis, or inflammations and thickenings of the synovial membrane from cold or other causes, are very distinct diseases from the scrofulous distemper of the large joints. In the first the pain is said never to occur without being attended with swelling. Scrofulous white swellings, on the other hand, are always preceded by a pain, which is particularly confined to one part of the articula-

tion. In rheumatic cases the pain is more general and diffused over the whole joint.

[Mr. Barwell has drawn attention to the distinctive differences between strumous articular osteitis and strumous synovitis in the earlier stages, which we may relate in this place. Both of these forms of strumous disease come under the general denomination of strumous arthritis, or white swelling, properly so called.

In strumous articular osteitis the first symptom is heavy dull pain, with limping or other imperfection in the use of the limb; this comes on before any swelling is perceptible. The pain is generally increased in bed, and is subject to variations; sometimes quite disappearing for a time and again returning. The swelling at first is confined to one portion of the joint,—for instance, at the knee,—the upper when the femur, the lower when the tibia, is affected. Afterwards, though the whole joint be enlarged, the tumefaction is more marked, harder, and larger over the bone primarily affected, and is nearly always on one side of the joint. The division between the bones remains evident to the touch. In all but the deepest placed bones the integuments over them are sensibly hotter.

In strumous synovitis the swelling is either before pain or is discovered with the pain. Pain being a later symptom as regards visible swellings, yet, when it comes on, is constant. The bones forming the articulation are blended by the swelling into one rounded shapeless mass, which overlies both parts of the joint equally, and conceals greatly or altogether the line of junction between the two bones. There is no preference of place; the swelling is equable over the whole joint. The integuments are not at all, or scarcely, increased in temperature. (*Diseases of Joints*, p. 247.)]

Mr. Lloyd thinks that the scrofulous white swelling may be distinguished from all other diseases of the joints by its being attended with less pain, by the great degree of external swelling often existing for a long time before matter forms in the cavity of the articulation, and by the swelling being but little diminished by any discharges of matter which may take place. In its first stage, before the interior of the joint is affected, it may be distinguished from primary ulceration of the cartilages by the pain not being much increased by motion. The grating produced by moving the joint is also commonly less in this disease than in ordinary ulceration of the cartilages. (*Lloyd, On Scrofula*, p. 142.) And, according to Sir Benjamin Brodie, the principal criterion between scrofulous diseases of joints and the primary ulceration of cartilages, is the little degree of pain in the former cases, which is never much complained of before an abscess forms, nor particularly severe, "except in a few instances, and in the most advanced stage of the disease, when a portion of ulcerated bone has died, and having exfoliated, so as to lie loose in the cavity of the joint, irritates the parts with which it is in contact, and thus becomes a source of constant torment." (*Brodie's Path. Obs.* ed. 5, p. 220.)

It seems probable that cases in which the cancellous structure of the bones is found quite undiseased, and in which the mass of disease is confined to the soft parts, are not scrofulous white swellings. Few persons who have attained the age of five-and-twenty without having had the least symptom of scrofula ever experience after this period of life a first attack of the white swelling of the strumous

kind. The general correctness of this observation, I believe, is universally admitted; and that there are but few exceptions to it is confirmed by the statements of Volpi, of Pavia. However, Mr. Lloyd attended a man who, at the age of between forty and fifty, died of phthisis, and had at the time a scrofulous ankle, besides several abscesses about his hip and groin. And the same gentleman met with another patient, upwards of forty years old, with a similar disease. (*On Scrofula*, p. 137.) But if these patients had had no marks of scrofula in their younger days—a circumstance not specified,—they form deviations from what is usual, as indeed Mr. Lloyd seems to admit. My own observations lead me to concur with Sir B. Brodie that scrofulous affections of the joints, so frequent in children, are rare after the age of thirty. (*Pathol. Obs.* p. 196, ed. 3.) This observation, however, is to be received as correct only with reference to persons who have been free from scrofula up to that period of life. I attended (Aug. 1829) a woman nearly forty, who had been first attacked with a scrofulous white swelling of the left knee about a year previously; but then she had had enlarged glands in the neck in her youth, and a scrofulous ulcer of long duration was still open on one of her legs. All cases in which the internal structure of the heads of the bones become softened previously to the affection of the cartilages and soft parts are probably scrofulous.

Mr. Russell has noticed the frequent enlargement of the lymphatic glands in the groin, in consequence of the irritation of the disease in the knee; but he justly adds that the secondary affection never proves long troublesome.

In the knee joint, when the bones are diseased, the head of the tibia always suffers more than the condyles of the thigh-bone. (*Russell*.) The articular surface of the femur sometimes has not a single rough or carious point, notwithstanding that of the tibia may have suffered a great deal. The cartilaginous coverings of the heads of the bones are generally eroded first at their edges; and in the knee the cartilage of the tibia is always more affected than that covering the condyles of the thigh-bone. Indeed, when white swellings have their origin in the bones, and the knee is the seat of the disorder, there is some ground for supposing that it is in the tibia that the morbid mischief usually first commences.

The ligaments of the knee are occasionally so weakened or destroyed that the tibia and fibula become more or less dislocated backward, and drawn towards the tuberosity of the ischium by the powerful action of the flexor muscles of the leg. It is observed by Sir B. Brodie, that just as ulceration of the cartilages is sometimes followed by dislocation of the hip, so we find that dislocation of the knee occasionally takes place from the same cause. When there has been considerable distension of the soft parts, in consequence of ulceration extending to them, the head of the tibia is gradually drawn backwards by the action of the flexor muscles; and Sir B. Brodie has even known this happen previously to the formation of any abscesses. (*Pathol. Obs.* p. 172, ed. 2.)

I have also seen one or two examples of this, and another case, in which the leg could be bent to each side for a considerable distance, both when the knee was extended and bent,—a state implying a preternatural looseness of the ligaments.



Scrofulous white swellings, no doubt, are under the influence of a particular kind of constitution, termed *scrofulous* or *strumous*, in which every cause capable of exciting inflammation, or an irritable state of a joint, may bring on this severe disease. On the other hand, in a man of a sound constitution, a similar irritation would only induce common healthy inflammation of the joint. In scrofulous habits, it also seems as if irritation of a joint were much more easily produced than in other constitutions; and no one can doubt that when once excited in the former class of subjects, it is much more dangerous and difficult of removal than in other patients.

The doctrine of particular white swellings being scrofulous diseases, is supported by many weighty reasons, the opinions of the most accurate observers, and the evidence of daily experience. Wiseman (book iv. chap. 4) calls *spina ventosa* a species of scrofula, and tells us that infants and children are generally the subjects of it. The disorder is said by Severinus to be exceedingly frequent in young subjects. Petrus de Marchettis observed both male and female subjects affected with what are called strumous diseases of the joints as late as the age of five-and-twenty; but not afterwards, unless they had suffered from scrofula before that period of life, and had not been completely cured. R. Lowerus also maintains a similar opinion. Even though a few persons have scrofulous diseases of the joints for the first time after the age of twenty-five, this occurrence, like the first attack of scrofula after this period, must be considered as extremely uncommon.

Another argument in favour of the doctrine which sets down particular kinds of white swelling as scrofulous, is founded on the hereditary nature of such forms of disease.

Numerous continental surgeons, particularly Petit and Brambilla, have noticed how subject the English are both to scrofula and white swellings of the joints. We every day see that young persons afflicted with the present disease are in general manifestly scrofulous, or have once been so. Frequently enlarged lymphatic glands in the neck denote this fatal peculiarity of constitution; and very often the patients are known to have descended from parents who had strumous disorders. (Crowther.) The disease is also frequently combined with swelled mesenteric glands, or tuberculated lungs. (Brodie's *Path. Obs.* p. 221.) As the same author remarks, since the disease depends upon a certain morbid condition of the general system it is not surprising that we should sometimes find it affecting several joints at the same time, or that it should show itself in different joints in succession, attacking a second joint after it has been cured in the first, or after the first has been removed by amputation (p. 230).

Besides the general emblems of a scrofulous constitution, we may often observe a shining, coagulated, flaky substance, like white of egg, blended with the contents of such abscesses as occur in the progress of the disease. This kind of matter is almost peculiar to scrofulous abscesses, and forms another argument in support of the foregoing observations relative to the share which scrofula frequently has in the origin and course of many white swellings.

Sir Benjamin Brodie's experience leads him to believe that, in scrofulous cases, the chance of ulti-

mate recovery is much less when the disease attacks the complicated joints of the foot and hand than when it is situated in larger articulations of a more simple structure. (*Path. and Surg. Obs.* p. 235.)

[*Treatment of Chronic Strumous Arthritis, or White Swellings.*—It must be borne in mind that we have to manage an affection which is truly scrofulous in its nature and in its results. Our first object, therefore, should be to prevent, if possible, the occurrence of suppuration. In the early stage, when the affection has come on insidiously, without any very active symptoms, we must employ general measures of an anti-strumous nature, for without them local treatment alone will be found wholly useless. The patient should have the benefit of good diet, and sea-air, and alterative medicines; cod liver oil and preparations of iodine should be prescribed. To these we shall again presently refer.

The most important element in the local treatment is rest, with perfect immobility of the articulation, without which all other measures will prove useless. The patient must therefore be prevented from walking about, particularly if the affected part is one of the joints of the lower extremity; for the weight of the body will alone cause much irritation. The limb should therefore be placed in such a position as shall be the most easy to the patient, but which will leave the member a useful one in the event of a stiff joint resulting.

If the symptoms are of a rather acutely inflammatory character leeches may be applied, but they are recommended to be employed as sparingly as possible, and chiefly at the earlier stages of the disease, or to the subduing of any more active intercurrent inflammation. In ordinary cases of scrofulous joints, Sir Benjamin Brodie considers topical bleeding as generally unnecessary.]

It is quite needless to expatiate on the mode of treating white swellings, complicated with acute inflammation, particularly as the treatment of those cases which consist of inflammation of the synovial membrane has been already noticed, and may be said to be applicable to other forms of white swelling, when they are attended with heat and inflammation of the soft parts. The most eligible plan of arresting the morbid process in the bones, cartilages, and soft parts surrounding the articulation, and the most successful method of lessening the chronic enlargement of the joint, are the subjects at present demanding our earnest investigation.

When white swellings are accompanied with ulceration of the cartilages all motion of the joint is extremely hurtful. Indeed, as Sir B. Brodie well observes, keeping the limb in a state of perfect quietude is a very important, if not the most important, circumstance to be attended to in the treatment. According to this gentleman, it is in these cases in which ulceration of the cartilages occurs as a primary disease that caustic issues are usually productive of singular benefit; but he deems them of little use in any other diseases of the joints. He thinks setons and blisters, kept open with savine cerate, may also be used with advantage. Bleeding is indicated only when, from improper exercise, the articular surfaces are inflamed, and there is pain and fever. Sir B. Brodie finds that the warm bath relieves the symptoms in the early stage, if it does not stop the progress of

the disease; but he condemns plasters of gum ammoniac, embrocations, liniments, and frictions, as either useless or hurtful. (See *Med. Chir. Trans.* vol. vi. p. 332—334.)

[Mr. Erichsen asserts that rest is best secured by the application of leather or gutta percha splints in the earlier stages; and at a later period by the starched bandage to the limbs. This kind of appliance, he says, will be found to give the most efficient support, and will keep the whole of the limb perfectly motionless, so that the patient can take open-air exercise, and walk with the aid of crutches, without the risk of injuring the diseased joint. In this respect the starched bandage presents great advantages over the short leather splints generally used. It may readily be cut open opposite the diseased joint, so as to admit of the application of proper dressings to it. (See *Erichsen, Science and Art of Surgery*, p. 693, ed. 2.) Mr. Pirrie prefers splints of gutta percha to those of leather, to obtain perfect immunity of the joint from motion. In the event of local applications not being necessary, he considers the starch bandage, applied so as not to cause any undue pressure, as exceedingly convenient; and even where issues are necessary, it will often be found the best means of keeping the joint at rest; and openings, or, as they have been called, traps, may be cut out to allow of the application of issues or other means of counter-irritation. If splints or the starch bandage be nicely applied, the patient may be drawn out into the open air, which is so important in this disease. (See *Pirrie, Prin. and Prac. of Surgery*, ed. 2, p. 436.)]

Mr. John Hunter had confidence in cicuta and sea-bathing, as possessing power over many scrofulous diseases; and that such diseases of the joints are often materially benefited by the patient's going to the sea-side and bathing is a fact which cannot be doubted, whatever may be the mode of explaining the benefit thus obtained. I fully believe that sea-air and sea-bathing have a beneficial influence over scrofulous diseases of the joints; but probably their effects are produced on the part through the medium of the constitution, and they should only be recommended as an auxiliary plan, to be adopted in conjunction with other still more efficacious measures.

One method of treatment which my own personal experience enables me to recommend for scrofulous white swellings in a chronic state, consists in keeping the joint motionless by means of a splint, and maintaining a discharge from the skin covering it. The opportunities which I have had of observing the effects of blisters and caustic issues, rather incline me to prefer the former to the latter. In particular individuals, however, blisters create so much irritation, heat, fever, and suffering, that a perseverance in them would be rashness.

The blister should be large. Many surgeons, instead of following Crowther's plan, prefer blistering first one side of the joint, and then the other, alternately, for a considerable length of time.

[The actual cautery is extremely beneficial in these cases, applied as directed in the treatment of the chronic and subacute forms of arthritis, to which we would refer the reader; or caustic issues may be put in at a little distance from the articulation, so that there may be no risk of the inflammatory action penetrating to it.]

In the beginning caustic issues are even more

painful than blisters; but they afterwards become more like indolent sores, and are more easily kept open for a length of time than blisters. Such issues are commonly made on each side of the diseased joint, and of about the size of half a crown. The manner of making the eschars and keeping issues open is elsewhere explained. (See *SETON and ISSUE*.)

The question has been contested among surgical writers and practitioners, whether blisters and issues produce benefit upon the principle of counter-irritation, or in consequence of the discharge which they occasion. They probably operate efficaciously in both ways; for there is no doubt that simple rubefacients possess the power of promoting absorption, and they may also modify the vascular action in diseased parts. Yet it is obvious that they can only act upon the principle of counter-irritation, and they have not been here recommended, particularly for white swellings; because it seems to me that whenever some good might be derived from their employment, much more benefit might always be obtained from blisters and issues. This sentiment is confirmed by experience, and we must, therefore, impute a great degree of efficacy to the maintenance of a purulent discharge from the vicinity of the diseased part.

Though my own observations have led me to think quietude of the joint, with issues and blisters, as efficient as any means hitherto devised for stopping the progress of scrofulous disease of the heads of bones, I am far from meaning to say that such disease can generally be stopped by these or any other remedies, local or general. Sir B. Brodie has seldom known any benefit derived from blisters or stimulating liniments; nor has he seen the same degree of good produced by issues in scrofulous cases, as in examples of primary ulceration of the cartilages. Cold evaporating lotions in the early stage of the complaint, perfect quietude of the joint, attention to the patient's health, and riding in a carriage in the fresh air, are the means which this gentleman particularly recommends in scrofulous diseases of the joints. During the formation of abscesses, he approves of fomentations and poultices. (*Pathol. Obs.* p. 242.) In a subsequent edition Sir Benjamin observes,—“I much doubt whether setons and issues are ever useful, except in some cases in which the disease has its seat in the hip-joint, and in which the patient suffers, in an unusual degree, from pain and muscular spasms in the limb, apparently in consequence of the irritation communicated to the trunk of the anterior crural nerve.” (Ed. 3, p. 205.)

[After all inflammation has been removed, and nothing but thickening and stiffness of the joint are left, measures must be adopted for removing these conditions, and restoring the flexibility of the articulation by frictions, with somewhat stimulating and counter-irritant embrocations, and eventually its strength by douches of sea-water. The effect of friction is to excite the action of the absorbents, which considerably lessen the thickened state of the parts around the affected joint; and it was on this principle that the old practice of dry rubbing was found so efficacious. The swelling and puffiness that are left, together with the debility dependent on relaxation of the ligaments, are perhaps best remedied by the use of Mr. Scott's strapping.] According to this gentleman, issues,



perpetual blisters, and other irritating remedies, may be all superseded by the following treatment:—The surface of the joint is first to be cleaned with a sponge and soft brown soap and water, and then thoroughly dried. It is next to be rubbed with a sponge soaked in camphorated spirit of wine, until it begins to feel warm, smart a little, and assume a red appearance. The joint is now to be covered with a cerate, composed of equal parts of ceratum saponis and the ung. hydrarg. fortius cum camphorâ; and this, in the knee, for at least six inches above and below the point at which the condyles of the femur are opposed to the head of the tibia. The limb is next to be supported to the same extent with strips of calico, spread with the emplastrum plumbi, and applied so as to prevent motion of the joint. Then is to be laid on an additional covering of emplastrum saponis, spread on thick leather, and cut into four broad pieces; one for the front, another for the back, and the two others for the sides of the joint; and, lastly, the whole is secured by means of a calico bandage, which is put on very gently, and rather for the purpose of securing the plaster and giving greater thickness and security to the whole, than for the purpose of compressing the joint.

[In the employment of this mode of pressure, care must be observed that there is no evidence of active inflammation going on in the articulation, which it would certainly increase. The pressure should at first be slight, and gradually increased at subsequent dressings. Sir Benjamin Brodie confirms the good effects of pressure in scrofulous cases, when suppuration has not only ceased, but there is a tendency towards the occurrence of ankylosis.]

If abscess form, it must be freely opened by an incision of a proper length, the joint poulticed, and the patient's general health attended to, so as to promote the evolution of granulations, and prevent hectic. In these cases, if the limb can be preserved, its after utility and the patient's comfort will mainly depend upon the position in which it is allowed to ankylose.]

With respect to medicines, Sir Benjamin Brodie has found preparations of steel more frequently useful than others, continued over a period of several years. The mineral acids are found serviceable when there are night sweats. Iodine, in some of its various forms, combined with cod-liver oil, is the chief remedial agent in this as well as in almost all other scrofulous affections. (See SCROFULA.) The diet should be nourishing, but plain; the open air should be enjoyed as much as possible, without exercising the joint. Mr. Lloyd recommends, in his work on "Scrofula," attention to the bowels and secretions; and, following out Mr. Abernethy's plan, he employs blue pill every night, and decoct. sarzæ twice a day. The advantage of mercury, however, is very questionable in scrofulous affections, unless as a regulator of the secretions. If there is a debilitating diarrhoea it must be controlled by proper remedies, into which opium and bismuth enter. In some cases amputation is indispensable. (See AMPUTATION.) In a few cases excision of the diseased joint is preferred to amputation of the limb, as will be hereafter noticed. (See JOINTS, EXCISION OF.)

*Disease of the Hip-joint.*—It seems probable that this disease has its varieties, some of which

may be connected with scrofula, while others cannot be suspected to have any concern with it. Sir B. Brodie's investigations lead him to believe, however, that the disease is of that nature in which the first change is mostly ulceration of the cartilages. The present complaint is most frequently seen in children under the age of fourteen; but no age, no sex, no rank nor condition of life, is exempt from the possibility of being afflicted; so that, though children form a large proportion of those subjects who are attacked, yet the number in adults, and even in old persons, is considerable. The disease is considered by Van der Haer and Morgagni to be more frequent in females than males; but by Albers, Fricker, and Rust, the male sex is specified as more often afflicted than the female. (See *W. Coulson, On Dis. of the Hip-joint*, p. 15.)

[Mr. Erichsen mentions that, out of forty-eight cases of this disease, of which he had taken notes, in sixteen only did it take place at or after fifteen years of age, and of these in six cases only it happened above the age of twenty; thus it may be considered essentially a disease of childhood or early life. (*Science and Art of Surgery*, ed. 2, p. 735.) Out of 102 cases, in which Mr. Pirrie had the age of the patients, eighty were under sixteen years of age, nineteen between sixteen and thirty-five, and three between thirty-five and forty. (*Prin. and Prac. of Surgery*, ed. 2, p. 437.) The general testimony of surgeons who have written upon this disease goes to prove that it is almost entirely confined to children or persons under the age of puberty.]

Some of the most recent writers describe hip-joint disease according to the special part of the articulation involved. Mr. Barwell believes that, in every case, the mischief commences either in the synovial membrane or in the bone; but he acknowledges it as a very difficult matter to determine whether a disease already somewhat advanced may have been originally synovial or osseous. In fact, some men of great experience and care have asserted that all hip-joint diseases begin in the bone (Rust, of Vienna, held this opinion), while others have as positively affirmed that all such maladies commence in the synovial membrane. (See *Barwell, Treatise on Dis. of the Joints*, p. 298.) There can be no doubt that the expression coxalgia, or hip-joint disease, is a too general one, and that certain forms of disease affecting this joint differ from one another, as in the other articulations of the body. We think, therefore, that the division of hip disease as adopted by Mr. Erichsen a good and practical one, and one that can be clearly recognised in practice. In a surgical point of view, the hip-joint is composed of three distinct parts—namely, the soft structures, the acetabulum, and the head of the femur. He therefore divides diseases of this joint into Arthritic, Acetabular, and Femoral. These we shall specially consider; but we may here mention that the last is the one in which the different stages of the disease exist, as usually described by most writers.

*Arthritic Coxalgia.*—The Arthritic form of hip-joint disease may commence in any of the soft structures of the joint: in the capsule, the synovial membrane, the cartilages, or the ligamentum teres. These are alone primarily affected, usually with acute inflammation, presenting the characters of arthritis in other joints; and the dis-

ease generally continues limited to these structures throughout. Mr. Aston Key believed that the ligamentum teres was very frequently the starting-point of inflammation of the hip-joint (*Med. Chir. Trans.* vol. xviii. p. 230), and other surgeons have referred its origin to each of the other structures mentioned. "Without denying the possibility of disease sometimes commencing in the ligaments," Mr. Erichsen observes,—“illustrative of which we have a beautiful model in the Museum of University College,—I believe that it more frequently appears first in the cartilage incrusting the head of the femur; for though it is extremely difficult to prove this, opportunities of dissecting this form of hip disease in its early stages being very rare, yet the symptoms that attend it so closely resemble those accompanying the diseases of the articular cartilage in other joints, that it is difficult not to infer that this may be the case in the hip.” (*Op. cit.*)

The symptoms of this form of disease are those of acute inflammation, coming on rapidly, and with great constitutional disturbance and pyrexia. Most excruciating pain is present in the joint, accompanied by spasms and twitchings of the limb, increased at night. The slightest movement of the limb, the weight of the bedclothes, a fit of coughing, or the shaking of the bed, gives rise to the most intense agony; and in the intervals of his suffering the patient is in constant fear of a return of the pain. The limb is inverted, adducted, helpless and motionless; the nates are flattened, and usually there is some fulness about the anterior part of the joint, under the pectineus muscle, or to its outer side above the trochanter. There is also sometimes true elongation of it, in consequence of the capsule becoming distended with synovial fluid, and pushing the head of the bone downwards. This may be so great in certain instances as to lead to rupture of the capsule, and sudden dislocation of the head of the bone on to the dorsum of the ilium, with great pain and shortening. This occurrence is however very rare, and seldom takes place unless the articulation has been destroyed by an abscess within it.

As ordinarily encountered, hip-joint disease is mostly chronic, and described as such; Mr. Coulson in his lectures applies the term Chronic Disease of the Hip-joint (*The Lancet*, vol. ii. 1854, p. 499) to all diseases of the hip. Chelius recognises an acute and a chronic form, the symptoms of which he divides into three very well defined stages. (See *System of Surgery*, translated by J. F. South, vol. i. p. 250.) Mr. Aston Key says, “the hip-joint is less frequently the subject of acute than of chronic inflammation, probably from being well protected from the influence of atmospheric changes, to which the knee and most other parts are exposed. In the adult, acute disease of the joint is occasionally seen, in which the whole structure of the joint, cartilage as well as ligament, undergoes complete disorganisation in the space of a few weeks.” (*Med. Chir. Trans.* vol. xviii. p. 230.)

The terminations of the acute form of disease are various, according to the constitution of the patient and the treatment pursued. The most favourable will be a subacute condition of disease, and a slow recovery, with a stiff and partially ankylosed and wasted limb. This may happen without suppuration. But in the majority of instances, abscess forms, and the patient is worn out by the continued irritation

of diseased bone, or by the profuse discharge; or, shortening ensues from absorption of the head of the bone, or its dislocation; the cavity of the abscess may ultimately contract, the carious bone exfoliate, and the sinuses close after years of suffering. Under the most favourable circumstances, when once the joint has been acutely inflamed, a year or two will elapse before the patient can use his limb with any degree of security. But the safety of the patient depends on the prevention of suppuration, which can rarely be done in strumous persons. If it occur in an adult, hectic and exhaustion will certainly prove fatal; but children may recover with permanent lameness. (See *Erichsen's Work*, already referred to, p. 738.)

*Acetabular Coxalgia*.—This is believed by Mr. Erichsen to be the most fatal form of hip disease. The disease originates in the pelvic bones, and the pain is described as existing rather around the hip than in the joint itself; the latter however is tender on pressure, and the patient cannot bear on the limb; but no alteration takes place in its length, although it becomes greatly wasted. “Abscess invariably forms, perhaps at first within the pelvic cavity; but it soon presents externally. Sometimes it passes down by the side of the rectum, or through the sciatic notch to the gluteal region; but generally it points near the pubes, under Poupart's ligament.” This is followed by hectic fever, exhaustion, and death. Dislocation rarely takes place; but when the disease has arisen in and has destroyed the head of the femur, the mere action of the muscles of the joint brings this about. Sometimes the destruction of the acetabulum is so extensive that the head of the femur penetrates it, and passes into the pelvic cavity.]

Sir B. Brodie has had opportunities of dissecting some diseased hip-joints both in the incipient and advanced stages of the complaint. From his observations, it appears—1st. That the disease commences with ulceration of the cartilages, generally that of the acetabulum first, and that of the femur afterwards. 2ndly. That the ulceration extends to the bones, which become carious; the head of the femur diminishing in size, and the acetabulum becoming deeper and wider. 3rdly. That an abscess forms in the joint, which after some time makes its way by ulceration through the synovial membrane and capsular ligament into the thigh and nates, or even through the bottom of the acetabulum into the pelvis. Sir A. Cooper showed Sir B. Brodie two specimens, in which the abscesses had burst into the rectum. Sometimes the matter makes its way through the acetabulum into the pelvis, or even into the vagina. Some years ago, there was, in the London Hospital, a case in which both hips were affected, and the abscesses communicated with the cavity of the pelvis through the acetabula. (See *Scott, On Chronic Inflammation*, &c. p. 106.) In the Museum of University College is a beautiful specimen, in which the head of the femur has passed through the bottom of the acetabulum into the pelvis. In a case, under Dr. Mackenzie, of Glasgow, a lad of sixteen died of enormously enlarged liver; but, on dissection, a communication was found through the bottom of the acetabulum, between the cavity of the hip-joint and the colon, smooth, as if of long standing. Another sinus, communicating with the joint, led into the thigh. In Mr. Liston's collection is a specimen of extensive destruction of the acetabulum,



head and neck of the femur, with several sinuses leading from the joint, and one, in particular, of large size, leading towards the rectum through the foramen ovale. There is also another in the rectum, with a rounded aperture sufficient to admit the point of the little finger, about an inch and a half above the anus. (See *W. Coulson, On Dis. of Hip-joint*, p. 40.) 4thly. In consequence of the abscess, the synovial membrane and capsular ligament become inflamed and thickened. The muscles are altered in structure; sinuses are formed in various parts; and at last all the soft parts are blended together in one confused mass, resembling the parietes of an ordinary abscess. (*Med. Chir. Trans.* vol. iv. p. 246-7.)

[Of late years, since the operation of excision has come into practice for the removal of the carious and necrosed parts of the hip-joint, we have been enabled to verify certain conditions of disease which formerly were only surmised. We have in fact an examination of a hip-joint in the living body, and are thus better enabled to understand the progress of the morbid processes which are taking place. It will be of advantage in this place to refer to the condition in which the hip-joint was found in the statistics of fifty-nine cases collected by Mr. P. C. Price, wherein excision of the whole or certain parts of the articulation was practised. The operation itself as a means of treatment we shall discuss in another place. (See JOINTS, EXCISION OF.)

Among the fifty-nine cases, the particulars of which had been authenticated by Mr. Price, in sixteen the head of the femur, much diseased, was dislocated from its acetabular connections, and no disease of the pelvis existed. In eighteen cases the head of the femur, also much diseased, was dislocated from the acetabulum, and more or less disease of the acetabular portion of the pelvis existed. Five cases had the diseased action more or less confined to the synovial and cartilaginous structures of the articulation; and such bony portions of the joint as were involved did not partake of the character of either caries or necrosis, being rather simple stripping or denudation of periosteum. In fourteen cases, the integrity of the joint was more or less destroyed, either femoral or pelvic, or both, although no dislocation or rupture of the capsular ligament had occurred. And in six cases no exact knowledge of the state of the parts was possessed by Mr. Price. (See *The Lancet*, vol. i. 1860, p. 419.) In an instance in which Mr. Hancock operated,—the second, in fact, wherein the joint was wholly excised,—the head of the femur and acetabulum were extensively diseased; the latter was penetrated with numerous openings. The spine of the ischium and a portion of the tuberosity, also both diseased, were removed with the entire acetabulum and head of the femur. The fingers could be passed into the pelvis through the ischiatic notches. Yet with all this amount of disease, the head of the thigh-bone was not dislocated, and the patient made a good recovery. (*The Lancet*, vol. i. 1858, p. 119.) Mr. Hancock had previously done the first operation of excising the entire joint, including the acetabulum, in a boy fourteen years of age, in the early part of 1857. (*Ibid.* vol. i. 1857, p. 141.) Mr. Erichsen had a girl under his care, whose pelvic disease was more extensive than in any case hitherto placed on record. He ex-

cised the upper end of the femur, the acetabulum, the rami of the pubes and of the ischium, a portion of the tuber ischii, and a part of the dorsum ilii. This patient, when admitted into University College Hospital, was in the last stage of disease, exhausted by the constant discharge, and must inevitably have speedily sunk under the effects of the disease, had no effort been made to remove the cause of the prostration. At the operation she was so exhausted that it was necessary to leave her on the table for some hours before she was sufficiently restored to bear moving into bed. Nevertheless this girl made a rapid and good recovery. (See *The Lancet*, vol. ii. 1858, p. 88; and *Erichsen, Science and Art of Surgery*, p. 745, ed. 3.) In the Museum of the Charing Cross Hospital there is a preparation from Mr. Howships' collection, showing an extensive perforation of the acetabulum from ulcerative disease, equally affecting the head of the femur. The acetabulum has been prolonged about an inch upwards. (See *Barwell, Dis. of the Joints*, p. 313.)

*Femoral Coxalgia*, or Chronic Disease of the Hip-joint. — This is usually divided into three stages, which for the most part are sufficiently well marked, and correspond with certain periods in the progress of the disease. The first or incipient stage, as it is called, extends from the appearance of the earliest symptoms to the period when elongation of the limb and lameness manifest themselves. The second is known by wasting and flattening of the nates, which are also flabby; the limb is weak, and elongated in reality, or apparently so, with a lateral twist of the spine; whilst in the third stage we have severe pain, the occurrence of suppuration, and shortening of the limb, either from ulcerative absorption of the head of the thigh-bone or dislocation. (See *Coulson, Lectures on Dis. of the Joints*, vol. ii.; *Lancet* for 1854, p. 499.)

The approach of this disease of the hip-joint may be rather insidious (in the first stage), its only forerunner being sometimes a slight weakness and limping of the affected limb. These trivial symptoms are often not sufficiently urgent to excite much notice; and, when observed by superficial practitioners, are commonly misunderstood, and wrongly treated. As there is sometimes an uneasiness in the knee when the hip is affected, careless practitioners frequently mistake the seat of the disease; and I have many times seen patients, on their entrance into an hospital, having a poultice on their knee, while the wrong state of the hip was not at all suspected.

This mistake is extremely detrimental; for in this stage of the disease mere rest and repeated topical bleeding will do more good in the course of a fortnight, than large painful issues will afterwards accomplish in the long space of a twelvemonth.

The symptoms of this disease of the hip-joint, when only looked for in the situation of that articulation, are not very obvious. Though in some instances, the attention of the surgeon is soon called to the right situation of the disease by the existence of a fixed pain behind the trochanter major; yet it is too often the case, that mere pain about an articulation, entirely destitute of visible enlargement and change of colour, is disregarded as a complaint of no importance among young subjects, and as a rheumatic or gouty affection in adults. Patients frequently complain of

their most painful sensations being in the groin; and all accurate observers have remarked that in hip disease, the pain is not confined to the real seat of disease, but shoots down the limb to the knee.

[It is to be remarked that the pain becomes very excruciating when the cartilages are ulcerating, whilst in scrofulous caries it is comparatively trifling; but in both forms it is felt chiefly in the knee; and it has been remarked that in the scrofulous caries, the pain in the knee may be the only symptom complained of; some surgeons have actually observed a swelling there. The means of distinguishing between disease of the knee and hip-joint is to press upon the latter, either in front over the iliacus and psoas muscles, or behind the great trochanter; or if the femur is gently jerked upwards towards the acetabulum, pain will be felt in the hip, and the pain in the knee will be greatly aggravated.]

Mr. Coulson observes that no particular seat can be assigned to this pain in the knee, nor are surgeons agreed as to the real nature of its cause. In some cases the whole joint is painful; in others the pain is just behind the patella, or on either side, on the condyles of the femur; it may extend along the leg, and in a few cases has been noticed to occupy the ankle joint instead of the knee. The pain is of the kind denominated sympathetic. (See *W. Coulson, On Dis. of the Hip-joint*, and *Lectures in the Lancet* in 1854.)

Sir C. Bell was of opinion that the pain arose from an affection of the obturator nerve; others have referred it to the branches of the anterior crural nerve; but Mr. Coulson observes that the same sympathetic pain in the knee-joint has been found to coincide with chronic inflammation of the sacro-iliac articulation,—a disease overlooked by most writers on surgery, though carefully described by Boyer, and noticed in the *Clinical Surgery* of Larrey.]

In dwelling upon the subject of pain, Sir B. Brodie observes, that, at first trifling and occasional, it afterwards becomes severe, constant, and more fixed. A boy, in St. George's Hospital, complained of pain in the inside of the thigh, near the middle; and another patient referred the pain to the sole of the foot. Wherever the pain is situated, it is aggravated by the motion of the joint, and especially by whatever occasions pressure of the ulcerated cartilaginous surfaces against each other. (*Brodie's Pathol. Obs.* p. 139.)

When the functions of a limb are obstructed by disease, its bulk generally diminishes, and the muscles become emaciated. Nearly as soon as the least degree of lameness can be perceived, the leg and thigh have actually wasted, and their circumference has diminished.

If the surgeon makes pressure on the front of the joint, a little on the outside of the femoral artery, after it has descended below the os pubis, great pain will be experienced.

The limping of the patient is a clear proof that something about the limb is wrong, and, if such limping cannot be imputed to diseased vertebrae, or some recent accident, and if, at the same time, the above-mentioned emaciation of the limb exists, there is great cause to suspect that the hip is diseased, particularly, when pressing the front of the acetabulum causes pain.

Diseased vertebrae generally produce a paralytic affection of both legs at once, if they produce it at

all; and they do not cause painful sensations about the knee, as the hip disease does.

[In the second stage, the symptoms are connected with a constant effort to keep the limb as free from motion as possible. The whole limb now becomes flabby and wasted, being diminished in size from disuse, and the constrained repose of its muscles. The affected buttock looks flatter and more wasted than the one on the sound side; the marked division between the buttock and thigh is lost; the buttock on the affected side is lower by an inch or more than is natural, and the whole limb appears to be longer than the one which is free from disease. In the greater number of cases the affected limb presents an appearance of elongation; in a few cases it is really elongated to a slight degree; but the second stage may pass over without any change whatever taking place, either in the real or apparent length of the limb. (See *W. Coulson, Lectures on Dis. of Joints, The Lancet*, vol. ii. 1854, p. 499.)]

An actual lengthening does occur from effusion of fluid into the cavity of the joint. Mr. Coulson and many other surgeons fully believe this to be the case, but that it is not of frequent occurrence, and the elongation thus produced seldom exceeds one third of an inch. The influence exercised on the limb by the constant position of the patient, produces an apparent elongation of the limb, and this will be understood by what follows.]

The increased length of the limb, in the early, or second, stage of the present disease, is a very remarkable occurrence. The symptom is easily detected by a comparison of the condyles of the os femoris, the trochanter major, and malleoli, of the diseased limb, with those parts of the opposite member, care being taken that the patient's pelvis is evenly situated. The thing is the more striking, as the increased length of the member is frequently as much as four inches. The rationale of this fact, John Hunter used to explain by the diseased side of the pelvis becoming lower than the other. (*Crowther*, p. 266.) The same thing had also been noticed by Falconer (*On Ischius*, p. 9); and this long before the period when Mr. Crowther printed his second edition. According to Sir B. Brodie, it is easy to understand how the crista of one ilium becomes visibly depressed below the level of the other, when the position is remembered, in which the patient places himself when he stands erect. "He supports the weight of his body upon the sound limb, the hip and knee of which are, in consequence, maintained in a state of extension. At the same time, the opposite limb is inclined forward, and the foot on the side of the disease is placed on the ground considerably anterior to the other, not for the purpose of supporting the superincumbent weight, but for that of keeping the person steady, and preserving the equilibrium. Of course this cannot be done without the pelvis on the same side being depressed. The inclination of the pelvis is necessarily attended with a lateral curvature of the spine, and hence one shoulder is higher than the other, and the whole figure in some degree distorted. These effects are in general all removed by the patient's lying in bed a few weeks, except where the deformity has continued a long time in a young growing subject. (*Pathol. Obs.* p. 146.)

[Sir Astley Cooper says, in relation to the lengthening of the limb, that it is possible that an effusion into the joint may push the limb a little,



but he doubts whether this has any influence in producing an elongated appearance of the limb. Mr. Lawrence, who has given a good description of the lengthening of the limb, says, that in the earlier period of the disease we sometimes find the limb longer than that on the sound side, and sometimes shorter. This is only apparent. It depends, he observes, on the position of the pelvis; hence, when the lower extremity of the affected side appears to be longer than that of the other, we shall find that the anterior superior spine of the ilium on that side is so much lower than its fellow; if the extremity of the sound side appear to be the longest, we shall find that the anterior superior spine of the ilium of that side is lower down than that of the affected side. (*Lectures in the Lancet*, p. 484.)]

The deformity of the spine was first pointed out by Dr. Albers of Bremen, in his work on Coxalgia. That the early stage of this complaint is sometimes attended with an appearance of shortening instead of lengthening of the limb, has been dwelt upon by Volpi, Albers, Sir Benjamin Brodie, Mr. Lawrence, and many others. Mr. Coulson thinks it probable that the head of the bone may occasionally be drawn by the muscles to the upper edge of the acetabulum, and the already lengthened limb shortened, without the head of the femur being pushed back into the acetabulum. (*Op. cit.* p. 55.) It is added, that in this case, the shortening is never so considerable as in a later stage.

Though there may be more pain about the knee than the hip, at some periods of the malady in its incipient or first stage, yet the former articulation may be bent and extended, without any increase of uneasiness; but the os femoris cannot be moved about, without putting the patient to immense torture.

The patient soon gets into the habit of bearing the weight of his body chiefly upon the opposite limb, while the thigh of the affected side is bent a little forward, that the ground may only be partially touched with the foot. This position is found to be the most comfortable, and every attempt to extend the limb occasions an increase of pain.

[The third stage is characterised by the gradually increasing severe pain, which impedes every motion of the joint, particularly that of extension. This pain is also violent during the night, preventing rest; the slightest movement of the joint causes agony, and the patient is confined to bed, or hobbles along with difficulty upon crutches. In many cases, however, even in this stage, the pain in the hip is masked until the precursory symptoms of suppuration make their appearance. Constitutional disturbance is now observed perhaps for the first time, and ushers in this stage of the disease. The pain in the joint is aggravated, febrile symptoms continue; there are frequent shiverings with painful startings of the limb; the patient's rest is disturbed, and he is distressed from starting and catching in his sleep. Suppuration now takes place sometimes in the cellular tissue external to the joint, sometimes within the joint itself, in which latter case the capsular ligament soon gives way, and the effused matter gradually makes its way to the surface. (See Mr. Coulson's *Lectures on Dis. of Joints*. *The Lancet*, vol. ii. 1854, p. 500.)

The extremity becomes really shortened in this stage from ulceration, absorption of the head of the

thigh-bone, or from destruction of the margin of the acetabulum, whereby the cavity becomes shallower and wider, which permits of the limb being drawn up, or from deep ulceration of its socket, which, as has been previously shown, in extreme cases, has been found perforated by the head of the femur; or lastly, dislocation of the latter may occur. This last process is not so frequent as has been supposed by surgeons, and the latest writer on diseases of the joints (Mr. Barwell) asserts that spontaneous dislocation of the hip-joint is uncommon in comparison to the frequency of its absence. (*Op. cit.* p. 317.) Mr. Liston says that shortening does not often take place from dislocation, and Dr. Bauer also insists upon its rarity. When the dislocation has occurred it takes place usually but not always upon the dorsum of the ilium.]

In Mr. Coulson's work is an excellent drawing taken from a case of dislocation of the head of the femur on the dorsum of the ilium from the effects of disease. (*On the Dis. of the Hip-joint*, pl. 6. 4to. London, 1837.) In rarer cases, the head of the femur, after being dislodged, has been drawn downwards and inwards on the foramen ovale. In still rarer cases the head of the femur is drawn forward and rests on the pubes, the knee and toes being turned outwards. (See *W. Coulson's Work*, p. 40.)

In some cases, indeed, the shortened state of the limb arises from an actual dislocation of the head of the thigh bone, in consequence of the destruction of the cartilages, ligaments, and articular cavity.

In University College museum is a fine specimen of the termination of the disease in a new joint, the articular cavity being formed in the upper portion of the femur and a new ball on the ilium. The old acetabulum is nearly obliterated, and near it, within the pelvis, the remains of the cyst of an abscess. I obtained this preparation from the body of a woman who died in the neighbourhood of University College Hospital. I believe it to be the only one of the kind in London.

A case is mentioned by Mr. Earle, in which the head of the bone was dislocated into the ischiatic notch. (See *Coulson on Dis. of Hip*, p. 60.) In the museum of the College of Surgeons, in London, is a preparation in which the head of the femur is dislocated from the effects of disease into the foramen ovale. Other instances of it are mentioned by Mr. Coulson (*Op. cit.* p. 61), Boyer, and Sir B. Brodie.

Mr. Coulson attended a young woman, whose thigh bones were both dislocated from disease, and who could walk about very well; and Mr. Wickham has recorded a similar case, in which the limbs are represented in the everted position, so that I infer that the new joints are formed on the ossa pubis.

[When an abscess has formed, instead of appearing in the thigh, it may make its way into the pelvis through ulcerated openings in the bottom of the acetabulum. In some cases it has burst into the vagina, in others into the rectum. Occasionally it discharges into the pelvis, and thence escapes through the ischiatic notch. Mr. Pirrie met with a case in which the abscess opened into the bladder. In the acetabular form of coxalgia abscess is often one of the earliest signs of serious mischief. Abscesses usually form behind the joint

under the gluteal muscles; they may open in this situation or burrow under the fascia lata, and present on the outer aspect of the thigh below the tensor vaginæ femoris. Sinuses form in various directions; their situation and course will oftentimes lead to an accurate diagnosis of the seat and extent of the osseous disease.]

Sir Benjamin Brodie recollects no instance of an adult, in whom abscesses had formed, who did not ultimately sink exhausted by the hectic symptoms which they induced. Children may recover in this ultimate stage of the disease; but seldom without a complete ankylosis of the joint. (*Med. Chir. Tran.* vol. vi.)

[When the head of the thigh-bone has become dislocated on to the dorsum ili, a false joint may eventually form, or osseous ankylosis in a more or less faulty position may take place. If the head of the bone continue in the acetabulum without suppuration, osseous ankylosis may ensue with but little shortening of the limb. The ankylosis that generally results, however, is that known as the false kind, which may even permit of very slight motion.

Fortunate will be the patient if his disease terminate in ankylosis, for more generally, as the constitutional powers become exhausted, a tendency to organic disease sets in; the lungs and abdominal viscera become the seat of scrofulous affections, and they prove the immediate cause of death. In some cases the patient is suddenly cut off by disease of the brain, which in young subjects is probably of a tubercular character. Such cases are described by Mr. Coulson and Mr. South. (See *Mr. Coulson's Lectures in the Lancet*, already referred to.)

*Treatment of Disease of the Hip-joint.*—This will depend upon the form of the disease, the acuteness of the attack, and the severity of the local and constitutional symptoms. Those general principles must be attended to, which guide us in the treatment of inflamed joints, which have been previously considered.

Very early treatment is of great importance, as likely to ward off suppuration and its consequences, and thus effect a cure; this will consist of proper constitutional treatment, and complete rest of the limb, by means of a suitable well-fitting leather or gutta percha splint. If the case be neglected, the utmost the surgeon can do is to save the life of the patient.

In the *Arthritic* form of the disease, the treatment should consist of rest in bed, calomel and opium freely administered, and opiates at night, to prevent the painful startings of the limb. Leeches or cupping-glasses may be applied behind the trochanter, the limb must be supported on pillows, and hot poppy fomentations may be employed. After the inflammation is reduced, the joint may be fixed by means of a leather splint or starched bandage. Mr. Erichsen prefers the latter, from its easy application, and from its forming a more secure casing to the limb. It should be commenced from the toes upwards, and after it has set, a trap may be cut in it opposite any part of the joint to which it may be thought necessary to make applications. The patient will require the inhalation of chloroform to undergo the application of this or any other form of apparatus. (See *Erichsen's Art of Surgery*, ed. 3, p. 741.)

The *Femoral* or chronic form of disease of the hip-joint requires a different and less active line

of treatment. In such cases, rest and perfect immobility, by means of the starched bandage or leather splint, are indispensable; in conjunction with these, the employment of counter-irritants, more particularly the caustic issue, will be attended with great advantage; the issues may readily be applied through traps, cut in the apparatus behind the trochanter, and at the fore part of the joint opposite the pectineus muscle. At the same time a course of moderate alteratives and tonics will be found of advantage. To children, Hyd. cum creta, carb. of soda and rhubarb, with a little quinine, may be given twice a day. To adults, the bichloride of mercury, with bark or sarsaparilla, will be found useful. Should strumous disease afterwards appear, cod-liver oil, with the iodides of potassium and iron, may be advantageously substituted. (*Erichsen, op. cit.*)

The writings of Hippocrates, Celsus, Cælius Aurelianus, &c., prove that the ancients treated the chronic form of the present disease much in the same way as it is treated by the moderns. Forming an eschar, and keeping the sore open; topical bleeding, cupping, fomenting the part, &c., were all proceedings adopted in the earliest periods of surgery.

*Quibus diuturno dolor* (says Hippocrates) *ischiodico vexatis coxa cecidit, iis femur contubescit, et claudicant nisi urantur.* Forming an eschar, or issue, is one of the most efficacious plans of treating the disease even now known. A caustic issue seems to me more beneficial than a blister. The depression just behind and below the trochanter major is the situation in which surgeons usually make the issue, and the size of the eschar should be nearly as large as a crown piece. In general, it is necessary to keep the issue open a long time.

For the cure of the disease in adults, Sir B. Brodie and Dr. Albers express a preference to caustic issues; but in children, and even in grown-up persons, when the complaint is recent, they agree in thinking blisters capable of affording complete relief.

[Mr. Barwell thinks the issue and the moxa cruel remedies, but he recommends the actual cautery as by far the most efficient means of counter-irritation. Its efficacy cannot be too highly extolled, he observes, in the first stage of hip-joint disease, commencing in the bone, and when the patient is not very feeble. It is not only more efficient, but also less painful in its operation than the potassa. (See *Barwell on Dis. of Joints.*, p. 323.)

Bonnet recommends placing the limb in its natural position in the second stage, and keeping it so by means of a particular form of splint, to prevent the starting of the limb in its second stage. (*Traité de Thérapeutique des Maladies Articulaires*, p. 416.) Mr. Barwell describes and figures a special splint for this stage of the disease, but we must refer the reader to his work for a description of it. (*Op. cit.* p. 327.)]

The general health must not be forgotten throughout the treatment of this disease. The diet should be nutritious; the bowels regulated; the skin kept in good action with a flesh brush; and the apartments thoroughly ventilated. A change to the sea-side will be found an advantage as the health improves. Mr. Coulson thinks that patients derive most benefit from the sea-side, either at the commencement of the disease, or in the



third stage when the abscesses are discharging, and the health is impaired. He recommends also the warm salt water bath, three times a week, and afterwards the tepid bath; the time for bathing, in the morning. The cold or warm *douche* bath is often used in this stage of the complaint with very good effect. (*Op. cit.* p. 88.)

In some cases the patient may be allowed to move about on crutches, with the foot suspended in a sling, as in the case of a fractured thigh.

With respect to rubbing the joint with the ointment of aconitine, grs. vi. to 3 vi. of lard, see *Coulson*, *Op. cit.* p. 82. I apprehend that the friction, unless very gently conducted, would be objectionable.

The occurrence of suppuration makes a vast difference in the prognosis. "The formation of even the smallest quantity of pus in the joint, in cases of this disease, in young persons, considerably diminishes, and in the adult almost precludes, the hope of ultimate recovery." (*Brodie*, in *Med. Chir. Trans.*, vol. vi. p. 347.) This gentleman is not much in favour of opening the abscesses early, at least, before the joint has been kept for some time perfectly at rest.

[As abscesses form, most surgeons now recommend an early opening, to avoid spreading of the pus and disorganisation of the soft structures. If dislocation have occurred, and the limb be distorted in its position, especially drawn upon the abdomen, the deformity may be lessened by putting the patient under chloroform, bringing down the limb, and fixing it in a starched bandage. In this way ankylosis in a good position may be obtained, and the patient's condition be greatly improved. It is a question, however, whether this proceeding should be resorted to, in consequence of the amount of disease present. Occasionally, however, Mr. Erichsen states it may be successfully effected, and he relates a good instance in illustration. (*Op. cit.* p. 743.) If ankylosis be likely to occur, an endeavour must be made to secure it with the limb in a straight position.]

I have known so many instances of a return of the hip disease, after it had been for a considerable time apparently cured, and this from accidental blows and rough exercise of the limb, that I always recommend children who have had an attack of morbus coxarius, not to be sent to school, nor to be allowed to follow rough exercises.

Mr. J. Burns, in the second volume of his *Dissertation on Inflammations*, p. 311, has recorded a remarkable instance, in which this joint was affected with that intractable and fatal distemper, fungus hæmatodes. The case was at first supposed to be the disease of which we have just been treating in the preceding columns.

For a further account of malignant diseases of the joints, I must refer to Sir B. Brodie's valuable publication.

[For some further considerations respecting the treatment of disease of the hip-joint, see *Excision of Joints*.]

[*Stiff Joint or Ankylosis*.—This subject has already been dwelt upon in another place, and therefore we do not propose entering into its consideration further here, beyond a reference to the plan of treatment which has recently come into vogue, namely, that by forcible extension and rupture of the uniting medium, provided that be not

bone. This form of ankylosis goes by the name of spurious or false, in contradistinction to the true or osseous form, wherein the bony structure of the articulating surfaces has become fused or united into a firm unyielding and solid mass.

The most recent writer on the subject divides false ankylosis into five classes:—1. Extra-capsular adhesions, without alteration in the form of the articulation. 2. Extra-capsular adhesions, with muscular retraction, or with cicatrices, but without alteration in the form of the articulation. 3. Slight intra-capsular adhesions. 4. Slight intra-capsular adhesions, with muscular retraction and cicatrices. 5. Intra-capsular adhesions, with alteration in the form of the articulation. It will be seen that all these forms differ materially, and have resulted according to the amount of inflammation present which produced them, in various constitutions and classes of persons. It follows that the treatment of each form will vary somewhat, but it will agree in the general principles of—rupture of the adhesions by forcible extensions; section of tendons, and subsequent separation of adhesions; and gradual extension. (See *B. E. Brodhurst on Ankylosis*, 3rd ed. 1861, p. 49.) In some forms of ankylosis, the adhesions will alone yield to forcible extension; in others they will yield to forcible extension after the subcutaneous division of tendons; while again, in other cases, the adhesions will yield to gradual extension. In this plan of treatment there are some conditions which Mr. Brodhurst considers to be indispensable, and these are that the action of the voluntary muscles should be entirely suspended, under the influence of chloroform. Cicatrices, tense fasciæ, and tendons should be previously subcutaneously divided, and the punctures allowed to heal, before forcible flexion or extension is applied. In making flexion or extension, moderate force alone is to be used, with the hand only, and without instrumental aid. The adhesions should be ruptured in flexion of the limb. No attempt at the time of rupturing the adhesions should be made of restoring the position of the limb; nor, indeed, should the condition of the joint be further investigated. This is a point to which Mr. Brodhurst especially directs attention.

"Before chloroform is administered, a gutta-percha splint should be moulded to the limb; and it may be allowed to harden while the chloroform is taking effect. This splint is to be removed before extension is made, and it is to be replaced as soon as the adhesions have been ruptured; it may be worn until tenderness about the joint has ceased. When tenderness has entirely or nearly disappeared, the limb may be moved gently. This passive motion should be repeated at intervals." (*Op. cit.* p. 56.)

Under the influence of chloroform, muscular rigidity may, in a large number of instances, be so far overcome, that the adhesions may be ruptured without previous subcutaneous division of soft structures. Often, however, it is necessary to divide tendons, cicatrices, and fasciæ, before it is possible to affect the adhesions.

In all cases of partial ankylosis some muscular rigidity exists. Ankylosis of the hip causes more inconvenience than of any other joint, except that of the maxilla. For further information upon this important subject, we must refer the reader to Mr. Brodhurst's work, and to the article ANKYLOSIS.

In the former, the observations of the author are based on an experience of 114 cases.]

[*Hysterical Affections of the Joints.*—Under this heading many writers have described examples of great pain in the joints of hysterical females, which might be mistaken for some real and dangerous disease of the part. Sir Benjamin Brodie describes it as follows:—"At first there is pain referred to the hip, knee, or some other joint, without any evident tumefaction; the pain soon becomes very severe, and by degrees a puffy swelling takes place, in consequence of some degree of serous effusion into the cells of the cellular texture. The swelling is diffused, and in most instances trifling; but it varies in degree, and I have known, where the pain has been referred to the hip, the whole of the limb to be visibly enlarged from the crista of the ilium to the knee. There is always exceeding tenderness, connected with which, however, we may observe this remarkable circumstance, that gently touching the integuments in such a way as that the pressure cannot affect the deep-seated parts, will often be productive of much more pain than the handling of the limb in a more rude and careless manner. In one instance, where there was this nervous affection of the knee immediately below the joint there was an actual loss of the natural sensibility, the numbness occupying the space of two or three inches in the middle of the leg. Persons who labour under this disease are generally liable to other complaints, and in all cases the symptoms appear to be aggravated, and kept up by being made the subject of constant anxiety and attention." (*Path. and Surg. Obs.*)

Mr. Coulson observes that, in this affection, "the affected limb is liable to remarkable alternations of heat and cold; at one part of the day the limb feels cold, and assumes a purple aspect; at another, hot flushes, followed by perspiration, break out over the extremity; again, the limb does not merely feel hot to the patient, but is actually so to the touch of another, and the whole capillaries of the affected part become turgid with excess of blood." (*On Diseases of the Hip Joint*, p. 117.)

Mr. Skey has described some good examples of the disease affecting the spine and the knee. With respect to their frequency, he goes so far as to say: in three fourths of diseases of the knee-joint, occurring in young women from 15 to 25, we will find, more or less palpably, the traces of hysteria; for even the presence of real disease of the joint is no guarantee or safeguard against the existence of some symptoms really attributable to hysteria. (See the *Lancet*, vol. i. 1859, p. 257.)

The same class of affection has been lucidly described by Mr. Barwell, under the name of Hysterical Pseudo-disease of the Joints. In cases of doubt he speaks of the value of chloroform as a means of diagnosis, a fact which he believes he was the first to point out in a paper read before the Medical Society in 1858. Under its influence perfect motion, as of an entirely healthy joint, will be restored. There is a point, however, which he has known to mislead in diagnosis, namely, a certain crepitation in the joint complained of. "Now many boys, as well as girls, arrived at puberty, or at the period of rapid growth, are subject to a peculiar crackling at the joints, chiefly the knee,

hip, and maxillary articulation. This is quite painless under healthy circumstances, and children frequently amuse themselves with the odd sensation it produces. But if the individual be a girl, who, verging on puberty, becomes weaker with chlorotic tendency, this crackling is very apt to continue in one of the joints, and at last to become the secondary cause of a neuropathy fixing itself in a certain part, and gradually assuming the character of an hysterical joint. Thus then, we may find in such a malady a certain amount of crackling, comparable to rubbing together two surfaces of parchment, of coarse silk, or of crape, and which is not like any of the crepitations in joint disease, except an early stage of hydrarthrosis." (*On Disease of the Joints*, p. 371.)

Occasionally, though rarely, hysterical pseudo-disease of a joint goes so far that a sort of imitation of "starting of the limb" comes on, of which, in some cases, the patient complains, as causing great pain, and which in others is perfectly painless. No surgeon will for a moment mistake this phenomenon for the starting pain occurring in other really acute diseases; but the differences are worth recording, if merely for their curious physiological character when regarded in connection with the true symptom. In most cases the hysterical movements only come on when some one is present, though the patient may affirm them to be constant, which they rarely are. They are rhythmical, sometimes recurring with immense rapidity, sometimes synchronous with the pulse. But the circumstance most worthy of note, is that they cease during sleep, even before consciousness is altogether lost, and they do not return until the patient is fully awake in the morning. Now, the starting of the limb from articular inflammation is always worst just as the patient sinks to sleep, when the controlling power of the will is withdrawn. This difference in the time of occurrence marks their several origins; the one is dependent upon the cerebrum, the other, independent, even requires the withdrawal of its power.

Mr. Bryant lays some stress on the value of chloroform as an aid to diagnosis, for when insensibility is produced, not a single symptom of disease will be detected, and free mobility and signs of a healthy joint will clearly prove the character of the malady. He also, in common with Sir Benjamin Brodie, Barwell, and others, has met with this disease in males as well as in females, although, of course, it is more frequent in the latter.

The treatment must be of a general character, directed especially to re-establish a healthy condition of the uterine organs. If there be amenorrhoea and anæmia, aloectics and the preparations of iron must be given; if uterine irritation or ulceration exist, these must be removed by proper local means, and the general health attended to. The most efficient treatment that can be directed to the affected joint, is, Mr. Erichsen believes, the application of cold douches, and the employment of electro-magnetism, which he has found to cure cases in which all other means had failed; the application of atropine and aconite may be of service to allay the pain when especially severe.

If unfortunately this affection is treated for a diseased or injured joint, as has sometimes happened, by the employment of antiphlogistic measures, the general symptoms will necessarily



become aggravated. Hygienic remedies are considered to be more valuable than local. "The patient should have fresh air, generous living, and plenty of occupation for mind and body; she should be encouraged to take exercise, notwithstanding pain and weakness, and to resume, as far as possible, the habits of a healthy person."

Local sedatives applied in the form of the strong solutions of opium, are advised to be freely employed by Mr. Skey, who has found them most valuable. As a sedative agent, he thinks the common tincture of opium of little avail. An immediate resort to the extract of opium, he recommends as preferable, and will be found in the semi-fluid form, a valuable agent in most varieties of local pain of the neuralgic kind.

In certain cases it is necessary to excite some powerful emotion in the patient's mind, to which the morbid condition will readily succumb, if we can succeed in raising it. Fear is the most effective agent; but in the case of a vain woman, the gentler remedy of ridicule will suffice. "If you would bring an attack to a sudden termination, you must operate through the mind, not through the body. These people are remarkably insensible to physical pain, but their ears are open to the powerful agency of ridicule. I remember the case of a young lady, in whose mind a sense of indignation was impressed by certain offensively cutting remarks that moved her vanity to the utmost. She ceased to sob, the colour rushed to her cheeks, and she burst into a flood of natural tears. The disease had passed away. In all similar examples of hysteria, whether taken singly or congregated in sympathetic groups, kindness is thrown away; at least, it may tell for what it is worth, but it does not lead in the direction of cure. You will do far better if you can produce a shock on the mind, if you excite any powerful mental emotion, and still more efficiently by a painful one." (See *Mr. Skey in the Lancet*, vol. i. 1859, p. 259.)

In many cases, almost any form of treatment, whether mental or bodily, proves fruitless, and hence the notorious character which this affection has obtained. The hysterical joint is often observed too, in strong florid girls, who suffer from no menstrual or leucorrhæal disorder. It is expedient, therefore, to endeavour sometimes to draw away the patient's imagination from the spot whereon it is fixed. For this purpose, Mr. Barwell has made use of a plan, which he has found useful in cases where the patient's confidence rests fully in the attendant, and some real desire to recover exists. The value of the plan lies in calling the person's mind away from the affected spot of the body, and establishing a firm belief that when a certain event takes place the pain will cease. He has used a single-thread seton, through a small fold of skin, at some considerable distance from the seat of pain, and has endeavoured to make his patient firmly believe that when the silk comes away the pain will leave her. This has proved successful in many instances. (See *Barwell*, op. cit.)

We must observe, however, that there are many cases of pure neuralgia of joints which are wholly independent of any hysteric condition.]

[*Secondary Inflammation of Joints*.—Under this name Mr. Coulson has described a class of diseases of the joints arising from blood-poisoning. Taking the primary affections with which the articular

disease may be associated, as the basis of his classification, Mr. Coulson formed seven classes or groups of secondary diseases of joints. The first comprehended such as follow serious operations and injuries, as amputations, wounds, injuries of the head, &c. In the course of his description of this group, Mr. Coulson expresses the following opinion:—"That in every case the poisonous agent is purulent matter, either secreted by an inflamed vein or lymphatic, or taken up from an abscess &c., and that poisoning occurs when the pus becomes mixed with the general circulation; that there is an acute and chronic form of pyæmia; that the secondary affections which occur in the course of the latter, have a tendency to affect the subcutaneous tissues rather than the internal viscera, and are often prolonged to a considerable period." The second group included those cases connected with the puerperal state. The third group comprised those connected with operations on the genito-urinary organs of the male. The fourth group comprehended gonorrhœal rheumatism, which affection he considers to be distinguished from all other forms of secondary joint disease by its not being accompanied by constitutional symptoms. The fifth group comprised the secondary articular affections which accompany exanthematous disorders, as scarlatina and smallpox. Mr. Coulson describes two forms, one very mild, subsiding spontaneously in a few days; the other purulent and resulting in most extensive destruction of the joints. The sixth group includes the effects of morbid animal poisons, as glanders, farcy, the viper poison, the poison of decomposed animal matter, the effects of dissecting wounds, &c. The seventh class comprised that purulent affection of the joints occasionally met with in new-born children, which may depend upon hereditary syphilis or inflammation of the umbilical vein.

For the origin, progress, symptoms, and results of these various affections we must refer the reader to Mr. Coulson's paper in the *Med. Chir. Tran.* vol. xxxviii. and *The Lancet*, vol. ii. 1855, p. 496. And also to the article PYÆMIA.]

Mr. McDowal has published some observations on synovitis, connected more or less with periostitis. He met with several cases, attacking different articulations with great rapidity, and causing death, apparently by exciting pulmonary or cerebral inflammation, the affections of the joints and periosteum remaining throughout undiminished. The disease did not shift from one joint to another; but continued in the articulation first affected, when another was subsequently engaged. Where the periosteum was implicated, the inflammation obviously extended to it from the joint. The disease too frequently terminated fatally, not seeming to be influenced by the treatment ordinarily adopted in inflammation of joints and fibrous structures. It occurred with and without injury, and may therefore be considered as either idiopathic or symptomatic. The patients were invariably young, being from ten to twenty-two years of age. In several instances they had been exposed to cold, and engaged in labour beyond their strength. In one case it followed the disappearance of scarlatina maligna. In every instance the symptomatic fever was violent, and characterised by great depression, anxious and flushed countenance, moaning or screaming, more or less delirium, rapid pulse, short respiration and slight cough; sometimes there

was bilious vomiting, tenderness and fulness of the epigastrium, and always constipation and highly-coloured scanty urine. The constitutional symptoms, viewed in connection with the local, strikingly resembled those accompanying phlebitis. Dr. McDowal describes the *post mortem* appearances, and refers to the inefficiency of ordinary treatment. (See *Dublin Jour. of Med. Science*, vol. iii. p. 332, and vol. ii. p. 1.)

Dr. McDowal's description corresponds to that of Mr. Coulson, and applies to the same class of affections which are clearly the result of poisoning of the blood, and now recognised as pyæmia.]

Thomas H. Wakley.

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**JOINTS, EXCISION OF.** This operation consists in the removal of the parts of bones, entering into the formation of a diseased joint, together with the whole of the capsular ligament and synovial membrane. "It has a two-fold object: the first is to remove a formidable disease, and this might be effected by amputation; the second is to preserve a useful limb, and this amputation could not effect. The fact in morbid anatomy, on which the proposal mainly rests, is, that, in the large majority of the ulcerative diseases of joints, the bone is either primarily affected or becomes so secondarily." (See *Blackburn*, in *Guy's Hospital Reports*, vol. i. O. S. p. 277.)

[The first notice of any case of removing a portion, or the whole, of a diseased joint, is reported by Dr. John Daniel Schlichting in 1742; the head of the thigh bone was extracted in a case of hip-joint disease by a surgeon whose name is not mentioned. (*Phil. Tran.* vol. 42. p. 274, and *Barwell, Diseases of Joints*.) Mr. Wainman, of Shripton, excised the ends of the bones, in a compound dislocation of the elbow in 1758. (*Erichsen, Science and Art of Surgery*, ed. 3, p. 697.) In 1762, Mr. Filkin of Northwich, in Cheshire, removed the patella, along with the articular extremities of the femur and tibia in a case of diseased knee (see *Dr. Jeffray's Cases of Excision of Curious Joints*, Glasgow, 1806.) A similar operation was performed on the shoulder in 1767, by M. Vigaroux of Montpellier. (*Œuvr. de Chir. Pratique*, Montpellier 1812.) This was followed by one at the same joint by Daniel. (See *South's Chelius*, vol. ii, p. 969. In 1768 Mr. White, of Manchester, removed the diseased head of the humerus for caries. (See *White's Cases and Obs. Phil. Tran.* vol. lix.) In 1771 White's practice was imitated by Mr. Bent of Newcastle, and in 1778 by Mr. Orred of Chester, who removed the head of the humerus in a carious condition. (See *Phil. Tran.* vols. lxiv. and lxix.) With the exception of the cases of Mr. Wainman and Filkin, however, in all these examples only one articular surface was removed. The merit of suggesting the operation, as defined in the first sentence of this article, unquestionably belongs to Mr. Henry Park of Liverpool. In 1782 he published a letter to Mr. Pott, wherein he made the proposal of wholly extirpating many diseased joints, by which the limbs might be preserved, with a share of motion that would still allow them to be very useful.

Mr. Park first operated, July 2nd, 1781, on a strong robust sailor, aged 33, who had a diseased



knee of ten years' standing. This now well-known case, was successful. Subsequently to the publication of Mr. Park's letter, he performed another excision of the knee on the 22nd of June 1782, but the event was unsuccessful, as the patient lingered till the 13th of October, and then died.

In 1782, the year following that of the publication of Mr. Parks' pamphlet, the subject was brought before the Academy of Surgery in France. In 1775 Justamonde excised the elbow. In 1786, M. Moreau excised the head of the humerus and the glenoid cavity. In 1792, he operated on the elbow, and he and his son, several times, excised the articular surfaces of the knee, ankle, shoulder, and wrist. Their example was followed by Sommeiller and Baron Percy. In 1809, Mulder, of Groningen, cut out a knee joint. (See *Wachter, Diss. de Articulis extirpandis*, 1810.) In 1819, M. Roux, of Paris, performed the excision of the elbow. (See *Revue Méd.* 1830.) In 1823, the same operation was executed by Sir Philip Crampton, who has likewise excised the knee with success (see *Dub. Hosp. Reports*, vol. iv.); and in 1825, by Mr. Syme, who had excised the elbow in 14 cases.

[In 1805, Mr. Park, in another publication, expresses his mortification that this operation had not met with the success in this country which it deserved, and he observes that if it had not been for the Moreaus in France, it would have fallen into complete oblivion. Many successful cases were, however, performed both in Germany and France; though the practice fell into disuse for a time in England, so that Sir P. Crampton's operation in 1822, and Mr. White's, at the Westminster hospital (the removal of the head of the thigh bone in the latter), were considered quite a revival of the method. For the last revival of excision of joints, British surgeons are indebted to Mr. Syme, and for its present extension to Mr. Fergusson, more especially in the larger and more important articulations.]

Since their revival and extension, these operations have continued to gain in favour, and are now, we may say, constantly applied to all the articulations without any exception. It is possible, as Mr. Barwell mentions in his work (*On Diseases of the Joints*, p. 416), that several fluctuations will yet occur before their value is definitely fixed, yet when we remember that they now constitute that department of surgery which has been termed the *conservative*, or, more correctly, the *preservative*, according to Mr. Erichsen, there is good ground for believing that they have become as much established in suitable cases requiring their performance, as amputation is in those instances when the limb cannot be saved.

Mr. T. Holmes observes, on the subject of excision of joints: "In the upper extremity, almost any excision which affords a prospect of preserving to the patient the motion of the elbow, of the hand, of the fingers, or, perhaps, even of the thumb only, is to be preferred to amputation, even although the patient may not recover useful motion in the joint operated on, whether it be the shoulder, or the elbow, or the wrist. There is, however, a limit to the application of this rule, since a limb which swings useless, like a flail, may prove more of an annoyance than an advantage. In the hip, no question of amputation for disease ever occurs, under ordinary circumstances, in any case where excision is possible; and in gunshot injuries,

which are almost the only cases in which the operations are pitted against each other, the nearly uniform fatality of primary amputation at the hip, in modern military surgery, gives the surgeon a decided leaning to excision. In the knee the question is more difficult, and the advantages of the stiff limb, left after even the most successful excision, over the artificial substitute (especially in the case of a wealthy person who can afford to purchase the ingenious artificial limbs now manufactured), are not so great as to balance, in the minds of some surgeons, the increased danger to life which (as I fear we cannot help admitting) the operation entails, combined with the risk of failure, and of the necessity for consecutive amputation. But there seems every reason for thinking that excision of the knee will soon be generally adopted in patients otherwise healthy, when the disease is only of limited extent, so as to be curable by the removal of thin slices of the affected bones."—*System of Surgery*, vol. 3. p. 8.

We may briefly mention the conditions which call for excision in preference to amputation. Caries and necrosis of the joint-ends of the bones, where the pain and discharge are so excessive that the patient would ultimately sink from exhaustion. In certain incurable states of disease of the membranes of the joints wherein the surrounding soft parts are in a healthy condition. When amputation is not practicable, as in disease of the hip-joint, and of the temporo-maxillary articulation. In crushing of one or more of the joint ends, without splintering of the body of the bones or injury to the main vessels and nerves; in certain wounds of the joints with lodgment of balls, and in bad compound dislocations and fractures, especially in those of the head of the humerus and of the elbow, excision may be resorted to in preference to amputation. In true osseous ankylosis of certain joints, as the knee and elbow, in which the limb is in a faulty position, the joint may be excised in the manner first practised by Dr. Rhea Barton of Philadelphia, and since followed both in the knee and elbow by Mr. Fergusson, Mr. Erichsen, Mr. Price, and many other surgeons in this country. Of course there are many circumstances which will regulate the nature of the operation; for instance, if the external soft parts are too much involved, it would be useless to adopt excision: the same rule applies to the constitutional powers of the patient, for if he be highly strumous, or decidedly phthisical, he will not be able to bear up through the long convalescence which follows resection. In the extremes of life, resection is inadmissible.]

[*Excision of the Shoulder Joint.*—Velpeau remarks that in 1740, Thomas, of Perzenas, had successfully extracted the head of the humerus. (*Méd. Opératoire*, vol. ii. p. 703.) This case is related by Mr. Guthrie in his work on gun shot wounds. The surgeon had enlarged the opening into an abscess; two or three days after the necrosed end of the bone presented at the wound. In 1767 this operation was repeated by M. Vigaroux and M. David, and in 1769 by Mr. C. White of Manchester. In the last case the head of the bone was removed for caries, subsequently four inches of the end of the humerus exfoliated, yet there was only an inch of shortening, which Mr. White attributed to the weight of the limb

dragging it down, as "it was only suspended by a common sling, and the patient not at all confined to his bed;" the cure was a good one, for the patient could afterwards carry heavy weights, and regained every motion of the arm. (See *White's Cases and Obs. Phil. Trans.* vol. lix.) This joint was excised by Mr. Bent of Newcastle, in 1771, and by Mr. Orred of Chester, in 1778, for compound dislocations of the humerus.

In 1786 M. Moreau of Bar-sur-Ornain excised the head of the humerus and the glenoid cavity; this was one of the very few examples in which the whole joint was excised, for although excision has frequently been performed of late years in this joint, it has been mostly confined to decapitation of the humerus. In the operation, however, there is this similarity to that of the hip-joint: if the glenoid cavity participates in the disease it can be gouged away, as is frequently done in the acetabulum, and should the disease be extensive the glenoid cavity can be entirely taken away by the cutting forceps.

In studying the statistics of excision in the shoulder, it soon becomes apparent that in the great majority of cases it has been performed for fracture of a compound and comminuted character, the result of gun-shot injury. Disease in the articulation is of comparatively rare occurrence, and the cases which present themselves in practice, are those in which the disease very often is confined to the bony structures surrounding the joint, as the acromion and coracoid process of the scapula, or the spine of that bone. The operation for disease has however been very frequently done in civil practice, and with such results "that it is justly esteemed one of the most legitimate and brilliant operations of modern surgery." (See *Fergusson's Practical Surgery*, ed. 4, p. 304.) In military practice, the success of this operation has been astonishing; in 14 cases related by M. Baudens as occurring in the Crimea there was but 1 death; and of 14 cases in the British army, 12 recovered. Mr. Barwell (*op. cit.*) refers to 84 cases collected by Paul, in which there were 23 deaths.

In performing the operation, removal of the head of the bone has been accomplished in various ways. White made a single longitudinal incision; Moreau made a square shaped flap, one incision in front of the articulation, another behind, both being united above by a transverse division of the deltoid a few lines below the acromion. Other surgeons practised different forms of incision; Sabatier recommended a V incision. It may resemble a T or an 7; but as Mr. Fergusson observes, the surgeon ought not to limit himself to any one mode of procedure; but should rather, trusting to his anatomical and manipulative skill, adapt his measures to the peculiarities of the case.

The operation may be performed as follows: a semi-lunar flap is to be made about three inches in length, commencing at the posterior part of the acromion, cutting across the deltoid, and terminating at the inner side of the coracoid process. By a few touches of the scalpel, a large flap composed of the deltoid muscle may be raised, and the articulation fully exposed. As the capsule and ligaments are destroyed by the morbid action, the head of the bone may readily be turned out of the glenoid cavity; and, being freed by a few touches of the knife, and isolated by passing a

spatula behind it, may be removed with a narrow saw. In doing this care must be taken to encroach upon the healthy shaft of the bone as little as possible. The glenoid cavity must now be examined, and any affected part carefully gouged away. (See *Erichsen's Science and Art of Surgery*, p. 702.) The flap must now be adjusted, and its edges brought together by several points of suture; the arm is to be well supported in a sling, with the elbow sufficiently raised. Very little disturbance ensues, the wound unites by granulation, and in the course of two or three weeks the patient may be allowed to sit up with his arm in a sling. Usually a very good arm is obtained with a false joint, the limb becoming drawn upwards to a slight extent. On the whole it proves the most successful of all the excisions].

*Excision of the Elbow Joint.*—[The operation of excision of the elbow was first done by Mr. Wainman of Shripton, in 1758, in a compound dislocation of the joint. In 1775 the olecranon and two inches of the ulna were cut out by M. Justamond for diseased elbow joint. In 1782, Mr. Park of Liverpool proposed to excise the elbow and other joints, and in his paper detailed the steps of the operation on the dead body.] In the same year, 1782, in an elbow case operated upon by M. Moreau, the patient went on so favourably, that he was allowed to go about wherever he pleased, with his arm supported in a case. The limb was at first powerless, but it slowly regained its strength, and the man could ultimately thrash corn with it, and hold the plough. Seven months after, in another operation of the same kind, performed by M. Moreau the father, the patient was completely well, and in two years more, the flexion of the arm was very distinct. In another case, the patient got well in six months, and in three months more joined his regiment. In all Moreau's cases, the flexion and extension of the fore-arm were preserved, which circumstance, no doubt, depended very much on the insertion of the biceps not being destroyed. After the excision of the knee, however, the bones grew together.

[The elbow joint has now been so frequently excised, that it would be a superfluous task to enter into a detail of the names and number of cases in which surgeons have resorted to it. The records of surgery show that it has been extensively practised in all countries, with a very large amount of success, and with such results as gave in the great majority of instances good and useful arms to the patients, with a false joint possessing all the different powers of motion.]

There is not, in reality, a new joint with a capsule formed, but the ends of the bones become connected by ligamentous fibres, and a sufficiently firm substance is produced to serve as a fixed point for the muscles, which execute the flexion and extension of the forearm. (See *A. Velpeau, Nouv. Elém. &c.* t. i. p. 564.)

["To M. Roux and Sir Philip Crampton," observes Mr. Fergusson, "we may be almost said to be indebted for the revival of excision of the elbow; but to no one, so far as I am aware, is there so much merit due on this score as to Mr. Syme, who has, I believe, within the last thirty years had more personal experience in this proceeding than any other practitioner." (See *Fergusson's Prac. Surgery*, ed. 4, p. 297.)



The following observations were recently made by Mr. Syme upon excision of the elbow joint:—

“There is no operation in which the mode of making the incision is of more consequence. Unless they be sufficiently free, the portions of bone cannot be removed without risk of injury to the remaining parts, and unless they be properly directed, the resulting cicatrices will interfere with the free motions of the limb; and we are not satisfied here with the result unless there be perfect flexion, extension, and rotation, with the full natural amount of strength. I believe the only incisions by which this perfect result can be obtained are those originally practised by Moreau, which are, a transverse one, carried across the back of the articulation immediately above the olecranon, from the ulnar nerve to the external condyle, and two longitudinal through the extremities of the transverse, so that the incision altogether has the form of the letter H. When the flaps have been raised, free access is gained to the articulation, and when the operation is completed, the edges of the transverse incision, if brought accurately together, generally adhere by first intention, instead of healing by granulation and adhering to the bone, so as to prevent free motion. Having dissected up the flaps, do not attempt to remove all the articulation at once, as otherwise there will be a risk of cutting the ulnar nerve, with consequent deficiency of sensation and atrophy of the limb; but having exposed the olecranon, cut it off in the first instance, so as to get free access to the joint, then divide the external lateral ligament, and having pushed the ulnar nerve over the inner condyle, free the end of the humerus and saw it off on a line with the tuberosities; and, lastly, remove in succession the ends of the radius and ulna on a line with the base of the coronoid process. More than the extent thus defined would be unnecessary and injurious, while less would hardly remove the disease, and even if it did, would incur the risk of ankylosis.” (See *Syme's Lectures on Clinical Surgery in the Lancet*, vol. i. 1855, p. 231; also *Treatise on the Excision of Diseased Joints*, 8vo. Edinb. 1831; and *Principles of Surgery*, ed. 4.)

It is seldom that there is any bleeding of consequence, occasionally it becomes necessary to tie two or three vessels. The wound is now to be closed by sutures; and the arm laid in a semi-flexed position upon a well-padded angular splint. Or a box may be used with moveable sides, as recommended by Mr. Butcher of Dublin. In many cases a stiff arm has resulted from the operation; this it is important to guard against if possible, and with the view of obtaining a false or new joint in this locality, Mr. Fergusson and many other surgeons employ an instrument invented by Mr. Christopher Heath, and which is called Heath's splint, which serves to prevent the bones from coming into close contact, and yet permits of flexion and extension. (See *Fergusson's Prac. Surgery*, ed. 4, p. 303.) A description of this splint, with a drawing, is given in a report of several cases of excision of the elbow joint in the *Lancet*. (See vol. ii. 1857, p. 546.)

In that report, three cases are detailed, in which excision was performed through a longitudinal incision, with the most satisfactory results. Now, although every form of incision is practised, the single longitudinal incision has latterly received the preference in the hands of Mr. Pirrie of Aber-

deen, Mr. Fergusson, and many others. In adopting it, the soft parts are left in the best possible state for steadying the cut ends of the bones. Mr. Erichsen employs the T incision, but has occasionally adopted the longitudinal.

When the reparative stage has fairly set in, passive motion should be used from time to time so as to insure the formation of a false joint. Upon the care and attention bestowed in the after treatment will depend much of the success in the result of the operation.

Of cases which have been dissected some years after the operation, the ends of the bones have been found rounded and smooth, and firmly united by a dense fibroid or ligamentous structure, permitting of all the movements that occur in a healthy joint. A good dissection of the kind by Mr. Lister is given in Mr. Syme's clinical lectures previously referred to.

Excision of the elbow, although most frequently required for disease, is sometimes performed for compound fractures and dislocations, and for osseous ankylosis in a faulty position. We have now seen it done many times for the last condition, and with equally good results as when resorted to for disease alone. But it was not practised for ankylosis till long after it had been adopted for disease. On this point Mr. Syme observes that he had operated more than a hundred times for disease before he did so for ankylosis. “Though often requested to excise the joint under these circumstances,” says Mr. Syme, “I had not been prepared to interfere with the healthy integuments merely for the convenience of the patient. But at last a young man from the Highlands of Perthshire came to consult me, with both arms permanently extended, one immovably so, and the other admitting of but a very slight degree of motion at the elbow; resulting in the one case from fracture with dislocation, in the other from dislocation only. It is impossible to imagine a greater degree of helplessness than this young man's, who was obliged to seek assistance in the performance of the most ordinary offices. This case called loudly for interference, and I performed excision of one elbow. The result was an arm so perfect that it could not be distinguished from a sound one till his sleeve was removed.” (See *Lectures on Clin. Surgery*, *Lancet*, vol. i. 1855, p. 231.)

This operation is asserted to be most successful in young patients; the records of surgery, however, give ample proof of its advantageous employment in adults. The experience of most hospital surgeons has been extensive in this operation, and although there are no regular statistics of it published, this we believe is in consequence of its being looked upon as almost invariably successful in its results. Bad consequences have certainly followed some examples, but in these amputation would not, in all probability, have been attended with better results.]

[*Excision of the Wrist Joint* was first performed by Moreau, revived by Mr. Fergusson in 1851, and has been occasionally practised of late years by Stanley, Butcher, Erichsen, and other surgeons. Of all the joints submitted to resection, this promises to be the least satisfactory, for the results hitherto have been by no means what were anticipated. A successful case appears recorded here

and there, but there is no motion at the wrist, and in some cases the fingers have remained stiff. Resection of the wrist, however, is believed to be worthy of further trial, and Mr. Fergusson writes "in whatever state the hand might be left, I believe it would prove more valuable, in all respects, than any artificial substitute." He considers a hand with a stiff wrist as decidedly better than no hand at all, an opinion in which the majority of surgeons will fully agree.

The kind of operation will very much depend upon the amount of disease present. If it is confined to a few of the carpal bones, they are easily enough removed by the extension of any fistulous openings over them. When the lower ends of the radius and ulna are involved, a different operation is required.

Mr. Fergusson practises a single incision on the ulnar side of the joint, about six inches long, which he thinks affords ample room between the flexors and extensors, without dividing a tendon of either, to remove the whole of the carpal bones, and even the articular surfaces of the bones of the forearm, or of the metacarpal range. He recommends the cutting forceps to divide the bones, in preference to the saw. There is but little risk of hæmorrhage, and in the event of any interosseal or other branch being wounded, there will be no difficulty in applying a ligature. (See *Fergusson's Pract. Surgery*, ed. 4, p. 295.)

Mr. Erichsen recommends and practises a horse-shoe flap, with its convexity downwards on the dorsal aspect of the joint, to be dissected up without dividing the extensor tendons of the fingers; the articulation is thus freely exposed; the carpal bones may be removed, and the lower ends of the radius and ulna clipped off. (See *Science and Art of Surgery*, ed. 3, p. 708.)

In the case of a boy operated upon by Mr. Stanley, he made a semicircular incision above the wrist, turning back a considerable flap, together with tendons and integuments; he thus excised seven bones of the wrist and the flap was replaced. (*The Lancet*, vol. i. 1855, p. 288.)

Mr. Simon excised the wrist of a boy, by means of two long incisions on the anterior and posterior aspects of the joint, reaching a couple of inches above the wrist, back and front, to the centre of the palm and dorsum of the hand, the incisions being so managed as to run between the tendons coursing down to their destination.

Of all the different operations, however, which have been performed for excising the wrist, including a longitudinal incision on either side of the joint, preference is given to that practised by Mr. Butcher of Dublin, and which is called by his name. In his patient the wrist was excessively swollen, with numerous discharging sinuses around; the radio-carpal articulation grated on motion; a probe introduced into almost any sinus came into contact with roughened, crumbling, and broken-down bone; but the metacarpal bones and phalanges, the flexors of the fingers, and all the powers of the thumb were unimpaired. A curved incision was made, commencing a little below the wrist, two lines on the ulnar side of the extensor *internodii pollicis* tendon, going close to the carpal extremity of the metacarpal bones, and then sweeping upwards so as to finish below the end of the ulna fully half an inch higher up than the point where it began. "The flap thus marked

out was rapidly dissected up, and consisted of the integuments, areolar tissue, and extensor tendons of the four fingers, together with large deposits of fibrine." The diseased bones were at once brought into view; the soft parts were next liberated from the back of the radius and ulna, together with the second extensor of the thumb, from the osseous groove in which it lay. By forcing down the hand the carious ends of the radius and ulna were made to project, the soft parts were cautiously divided close to the bones, so as not to injure the radial and ulnar arteries, and the ends of the bones were then removed by the saw which goes by Mr. Butcher's name. The next proceeding was to remove the carpal bones, excepting the trapezium, which was healthy; the flaps of the wound were now placed in position, properly secured, and the hand and arm placed upon a padded splint in a prone position. (See *Mr. Butcher's papers on Excisions of Joints*, in *Dublin Quar. Jour.* for 1855 and 1859.)

Although the wrist often remains stiff after resection, the advantage of Mr. Butcher's operation is, that it leaves the extensor muscles of the thumb intact; the fingers become stiffened in a bent position, yet, with the aid of the thumb, they are available for writing and many other purposes.

As showing the advantages of the operation, a middle-aged man, in whom Mr. Erichsen removed the whole of the carpus and a portion of the metacarpal bones, recovered with a very useful hand, with some power of flexing and extending the wrist, and with very considerable mobility of the fingers. Such good results, however, are rare, the great obstacle to success being the superficial character of the articulation, and the close connection between the flexor and extensor tendons. This it is which explains the consolidation of all the parts during the process of cicatrisation, and the necessary impairment of the utility of the hand, which it is so desirable to retain, if possible.]

[*Excision of the Hip Joint.*—In 1742, for the first time, this important operation was resorted to as mentioned by Dr. Schlichting. (*Phil. Tran.*, vol. xlii.) This case was unknown until within the past year. The operation was proposed (but not performed) by Mr. Charles White of Manchester, in 1769. In 1818, Mr. Anthony White excised the hip joint at the Westminster hospital.]

The patient was a boy whose femur had been dislocated from disease of the hip, the head of the bone lying on the dorsum of the ilium. There were several fistulous openings in the hip through which the bone could be detected in a state of caries. He had suffered from the disease for three years, and was in an exhausted condition. Mr. White, reflecting that the original structure of the joint had been annihilated, that the boy would die if no attempt was made to get rid of the diseased head of the femur, and, even if he lived, the limb fixed in this manner across the other would be an incumbrance only, determined to operate. Being assisted by Mr. Travers, he cut down upon, and exposed the head and neck of the femur, and having sawn through the bone just below the trochanter minor, he raised the detached fragment with an elevator, and extracted it. At the end of a year he recovered, and so useful a new joint had formed, that with the assistance of a high-heeled shoe he could walk well, and execute the common



movements of the limb. He lived five years afterwards, and died of phthisis. [The parts were removed after death, and were placed by Mr. Anthony White in the Museum of the Royal College of Surgeons. An examination of the joint shows the cotyloid cavity to be filled up by firm fibrous tissue, which at the same time binds the femur and os innominatum strongly together, and yet permits of tolerably free motion.]

Five years later, in 1823, a Mr. Hewson of Dublin repeated the operation, and in 1836 it was performed by Sir Benjamin Brodie. It then remained in abeyance in this country till the year 1845, when it was revived by Mr. Fergusson, in the case of a boy, aged 14, who was gradually sinking from disease of the hip. The head of the bone was dislocated on to the dorsum of the ilium, and could be felt through the soft parts lying in that situation. Excision of the joint was attended by the most complete success. (See *Med. Chir. Tran.* for 1845.) In 1858 Mr. Fergusson writes, that this patient was in good health, and with a capital limb; he believed the parts to be in a similar condition to that found in Mr. White's patient, but happily, so far as could be then judged, there was no likelihood of an early opportunity of anatomical examination being permitted. (See *Practical Surgery*, ed. 4. p. 466.)

Mr. Fergusson was followed by Mr. Simon, Mr. Henry Smith, Mr. French, Mr. Haynes Walton, Mr. Morris of Spalding, and Mr. Cotton of Lynn, all of whom have performed the operation, and it has been since repeated by Mr. Fergusson. Within the past few years, Mr. Jones of Jersey, Mr. Erichsen, Mr. Hancock, Mr. Bowman, Mr. Partridge, Prof. Buchanan of Glasgow, Mr. Shaw, Mr. Stanley, Mr. P. C. Price, and many other surgeons, have frequently resorted to it, with more or less success.

On the Continent this operation would seem to have found greater favour than in England. In 1816, Schmalz, a Saxon surgeon, did the operation for Cais, and in his wake followed Textor, who did it four times, Oppenheim, Heim, Roux, Vogel, Vermandois, Seutin, and many others. In 1847, M. Roux mentioned twelve cases of excision, and they were the first statistics published. (*Gazette, des Hop.*, March 1847.) The operation is now confined chiefly to the British, German, and American surgeons, but has not been encouraged in France.

We have already adverted to the statistics of excision in the hip collected by Mr. Price, when speaking of Disease of the Hip Joint. Mr. Barwell has gathered the particulars of 104 cases. Twelve times the operation was performed for injury, and of these but one recovered; but eleven of these were gun-shot wounds, and one was a fracture of the neck of the thigh-bone and descending ramus of the pubes. Of the 92 cases in which the joint-disease was the cause of operation, 56 recovered, 32 died at various periods afterwards, and 4 remain uncertain. The recoveries therefore are 56, which is equivalent to 63 per cent. "It must be, nevertheless, acknowledged," Mr. Barwell remarks, "that several of the patients, after having lived, and even walked about for some months, or even more, ultimately succumbed to internal disease, generally to tuberculosis." (*Treat. on Dis. of Joints*, p. 438.)

The statistics of this operation, Mr. T. Holmes

says, are of little real value; nor are they, he says, of the same importance as in those excisions where the question lies between the removal of a joint and of a whole limb. "The rate of mortality is extremely high; so that out of 111 cases collected by Dr. Hodges, in which the result was known, 56 recovered 'with more or less useful limbs,' 53 died of the combined effects of the operation and the previous disease, and in the remaining two cases amputation was performed. But it is impossible to deduce any exact conclusion from such facts as these: since, without a personal knowledge of each case, no opinion as to the probability of recovery without operation can be formed. The average duration of treatment in those cases in which the point was noted (49 in number) was 230 days." Mr. Holmes further observes that, when the operation is once decided upon, it should not be delayed till the patient's health has given way, but should be performed at once.—*System of Surgery*, vol. 3. p. 816.

The cases in which resection of the hip-joint is demanded, are those wherein abscess has formed, and the constitutional powers have become so much impaired by the constant drain upon the system, that a fatal result would ensue. "This is the direct consequence of the wasting and exhausting influence of the long-continued discharge of pus from masses of carious or necrosed bone, too extensive or too deeply seated to be eliminated by the natural actions of the part. It is in such cases as these that conservative surgery steps in, and endeavours to save the patient's life by the removal of the morbid cause that keeps up the discharge which is wasting it away. The object here is simply to save life by the removal of diseased bones." (See *Erichsen, Science and Art of Surgery*, ed. 3, p. 744.)

The same surgeon considers the femoral form of coxalgia as the most amenable to operation. It is in the severe and extreme cases of this variety of hip disease, that the upper epiphysis of the femur will be found lying in a state of caries on the dorsum ilii, in a suppurating cavity, with sinuses leading down to it. "The pelvic bones are sound; the acetabulum is filled by fibro-plastic matter of a reparative character, though possibly slightly roughened and necrosed in one lip. The soft structures in the gluteal region are thinned and wasted; the limb is inevitably shortened and adducted." (*Op. cit.*)

Under the name of *Necrosis of Joints*, Sir Benjamin Brodie describes a condition, somewhat analogous to the foregoing, wherein resection, or at any rate an operation for the removal of the diseased bone, is a matter of the utmost importance. "Where the bones of a joint are in a state of ulceration or caries, it sometimes happens that a portion of such carious bone loses its vitality, and is separated by the usual process of exfoliation, forming what has been called a *sequestrum* in the articular cavity. This may happen whatever the cause of the caries may be." (See *Path. and Surg. Obs.* ed. 5, p. 220, 1850.) Sir Benjamin Brodie considers this to be more common in scrofulous caries than in any other, on account of the lower degree of vitality belonging to the bone in such cases. He gives some striking examples of this condition in the hip, one particularly of a lad 15 years old, who died of general hip disease, and after death a portion of dead bone was found

lying loose in the articular cavity. Similar examples have been recorded by various surgeons, who performed resection successfully. Three are published in the *Hospital Mirror*, in the *Lancet* for 1861 (vol. i. p. 85 and 108). In these, either the detached head, or portions of the diseased bone, lay loose in the acetabulum, and kept up such an amount of irritation as seriously to imperil life. A recovery followed in each, after excision. Nature alone will not cure such cases, and the patient is certain to perish unless the exciting cause of all his misery be removed, on the same principle that carious or necrosed bone is removed from any other part of the skeleton.

Of late years, whilst many surgeons were strongly advocating resection of the hip-joint, they dwelt upon one condition which was looked upon as a bar to the operation, and that was disease of the acetabulum. Subsequent experience has proved that the acetabular form of coxalgia is even a more fatal disease than the femoral, if allowed to run its course unchecked. The first surgeon who laboured to remove this erroneous idea was Mr. Hancock, who successfully excised the head of the femur and entire floor of the acetabulum in a very hopeless case. Although we have all along spoken of excision of the hip-joint, that proceeding has been chiefly confined to removing the head of the femur. Mr. Hancock, therefore, is in reality the first surgeon who has excised the hip-joint in its entirety. (See the *Lancet*, vol. i. 1857, p. 397.) In the form of hip disease which is now called acetabular, the pelvic bones in and around the acetabulum become extensively necrosed; this cavity may become either wholly detached and loose or else perforated; and the head of the femur, probably still occupying its natural situation, is denuded of cartilage, rough, and carious. With this state of the parts, large abscesses may be present both within and outside of the pelvis, and the worst examples of hectic fever are produced, the patients dying in the most extreme state of exhaustion, prostration, and emaciation. Such cases have come under the observation of Mr. Hancock and Mr. Erichsen, and operative measures have saved life.

Writers on excision of this joint, very strenuously insisted on its performance when the cotyloid cavity was free from disease, and the morbid action confined to the femur or soft parts. On this point Mr. Hancock very properly observes that "it is only in a very few instances that the surgeon can tell beforehand what is the condition of the cotyloid cavity; but supposing he can do so—that a patient presents whose case imperatively calls for operation in all respects, but that the acetabulum is extensively diseased, are we to abandon this patient to his fate, and allow him to die in agony? Is it not rather an additional reason for performing the operation? since the greater the amount of disease the smaller the chance of recovery, whilst the value of an operation does not consist in the facility of its execution, but in the urgency of the symptoms and the extent of disease and suffering it is capable of removing. It is very true that in many instances the bones of the pelvis appear to possess a wonderful power of reparation. The cases operated upon show this; but if we look through the list, we find three in which the patients died sooner or later from profuse suppuration, and wherein the acetabula were

found perforated after death. It would seem, therefore, much the safer proceeding entirely to remove the doubtful portion of the acetabulum than to leave it behind, or merely scrape it with a gouge." (See Mr. Hancock's paper in the *Lancet*, vol. i. 1857, p. 420.)

Mr. Hancock's patient was a lad of 14, in whom the neck of the femur was found to be so much involved, that the bone was sawn through below the great trochanter. The head of the bone was then readily removed from the acetabulum. This cavity was found to communicate by two openings at its deepest part with the pelvic abscess. An effort was made to excise the floor with bone-nippers, but unsuccessfully; with a metacarpal saw the acetabulum was cut round, and the whole of the diseased bone removed. This exposed the thickened pelvic fascia, and a large opening was left for the escape of matter from the pelvic abscess. The flaps formed by a crucial incision were then partially closed by sutures. A splint, extending from the armpit to the foot, was applied. Fourteen days after the operation he sat up in his bed for the first time for a year. In three weeks he dressed himself and sat in a chair by the fire. In five weeks he was able to walk with a crutch and a stick, and finally he made a good recovery, and was able to walk in the park daily.

Mr. Erichsen's case, which was even more remarkable than the foregoing, from the greater amount of disease present, and consequently larger amount of bone removed, we have already referred to. The patient was in a more deplorable and exhausted condition, and, although life hung upon a thread for some hours after the operation, the girl perfectly recovered, and is alive and hearty.

The operation is one of extreme simplicity. An incision may be practised of a form suited to the exigencies of the case; if there are sinuses, they may be slit up, and the carious head of the bone, if dislocated, will be exposed to view. If, however, the soft structures are thickened, and the diseased bone deeply seated, a crucial or T shaped incision may be made over the upper end of the femur so as to expose it, when an assistant forcibly adducts the limb, rotates it inwards, and pushes it upwards. The soft structures are now divided around the upper end of the bone by a scalpel or probe pointed bistoury, when the diseased parts are at once exposed. In sawing off the diseased part of the femur, retractors may be employed, if necessary, to prevent injury to the soft parts.

When the acetabulum is diseased, it may be necessary to enlarge the incisions, care being taken not to extend them too far backwards, lest the sciatic nerve be injured. Any loose fragments of bone are to be removed, and then, with a gouge or cutting forceps, the acetabulum itself, or any other diseased parts, may be cut away piecemeal.

Many surgeons believe it is easier to remove the glenoid cavity in the shoulder joint, than the acetabulum. Mr. Fergusson observes that no greater mistake can be imagined, for if the trochanter major be taken away, a step which he recommends should always be adopted, it is actually easier to get at the acetabulum than the glenoid cavity. (See *Pract. Surgery*, ed. 4, p. 468.)

As in other excisions, that in the hip is attended with but very little bleeding; there is but little risk of wounding the gluteal artery, and any of its branches can readily be tied.



A splint is to be applied immediately after the operation. Of this, various contrivances have been suggested. Mr. Fergusson recommends that the extension should be made from the opposite thigh, round the upper part of which, a laced socket is fixed, to which the band is attached. Mr. Christopher Heath has invented a hammock slung in a four-legged stand, which supports the back and thighs, the head and legs projecting beyond and lodged upon cushions. A hole is present in the region of the buttocks for cleanliness and dressing the wound. Mr. Price employs a splint, the lower part of which can be depressed, adducted, or abducted by means of screws at the steel bracket.]

*Excision of the Knee Joint.*—[Although this operation was first performed by Mr. Filkin of Northwich, in 1762, the merit of originating the operation is certainly due to Mr. Henry Park of Liverpool, who published the first recorded case in 1782. Park's first operation was performed in 1781, and his second in 1789. It was not until after the publication of Mr. Park's pamphlet, that Mr. Filkin claimed priority. In 1792 M. Moreau was the first to try this operation in France, on a boy, with success. He repeated the operation on another patient, but not with the same good fortune. In 1811 his son performed it with good results. In England the operation remained in abeyance until 1823, when it was resorted to by Sir Philip Crampton. Mr. Syme had recourse to it in 1830, and his operation made the sixth done in Britain. For twenty years it remained unattempted, until it was revived in 1850 by Mr. Fergusson. In the meantime, in France and Germany it had been performed once by Mulder, four times by Fricke, twice by Textor, and once by Jaegar, and by Roux. In the table of cases given by Mr. Butcher in his first Memoir on Excision of the Knee Joint, operated on within the first epoch, of 19 cases, 8 were cures, and the remainder failures. (*Dub. Quar. Jour. of Med. Science*, Feb. 1855.)

A reference to the carefully collected and reliable statistics of Mr. Butcher in his first and second Memoirs on this operation, affords all the information to be desired upon it, up to the year 1856 inclusive. Altogether he enumerates 82 cases. In May 1859 Mr. P. C. Price had collected the particulars of 78 additional cases making a total of 160. (See *Contributions to the Surgery of Diseased Joints, with especial reference to the Operation of Excision*. p. 36.) All these were done in Britain. Two years later, in 1861, Mr. Price had collected the particulars of 235 cases in which excision of the knee had been performed in Great Britain and Ireland and Jersey. Of this number, 144 were cured with good and useful limbs; 50 died from the immediate effects of the operation, indifferent treatment and other causes; 33 were submitted to amputation at various periods after excision; and in 8 cases the correct result was not determined. (See *Mr. Price's Manuscript Prize Essay on Excision of the Knee, in the Library of the Royal College of Surgeons*. 1861. folio.)

We will observe here, that the mortality after excision of the knee joint has been stated by the writings of many very careful surgeons to be much less than that of amputation through the thigh, and this is a circumstance that must

not be overlooked, in determining upon the choice of the operation to be adopted. Excision should have the preference when disease more or less extensive is confined to the articulation itself, or if there is faulty ankylosis from old disease or injury, which has rendered useless a limb, in an otherwise healthy and not old person.

Mr. T. Holmes thinks it unlikely that this operation will ever come into such favour as that on the elbow; still, though it has, he remarks, been vehemently decried, and although its general adoption has possibly been equally retarded by its having been vehemently overpraised, it seems likely to hold a permanent place among the resources of operative surgery, for the treatment of appropriate cases.

"The acceptance which this operation has met with is not due to its lower rate of mortality. It has been clearly shown, by the statistics collected by Dr. Hodges, that, in general practice the mortality has been about one-third; a far higher average than that after amputation at the lower third of the thigh, for chronic disease of the knee; and, from what I can learn of the statistics of metropolitan hospital practice, I believe the same rate of mortality has prevailed. But this only imperfectly represents the ill-success of the operation, for if to those who have died we add those whose limbs have been amputated, or have remained useless, we shall find that the failures, after the operation, at least equal the successes. In spite of this known fact, however, it seems to be the growing conviction of hospital surgeons that the operation ought to be introduced into practice. This conclusion must rest upon other considerations than those of the mere mortality after amputation and excision. It is not very probable that excision of the knee will ever be less fatal than amputation."—*System of Surgery*, vol. 3. p. 818.

The following is the mode of performing excision in the knee as adopted by the reviewer of the operation, Mr. Fergusson:—"An incision between three and four inches long should be made on either side of the joint, opposite the lateral ligaments, and a third should be carried across the fore-part, so as to unite the whole, like the letter H. The lateral incision should belong more to the thigh than to the leg, and that in front should be across the lower end of the patella. This bone should now be detached by dividing the textures around it, close to its margins, and with the soft parts should then be dissected upwards, to a sufficient extent to permit a thorough examination of the diseased joint. To facilitate this, as well as the future stages of the operation, the lateral and crucial ligaments should be divided: the saw, forceps, and gouge must be used according to circumstances. It will in most instances be requisite to apply the saw, and the forceps will not be so useful here as at the elbow, although they will be of service in smoothing points which are left untouched by the saw. The diseased portion of the femur, usually limited to the extent of the articular surface, may be first removed, and the head of the tibia, as also that of the fibula, should it be involved in the affection. In using the knife in the posterior part of the joint, considerable care is required in dividing the crucial ligaments, as there is nothing between the instrument and the popliteal vessels but the posterior ligament and some cellular texture: in applying the saw, too, care is required; yet

I cannot recommend the introduction of a spatula of wood to protect these and other parts.

"Greater isolation of the bones would be thereby produced than the circumstances warrant, and it appears to me that the supposed danger can, by due caution, be avoided." (See *Practical Surgery*, ed. 4. p. 454.)

In the great majority of instances, the H incision is the one practised, but some surgeons vary it; thus Mr. Erichsen recommends a horse-shoe incision with the convexity downwards, from the side of one condyle of the femur across the tuberosity of the tibia, to a corresponding point on the opposite side. Mr. Fergusson has also practised a semilunar incision, the form which Mr. Jones of Jersey recommends. In sawing off the slices of diseased bone, Butcher's saw is commonly employed for that purpose. It is a matter of choice whether the patella should be taken away or allowed to remain. If much diseased it must be removed, but if slightly so the affected part can be gouged away or scraped. The preservation of the patella has materially added strength to the articulation in producing considerable consolidation. If any carious or necrosed cavities exist in the bones, below the level of the excised portions of bone, they should be carefully gouged out; this is deemed preferable to the removal of too much osseous material. The amount recommended for removal in cases absolutely requiring it, is from one-third to to three-quarters of an inch of the tibia, and about one inch to an inch and a half of the femur. After excision, Mr. Holt recommends perforation of the soft parts of the ham to allow of the discharges to drain through. Mr. Butcher recommends division of the ham-string tendons, to facilitate coaptation and to prevent displacement and jerking; this proceeding is, however, seldom required. There is no bleeding of consequence in excision of the knee, and commonly there is not a single articular artery to be tied.

Experience has amply proved that the beneficial results of the operation will chiefly depend upon the care and attention bestowed upon the after treatment of the case. "The wound should be carefully dressed, the margins brought together with stitches, the ends of the bones allowed to be in contact, and the limb should be steadily supported in the extended position by any convenient apparatus; a McIntyre's splint made straight would answer well. The dressing and the after treatment must be conducted on the ordinary principles of surgery; and if cicatrization is complete, in the course of three or four weeks, or even so many months, and the knee stiff, the surgeon may flatter himself that he has done all which his art permits." (See *Fergusson, op. cit.*)

In his second Memoir on Excision of the Knee Joint, Mr. Butcher has most ably entered into the consideration of the various objections which have been brought forward against the operation; and in his two memoirs he has pretty clearly proved that the growth of the limb was not checked by excision of the joint in childhood. Care should be taken, however, not to remove the whole of the epiphysal end, as pointed out by Mr. Humphry in 1857, else there is a probability of considerable shortening as the young patient grows older. When the healing powers have gone on well, and osseous union of the ends of the bones has occurred, the limb will be shorter than its fellow to the extent

of from one to three inches, but this is obviated by wearing a high-heeled shoe, and it is remarkable to notice the excellence of the limb saved in every respect.

"But what has really brought excision of the knee into practice, and has compensated for the failures induced by its indiscriminate adoption in all kinds of cases, is its striking success in cases which are fitted for it; and it is, therefore, to the discovery of rules whereby such cases can be diagnosed, that the efforts of those who wish to promote this operation should be directed."—(*T. Holmes, Op. cit.*)

In dwelling upon this operation, Mr. Fergusson makes the following very pertinent remarks:—

"I know of no new operation, as it may yet be called, in the whole range of surgery which has been so frequently performed in such a brief period as seven years, and I have confidence in stating that I know of none so thoroughly worthy of the attention of the surgeon. Amputation has often been called the opprobrium of surgery. Modern practice has done much to set this axiom aside. It is difficult to say whether pity, amazement, or horror is uppermost in the mind when one hears, now-a-days, of amputation in the arm for disease of the elbow-joint, and such, I believe, will be the case in a few years hence, when some 'statistical table' shows how a patient has fared after amputation in the thigh for 'disease of the knee joint.' That such a proceeding is never needful in such disease I am not prepared to say, but I firmly believe that in eight cases out of ten, under the ages of twenty or thirty, in whom disease of the articular surfaces of the bones of the knee joint seems incurable, the operation of resection should be preferred to that of amputation. Whilst I write (1857) there are four patients in the wards of King's College Hospital, who have within these seven weeks, undergone excision of the knee under circumstances where amputation would formerly have been the legitimate operation, and the only reasonable course for each person's comfort. All of them are in a condition, as regards health, strength, and suffering, equally comfortable as if amputation had been done; perhaps much more so, both physically and morally, and each has the prospect of walking comfortably on his own leg, at a reasonably early date.

"The wound is less than that in amputation in the thigh; the bleeding seldom requires more than one or two ligatures, the loss of substance is less, and probably on that account there is less shock to the system, the chances of secondary hæmorrhage are scarcely worth notice, as the main artery is left untouched; there is, in short, nothing in the after consequences more likely to endanger the patient's safety than after amputation, whilst the prospect of retaining a useful and substantial limb should encourage both patient and surgeon to this practice.

"One of the strongest objections to this operation, has been the length of time needful for a cure. Some patients have been twelve and eighteen months under treatment, whilst during the same period some who have had amputation performed, have been declared cured. But the objection, I believe, is fallacious, and made without experience or data. I have had a patient on crutches within six weeks after resection; I have rarely seen one about at an earlier period after amputation; and I have seen one walking firmly and nimbly within twelve



months after resection, in a style far superior to that which an unfortunate might display with an artificial limb. My impression is, that as we learn more of the after treatment of these cases, the result will be even more satisfactory than that already achieved." (See *Practical Surgery*, ed. 4, pp. 456 and 457.)

We cannot enter into the details of any of the numerous cases which have been published, but would refer the reader to the two memoirs on this operation in the knee, by Mr. Butcher, which are full of useful and sound information, accompanied with excellent rules for general guidance in the after treatment; and also to Mr. P. C. Price's memoir on the same subject, and to his prize essay, at present in manuscript in the library of the Royal College of Surgeons, which affords the latest and fullest information. The *Lancet* also, since 1850, abounds with the reports of cases of this highly important conservative operation.

Within the last three or four years, surgeons have somewhat modified their opinion in reference to the success attendant on excision of the large joints, more particularly the knee. This has resulted, not from the mortality after the operation, but the subsequent demand for amputation of useless limbs. Very recently, in one hospital in the metropolis, there were as many as five cases of excised knee joints, which were mostly submitted to amputation, wherein the former procedure was not found to have been permanently beneficial. We will, therefore, add the following remarks from Mr. T. Holmes' article :

"The process of recovery is usually a slow one. In Dr. Hodges's tables, already referred to, the duration of the treatment in 48 cases, in which the patella was removed, is stated to have been 225 days ; and in 38 cases, in which that bone is believed to have been left, 255 days ; or, roughly speaking, the average duration of treatment was about eight months ; and, in many of the cases which afterwards turn out the most successful, sinuses remain open, and the limb is in a state which cannot but cause anxiety for many months after formal treatment is discontinued. In some exceptional cases, indeed, matters go on much more rapidly than this, and the recovery is completed as soon as (indeed, it may be that one or two have recovered sooner than) after amputation ; but, as a general rule, the time required for recovery after excision may be taken at about four times as long as after amputation. In fact, I think we are taking a view very favourable to excision, if we say, that every month after the operation advances the cure only as far as a week would after amputation."—*System of Surgery*, vol. 3. p. 823.]

[*Excision of the Ankle.*—The ankle joint was first excised by the elder Moreau in 1782, and it has been practised by Jaeger, Mulder, Kerst, and other continental surgeons. Mr. Hancock has the merit of having first performed the operation in this country in 1851. The patient was a boy eight years of age, with strumous disease of the ankle-joint of several months' standing, followed by sup-puration. The superior half of the astragalus and the lower end of the tibia were sawn away, without any injury to the vessels and nerves. (See the *Lancet*, vol. i. 1851, p. 356.) The results were perfectly satisfactory, three years afterwards

the boy was shown to the Medical Society of London, when he walked remarkably well, with scarcely any halting, and possessed considerable motion in the joint.

In a second instance Mr. Hancock excised the ankle of a young woman, aged 22, for strumous disease of the articulation. The case promised most favourably, but on the fourth day sloughing ensued, and the ultimate result was not favourable. (The *Lancet*, vol. ii. 1855, p. 578.) A third operation by the same surgeon, was performed in a young man, aged 25, for chronic disease of the ankle joint, with complete success. The wound in front of the joint healed by first intention in about a week, over the inside of the ankle it was healed in about two months, and in four months the entire wound was healed. The patient had free movement of his toes, and considerable motion in the joint. (The *Lancet*, vol. i. 1858, p. 36.) A fourth case, with equally satisfactory results, occurred to Mr. Hancock in a little boy, aged 6 years. After removing the upper portion of the astragalus which was carious, he found the disease extended through and beneath this bone, involving the os calcis to a considerable extent. The convex tibial articular surface, and the whole of the body of the astragalus, behind the interosseous calcaneo-astragaloid ligament, were removed, as well as the remains of the corresponding articular surface on the upper part of the os calcis ; whilst the interior of that bone, behind the interosseous notch, was carefully gouged out before the disease could be got rid of, so that little more than the shell of bone remained in that situation ; no arteries were tied. The boy suffered very little constitutional disturbance. In five months, the wound was entirely healed, he could stand upon his foot and walk without pain. His cure was a rapid and a perfect one. (See the *Lancet*, vol. ii. 1859, p. 332.)

Thus, out of four cases, but one proved fatal, the patient dying some six months after operation, from disease of the lungs, the result of a dissipated life. "In no instance," Mr. Hancock remarks, "has there been sloughing; there need not be a single tendon or artery divided; there is afterwards very little, if any, deformity—comparatively little shortening; the foot is preserved, and, as you will see by the cases related, the patients are able to walk and run about with scarcely any perceptible limp."

This gentleman further observes : "Why, in this age of conservative surgery and joint resection, the solitary exception should be made in the case of the ankle-joint, and so useful a member as the foot needlessly sacrificed, is an anomaly which I confess I do not understand. We have seen that, in Syme's operation, independently of the entire loss of the foot, there is danger of sloughing or bagging of matter; and in both Syme's and Pirogoff's operations, inflammation, sloughing, and suppuration in the course of the divided tendons. In excision of the ankle-joint these dangers do not exist." (See *Remarks on Resection of the Ankle-joint*, the *Lancet*, vol. ii. 1859, p. 331.)

We would remark that there is probably more risk of injury to the vessels and nerves in excision of the ankle than in any other joint, from their proceeding both anteriorly and posteriorly from the leg to the foot. Upon the integrity of these depends the success of the operation.

Mr. Fergusson has performed excision of the

ankle with success, and so has Mr. Pirrie of Aberdeen; in the opinion of the latter, the operation has never met with the favour that it deserves. No other English surgeon has resorted to it in the ankle that we are aware of. Mr. Syme has not performed resection of the ankle, but he considers it as likely to be a more favourable proceeding than in the wrist, because but 3 bones only enter its formation.

Mr. Barwell has gathered the particulars of 30 cases of this operation, with a mortality of 5, assuredly a very small percentage. The results on the whole have been pretty satisfactory; in the majority of cases, there was free motion, very little shortening, and but the barest approach to lameness. (See *Treatise on Disease of Joints*, p. 463.) One of Mr. Hancock's cases, a man of 32, walked several miles a day at a rapid pace, 10 months after the operation.

The operation as performed by Mr. Hancock is much on the plan pursued by Moreau. The foot is laid on its inner side, and an incision is made over the lower three inches of the posterior edge of the fibula. On reaching the malleolus, it forms an angle and runs forward and downward to within half an inch of the base of the outer metatarsal bone. The angular flap is now reflected forwards, which permits of the fibula being cleared and cut off with forceps, leaving the peroneus longus and brevis tendon uncut. The foot is now turned over, and a similar incision is made as on the outer side, terminating on the foot over the projection of the inner cuneiform bone. The flap is turned back, and the sheaths of the flexor digitorum and posterior tibial tendons divided, keeping the knife close to the bone to avoid the artery and nerve. The internal lateral ligament is next divided close to the bone; the foot is twisted outwards, and the astragalus and tibia will be seen at the inner wound; a narrow bladed saw, put in between the tendons into the inner wound, projects through the outer, and the lower end of the tibia, and the top of the astragalus are sawn off in a proper direction. The wound is closed with sutures, except that part opposite the breach of osseous matter, and the leg and foot placed on a splint with a footboard, and cold water applied. Should there be any disease of the articular surfaces of the os calcis or scaphoid, it must be gouged away. (See *Hancock and Barwell, op. cit.*) Mr. Pirrie thinks the operation is best performed by making a semilunar incision on the outer side, raising up the flap, cutting off the under extremity of the fibula, opening the joint, bending the foot inwards, and cutting the bones with pliers. (*Prin. and Prac. of Surgery*, ed. 2, p. 736.)]

[*Excision of the Tarsal Bones.*—Of the various bones which compose the tarsus, the os calcis is more frequently diseased than any of the others, and the reason of this is apparent from its large size, exposed situation, and spongy structure. It, as well as the other bones, is affected with caries and necrosis. The entire excision of this bone is seldom necessary, unless the disease has extended to the superior or anterior portions of the bone, when it is most liable to involve the entire tarsus. It has been excised twice by Mr. Hancock, but was first done in this country by Mr. T. M. Greenhow. Mr. Page of Carlisle, Mr. Erichsen, Mr. Gay,

and many other surgeons in this country and in America have resorted to it with success. If the diseased part can be removed with a gouge, even with the result of leaving a mere shell, it is better in the majority of instances to do that, for the cavity in the bone becomes filled up with dense fibrous tissue. It is recommended to avoid its complete extirpation whenever practicable, on account of the large size of the bone, its importance as a basis of support to the body, and as affording a point of attachment to the strong muscles of the calf.

Various methods are adopted in removal of this bone, but the incisions will frequently depend upon the seat of the disease. The operation is usually done by making a heel flap as in disarticulation of the ankle joint, and carrying it forward into the sole of the foot, by which another flap is turned up, and the calcaneo-cuboid articulation exposed and opened. The os calcis is then removed by separating it from the astragalus with the knife.

To obviate the wounding and subsequent cicatrices in the sole and heel, Mr. Erichsen readily disarticulates this bone by making a horse-shoe incision, when the patient is lying on his face, carried from a little in front of the calcaneo-cuboid articulation around the heel, along the sides of the foot, to a corresponding point on the opposite side. "The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under surface of the os calcis thus exposed. A perpendicular incision about two inches in length is then made behind the heel, through the tendo-Achillis, in the mid line and into the horizontal one. The tendon is then detached from its insertion, and the two lateral flaps dissected up, the knife being kept close to the bones, from which the soft parts are well cleared." The articulation is now opened above, the interosseous ligaments divided, and the bone detached. (See *Erichsen, Science and Art of Surgery*, ed. 3. p. 717.)

Those examples of excision of the os calcis which have been recorded, Mr. Fergusson speaks of, as strongly illustrative of the spirit of conservatism, which happily seems to pervade British surgery in the present day.

"Mr. Thomas Wakley," Mr. Fergusson observes, "has even gone a step further in this most praiseworthy direction. He has removed both astragalus and os calcis at the same time, with the laudable purpose of saving the rest of the foot, and has accomplished the object in the most satisfactory manner. The operation which he performed is detailed in the *Lancet* for July 1, 1848. He removed the os calcis first, with a portion of the integument covering it, and then the astragalus with the malleoli, the parts being removed through a gap made in the back of the foot by lateral and posterior incisions. The cure seems to have gone on very satisfactorily, and not long ago the person who had undergone this operation was submitted to the notice of the London Medical Society, able to move about on the lame foot with wonderful facility. I have more recently learned from Mr. Wakley that the result was in every way as satisfactory as could be desired." (See *Fergusson's Practical Surgery*, ed. 4. 1857, p. 447.)

At the time of the operation, December 1847, the man was twenty-three years of age, and had



been for twelve years a sufferer from disease of the ankle joint. The steps of the operation were as follows: the diseased foot was drawn forwards, an incision was made with the left hand from the prominence of the *internal* malleolus backwards and downwards, to the middle of the heel. A similar incision with the right hand was then made from the *external* malleolus, downwards and backwards, to join the foregoing. A third incision was next carried along the edge of the sole, from the middle of the first to a point opposite the astragalo-scapoid articulation; and a fourth on the opposite side of the sole, from the vertical incision to the situation of the calcaneo-cuboid joint. These latter incisions permitted a flap being made, two inches long from the under part of the sole. In the next place, a circular flap of integument was formed between the two malleoli, posteriorly, the lower border of the flap reaching to opposite the insertion of the tendo-Achillis. This flap being turned upwards, the tendon was cut through, and the os calcis having been disarticulated from the astragalus and cuboid bones, was removed, together with the integument of the heel included between the two incisions. The lateral ligaments connecting the astragalus with the tibia and fibula were now divided, and the knife was carried into the joint on each side, care being taken to avoid wounding the anterior tibial artery, which was in view. The astragalus was then detached from the soft parts in front of the joint, and from its articulation with the scaphoid bone, and the malleoli of the tibia and fibula were removed with the bone nippers. The only artery requiring ligature was the posterior tibial artery. A good recovery ensued, and with the aid of a high-heeled shoe, the man was able to walk about with much ease and comfort, and with the possession of perfect flexion and extension. (See the *Lancet*, vol. ii. 1848, p. 5.)

When the astragalus is diseased, it is seldom that the morbid action is confined solely to it. When this bone alone is affected, it is advised by some surgeons to perform excision as a rule in preference to gouging. It has been excised for disease by Mr. Statham, Mr. Erichsen, Mr. Fergusson, Mr. T. Wakley, and others. More usually its removal is called for in compound dislocation, in which case, the bone, from its displacement, eventually becomes carious or necrosed. The operation employed consists of an incision across the outer and anterior aspect of the ankle, exposing the bone, cutting across its neck with bone forceps, and then with stronger forceps forcibly elevating it

from its bed, and detaching it by the cautious application of the knife, especially at the inner side, where the plantar arteries are in danger. When the bone is dislocated, its removal is comparatively an easy matter. A good example of excision of this bone for disease, by Mr. Statham, is published in the *Lancet*. (Vol. ii. 1855, p. 167.)]

Thomas H. Wakley.

Consult *White's Cases in Surgery*. Sabatier, Séances publiques de l'Acad. de Chir. Paris, 1799, p. 73; et Mém. de l'Institut National, vol. v. 1805. Roux, de la Résection, &c. des Portions d'Os Malades, &c. Paris, 1812. Ph. Crampton, in Dublin Hospital Reports, vol. iv. 1827. A. Velpeau, Nouv. Elém. de Méd. Opér. t. i. Blackburn, in Guy's Hospital Reports, vol. i.; Wachter, Diss. de Articulis Extirpandis, Groning, 1810. Jeffray's Cases of Excision of Joints, &c. 8vo. Glasgow, 1805. James Syme on the Excision of Diseased Joints, 8vo. Edinb., 1831; and in Principles of Surgery, 1837, ed. 2. [And the various modern works alluded to in the course of this article.]

**JUGUM PENIS.** A contrivance for preventing the inconveniences of an incessant dribbling of the urine in persons who are unable to retain this fluid in the bladder. A jugum penis, strictly speaking, is an instrument that operates by compressing some part of the urethra. A jugum of this kind, which was invented by Nuck, is described in Heister's Surgery. (See tab. xxvi. fig. 8. et 9.) But, when erections are likely to take place, a jugum constructed on this principle is not applicable; and, indeed, in most cases it creates pain, and is not found to answer. When, in men, the infirmity is incurable, and a jugum cannot be worn, an apparatus for receiving the urine directly it escapes from the urethra, is the best resource. One of the best contrivances which I have seen, was worn by a gentleman who was desirous to have some invention which would receive a sufficient quantity of urine, and yet cause no disfigurement. The machine consisted of a long tube made of oiled silk, waterproof, and which extended down the inner side of the thigh, within his trousers. The diameter of it being very moderate, prevented it from making any prominence, while its length rendered it capable of holding two or three pints of urine.

[India-rubber urinals, both for male and female patients, answering their purpose very completely, may be obtained at all the surgical instrument makers. Some of them are provided with a valve which will not allow the urine to return after it has once entered the receptacle.]

## K

**KERATONYXIS.** This term, derived from *κέρας*, a horn, and *νύξις*, a puncture, has been employed to denote the operation of couching, performed through the cornea, or *horny* coat of the eye, the opaque lens being, in that manner, either depressed or broken piecemeal, or, in other instances, merely turned, so as to place its anterior and posterior surfaces in the horizontal position. See CATARACT.

**KNEE, DISEASES AND INJURIES OF.** See DISLOCATIONS; FRACTURES; GUNSHOT-WOUNDS; JOINTS, &c.

**KREOSOTE** (from *κρέας*, *flesh*, and *σώζω*, *I*

*save*). A new principle, discovered by M. Reichenbach, in 1804, in pyroligneous acid and all the tars, and so named from its property of preserving animal matter. According to this gentleman, it is of service in caries, cancerous ulcers, rheumatic pains, and other diseases. It appears, from Dr. Elliotson's researches, that it has considerable power in checking vomiting, even that attending Asiatic cholera. He also found it of use in phthisis, epilepsy, diabetes, and neuralgia. "Of its external application (says he) I can speak favourably. When an ulcerated surface has required a stimulus, or when a slough, or unhealthy,

perhaps offensive, discharge existed, I have seen it of great utility. As it prevents or arrests putrefaction, and removes all taint in dead matter, we cannot be surprised at its removing the offensive nature of discharges, whether from mucous membranes, or ulcers, and preventing the injurious effects of diseased animal matter upon the part with which it is in contact. I have seen foul ulcers become clean, and ulcers of long standing have sometimes healed rapidly on its application." Dr. Elliotson bears testimony also to its efficacy in pruritus podicis, toothache, and porrigo. (See *Med. Chir. Trans.* vol. xix. p. 217.) For external use, he says that from half a drop to two or three, diffused in water by means of mucilage, will usually be sufficient, though its application must be very frequent. I have tried it in a few examples of phagedenic ulceration, in University College Hospital, and occasionally with success. I have known it used in the proportion of from three to eight or ten drops in each ounce of water. If given internally, it is best to begin with one or two drops, and increase the dose very gradually.

It is alleged that kreosote, as an external application, is advantageous in preventing the con-

traction of cicatrices, and that it is therefore useful in burns. (See *Sir F. Smith*, in *Dublin Journ. of Med. Science*, vol. xi. p. 237.) "In different eruptions of a scaly nature (says this gentleman) kreosote has been found decidedly useful, and results the most favourable have followed its application to ulcers, and solutions of continuity, having a venereal or scrofulous origin. From its known antiseptic properties, it has been recommended in gangrene." He also refers to its use in external and internal hæmorrhages. Sir F. Smith tried it with success in phagedenic ulceration of the penis, disease of the septum narium, tinea capitis, and cancrum oris. Sometimes he employed one part of kreosote to sixty of water; sometimes one of kreosote to sixty of acetic acid; and occasionally he brushed the edges and surface of ulcers with pure kreosote.

[The London Pharmacopœia contained an unguentum kreosoti, composed of half a drachm of kreosote to an ounce of lard. In the new British Pharmacopœia the strength of this ointment is doubled. The British Pharmacopœia gives also a kreosote mixture, containing one minim of kreosote and one minim of glacial acetic acid, in an ounce of distilled water.]

## L

**LACHRYMAL ORGANS, DISEASES OF THE.** The *lachrymal gland* cannot be said to be a part which is frequently the seat of disease. Richerand has seen no instance of an inflammation of this gland, unless by this expression be implied cases, in which all the contents of the orbit are more or less affected. (*Nosogr. Chir.* t. ii. p. 32.) Mr. Lawrence has met with no example of it. (*On Dis. of the Eye*, p. 691.) Mr. Middlemore regards it as not of great frequency, and, when idiopathic, as mostly met with in children of a strumous habit. (*On Dis. of the Eye*, vol. ii. p. 637.) I believe that the surrounding cellular substance is more frequently attacked with inflammation and suppuration than the gland itself. According to Beer (*Lehre von den Augenkr.* b. i. p. 349), true idiopathic inflammations of the lachrymal gland are very rare, and he declares, that, in the course of a practice of twenty-seven years, he has but seldom met with them. On this point he differs from Schmidt, who fancied that he had often had under his care cases of this description in gouty and scrofulous subjects. (*Ueber die Krankh. des Thränenorgans*, p. 134.) Mr. Todd also states, that acute and chronic inflammation and abscesses of the lachrymal gland, are common occurrences. (See *Dublin Hospital Reports*, vol. iii.) When the lachrymal gland is attacked with inflammation, its secretion, far from being augmented, as Richerand describes, is considerably lessened, and therefore one of the earliest symptoms is an uneasy dry state of the eye, the secretion from the Meibomian glands, and mucous membrane of the eyelids, not being alone sufficient for keeping the eye duly moist and lubricated. This state is succeeded by a throbbing acute pain in the temple, shooting to the eyeball, forehead, upper and lower jaws, and back of the head. In the meanwhile,

the temporal portion of the upper eyelid becomes swelled, tense, red, and exceedingly tender, the tunica conjunctiva being scarcely at all affected, and merely exhibiting a slight degree of redness and tumefaction towards the outer canthus. However, as the swelling of the gland increases, the eyeball becomes pushed more or less downwards and inwards towards the nose. But, though there is little or no redness, nor any mark of inflammation about the eye, this organ is tense, and extremely tender. The freedom of its movements towards the temple is much lessened in the beginning of the complaint, and when the tumour has acquired a very large size, is quite destroyed. The impairment of vision is always proportionate to the protrusion of the eyeball, the pupil being diminished, and the iris motionless. The second, or suppurative stage, Beer describes as ushered in by fiery appearances before the eye; an increased displacement of the eyeball; throbbing pain; great increase of the swelling of the upper eyelid, and of the conjunctiva, towards the temple; an annoying sensation of cold, and heaviness in the eye and orbit. Now, under febrile symptoms, shiverings, &c., a yellowish point presents itself, either on the reddened portion of the conjunctiva, or on the outside of the eyelid, and a fluctuation becomes distinguishable. (Beer, *Lehre*, &c. b. i. p. 350.) Beer speaks of abscesses sometimes forming in the vicinity of the lachrymal gland, and terminating in a small sinus, which communicates with one of the principal excretory tubes, and discharges occasionally a thin limpid fluid. (*Lehre von den Augenkr.* b. ii. p. 184.) The experience of this author leads him to consider these sinuses either as a consequence of an unskillfully treated abscess of the upper eyelid, or of a similar neglected affection of the cellular membrane, near the lachrymal gland; or, lastly, of the pre-



sence of a portion of the sac of a burst encysted tumour. According to Mr. Travers, the lachrymal gland often suppurates in children, and occasions an excessive swelling above the upper eyelid, depressing the tarsus so as completely to conceal the eye. The abscess, he says, may be conveniently opened, and discharged beneath the eyelid. (*Synopsis of the Diseases of the Eye*, p. 228.) With respect to the treatment of any local inflammation in and about the lachrymal gland, the best means of relief would be leeches, fomentations, emollient poultices, and other common antiphlogistic remedies.

The lachrymal gland is subject to scirrhus enlargement. Sometimes, though rarely, the gland is primarily affected. Schmidt never met with the disease confined to the gland. Guérin removed one in the state of schirrus, and so much enlarged, that the eye was entirely covered by it. This operation was performed with such dexterity that the external straight muscle was not at all injured. Mr. Travers removed a scirrhus and enlarged lachrymal gland. The vision of the eye had suffered considerably during the growth of the tumour. The only deformity, after the operation, was a slight prolapsus of the eyelid. This gentleman recommends operation of this kind to be always done, if possible, beneath the eyelid. (*Synopsis*, &c. p. 228.) The lachrymal gland, in the state of scirrhus, has been successfully removed by Mr. Todd (see *Dublin Hospital Reports*, vol. iii.), by Mr. O'Beirne of Dublin, and Mr. Lawrence. (*On Dis. of the Eye*, p. 697.) The latter gentleman does not regard the disease as malignant, like true scirrhus. It does not become adherent to the surrounding parts. It does not contaminate the surrounding glands; nor does it return after extirpation. (See also *Guthrie's Operative Surgery of the Eye*, p. 159, &c., and *J. Schmidt, Ueber die Krankheiten des Thränenorgans*.)

Cases are related, in which the secretion of tears is said to have gone on as usual after the operation; but it is conceived that the accounts cannot be correct. M. Magendie removed the lachrymal gland from rabbits, and tears were no longer secreted. (See *R. Middlemore on Dis. of the Eye*, vol. ii. p. 652.) Leeches, iodine, and mercury should be tried, before the operation is decided upon.

[Mackenzie (*On Dis. of the Eye*, ed. 4, 1854), mentions an inflammation and suppuration of the glandulæ congregatæ, in which the external angle of the eyelids is swollen, red, and painful, and if the upper lid is raised, several of the acini of the glandulæ congregatæ are seen to be enlarged. The causes and treatment are similar to those of hordeolum.]

Mr. Mackenzie admits the following kinds of chronic enlargement of the lachrymal gland:—1. Simple hypertrophy; 2. Chloroma, green tumour, or fibroplastic tumour; 3. Scirrhus; 4. Medullary fungus. Of the first kind is a case related in the *Ann. d'Oculist.* t. xxiii. p. 145, *Bruxelles*, 1850. For cases of chloroma, see *Paget's Lectures on Tumours*, lect. v. pt. ii., *Medical Gazette*, vol. xviii. p. 177, Lond. 1851; *Burn's (Surgical Anatomy of the Head and Neck*, p. 385, Glasgow, 1824); *Dr. J. H. Balfour (Edinburgh Medical and Surgical Journal*, vol. xliii. p. 319, Edinburgh 1835); *Durand Padel (Journal Hebdomadaire des Progrès des Sciences Médicales*, t. iii. p. 207, Paris

1856). In addition to these cases, see one by *Williams*, in which the pericranium, dura mater, and various other organs were affected. (*Medical Gazette*, vol. xlv. p. 854, London 1849); *Dr. King of Glasgow (Monthly Journal of Medical Science for August*, 1853, p. 93); *Vogel (Anatomie Pathologique Générale*, p. 199, Paris 1847); *Lebert (Physiologie Pathologique*, t. ii. p. 120, Paris 1845); (*J. B. Lancet*, February 26, 1853, p. 203); *Dr. Halpin Dublin Quarterly Journal of Medical Science*, vol. i. p. 88, Dublin, 1846); *Pemberton (Ibid.* vol. iv. p. 246, Dublin 1847); *Dr. A. Anderson (Monthly Journal of Medical Science*, vol. viii. p. 464, Edinburgh 1848).

Cases of scirrhus have been observed by *Travers (Himly Krankheiten und Missbildungen des menschlichen Auges*, vol. i. p. 201, Berlin 1843); *Lawrence (Treatise on the Diseases of the Eye*, p. 798, London 1841); *Genge (Atlas der Pathologischen Anatomie*, zweiter theil, 17th lief. tab. 3, Jena 1850). For medullary fungus, see *Dr. Tortnal, jun. (Himly, Op. cit.* vol. i. p. 292; *Ammon, Klinische Darstellungen*, vol. ii. p. 27, Berlin 1838). *Mackenzie* says, in cases of scirrhus or medullary fungus the operation can be regarded only as palliative. Chloroma or fibro-plastic tumour is a non-malignant disease; the circumstance, however, of its so frequently implicating other organs along with the lachrymal gland, and especially the dura mater, materially affects the prognosis. The mode of operating is to cut down directly over the tumour, through the integuments and fibrous layer of the upper lid parallel to the edge of the orbit. As the gland lies over the levator palpebræ, this muscle is avoided in this method of operation. The gland being exposed, projecting from the lachrymal fossa, it is to be isolated as much as possible with the scalpel, then seized and drawn out with the double vulsellum, and its remaining adhesions divided. The eyeball is to be removed if already destroyed. The moisture and lubricity of the conjunctiva remaining unaffected after extirpation of the lachrymal gland, has partly given rise to the statement, that the patient continues capable of weeping. Tears are undoubtedly discharged, however, from an eye from which the glandula innominata has been removed, owing, no doubt, to the glandulæ congregatæ being left untouched.

For cases of encysted tumours in the lachrymal gland, see *Mackenzie (On Diseases of the Eye*, ed. 4 1854.)

Concretions deposited from the tears occur in the sinuses of the conjunctiva, in the caruncula lachrymalis, and in the excreting lachrymal passages; similar concretions are also met with in the Meibomian follicles. See *Mackenzie (l. c.* p. 166, &c.)]

From these subjects, I proceed to consider the diseases of the excreting parts of the lachrymal organs; cases which, though of the most various natures, were formerly all confounded together, under the title of *fistula lachrymalis*. One important improvement is the discrimination of *epiphora* from *stilleididum lachrymarum*. The meaning of the former term being now applied to a watery state of the eye, occasioned by a redundant secretion from the lachrymal gland; while *stilleididum lachrymarum* is produced by causes which interfere with the regular excretion of the tears. This distinction at once informs us, that every case of disturbance of vision by the tears collecting in

the corner of the eye does not depend necessarily upon any disease of the nasal duct. As Dr. Mackenzie has judiciously remarked, the consequence of not distinguishing the different diseases of the excreting parts of the lachrymal organs from each other has been an attempt to discover a single successful method of curing them all. "Now there is no one method of treatment by which this can be accomplished; and hence it is that the several remedies which have been proposed, being eminently successful in one or other of these diseases, but not adapted to all the rest, have at different times been held in such various degrees of estimation." *On Dis. of the Lachrymal Organs*, p. 10, 8vo. Lond. 1819.) And an intelligent critic observes that in lachrymal diseases, obstruction of the nasal duct appears to be almost the only circumstance, against which the treatment recommended by the surgeons of France and England has been directed. "On sait qu'au rétrécissement ou à l'oblitération du canal nasal, produits par une cause quelconque, est due, dans presque tous les cas, la maladie qui nous occupe; soit que, restées intactes, les parois du sac présentent une tumeur lachrymale, d'où les larmes refluent continuellement sur les joues, à travers les points lachrymaux: soit qu'en partie détruites et ulcérées, ces parois présentent une fistule, qui offre aux larmes un passage contre nature, sans cesse entretenue par elles; en sorte que ces deux états, la tumeur et la fistule, sont presque toujours des degrés différens, d'une même affection, et que le traitement qui convient à l'une repose sur les mêmes bases que celui indiqué dans l'autre." (*Œuvres Chir. de Desault*, t. ii. p. 120.) It is evident, from the writings of Pott and Ware, that even these authors considered the obstruction of the nasal duct as the foundation of all the train of varied symptoms presented by the excreting lachrymal organs. "An obstruction in the nasal duct is most frequently the primary and original cause of the complaint." "The seat of this disease is the same in almost every subject," says Mr. Pott (*Obs. on the Fistula Lachrymalis*); and the late Mr. Ware, in his observations on the same disease, sets out with the same assumption. Now, obstruction of the nasal duct is an occasional consequence merely of inflammation of the excreting lachrymal organs; in most of their diseases, obstruction of the nasal duct has no part; and one might, with as much propriety, treat all the affections of the bladder and urethra, by the dilatation of the latter part, as treat all the diseases of the excreting lachrymal organs, by dilating the nasal duct. The false assumption in question has led to most erroneous treatment. For instance, in blennorrhœa of the sac, and in hernia of the sac, though in both these diseases the nasal duct is free, the common treatment, in this country, has been to open the sac with a knife and thrust down a style, or some other instrument, into the nose; thus destroying the organisation of the parts which are affected merely with a gleet secretion in the one case, and with extreme relaxation in the other. Indeed, it is somewhat surprising that errors of this kind should have prevailed so long, particularly as experience had taught Mr. Pott, that slight cases might be benefited by the simple employment of a vitriolic collyrium; a fact which ought to have convinced him that the disease did not always depend upon obstruction of the nasal

duct. It is curious, therefore, that he did not fully see this mistake, for that he knew of these diseases having great variety is evident from the following remark:—"As the state and circumstances of this disease are really various, and differ very essentially from each other, the general custom of calling them all by the one name of fistula lachrymalis is absurd." I believe that one great cause of deception has been the fact, that, though laying open the lachrymal sac, and the introduction of instruments down the nasal duct, have been frequently practised, when milder plans would have answered every purpose, yet a cure has often followed the practice, and thus confirmed the supposition of relief having been effected by the removal of the imaginary obstruction in the nasal duct. Thus, the late Mr. Ramsden, of St. Bartholomew's, always followed the common plan of passing a probe down the nasal duct, and letting the patient keep a piece of bougie, or a style, in the part for two or three months afterwards; and I scarcely recollect an instance in which he failed to accomplish a cure, though, I have no doubt, that the same benefit might sometimes have been obtained without any operation at all. And a discerning practitioner should never forget that, if no permanent obstruction exist in the nasal duct, a cure will generally follow, on the subsidence of inflammation, and a change taking place in the action of the parts whether a probe, style, canula, bougie, or seton, be employed or not.

*Erysipelas of the parts covering the Lachrymal Sac.*—Beer considers it highly necessary that this case should be discriminated from inflammation of the sac itself, which is often but little affected, and this even when an abscess forms. Unless the true nature of the disease be comprehended, the surgeon is apt to suppose that the matter is in the sac itself, and believes that when he makes an opening he is puncturing that receptacle, whereas he is in reality merely dealing with a superficial abscess of the integuments. Nor, as Beer has observed, is the mistake free from ill consequences; for, imagining that the wound is made into the sac, the surgeon pokes about with his probe so long, that a good deal of unnecessary pain and inflammation is produced. The case is not very frequent, and is mostly met with in scrofulous subjects, who have had for a considerable time a blennorrhœa of the lachrymal sac. The inflammation partakes of the usual characters of erysipelas, and commonly extends to the eyelids, particularly the upper one. The absorption and conveyance of the tears into the lachrymal sac are interrupted, because the inflammation constantly affects the lachrymal ducts and puncta. When the inflammation spreads over the side of the face, Beer says, there is usually a discharge of thin mucus from the nose; and when the affection extends more deeply, to the anterior portion of the lachrymal sac, as may easily happen when the case is neglected or treated in its first stage with stimulating application, a bean shaped, circumscribed, hard, painful tumour may be felt, or is even denoted by its very red appearance. The puncta lachrymalia are now completely closed, the papillæ shrivelled up, and the nostril on the affected side dry and tender.

If in the first stage of the disorder, the lachrymal papillæ and canals have not been too violently affected, the former parts expand again, and the absorption of the tears recommences



with the second stage. But, at this period, a good deal of mucus is secreted from the caruncula lachrymalis and Meibomian glands, and collects and glues the eyelids together, especially during sleep. At the same time mucus generally accumulates in the lachrymal sac itself, and may be voided both through the puncta lachrymalia and nasal duct by gentle pressure. The mucus, discharged from the nostril, also acquires a thicker consistence. Should the lachrymal papillæ and ducts have suffered more severely in the first stage of the disease, the due absorption of the tears does not begin after the subsidence of the inflammation, and a dropping of them over the cheek, a *stillicidium lachrymarum*, frequently continues a long while after the termination of the other symptoms. It depends upon the atony of the lachrymal puncta and ducts, and is very troublesome in cold wet weather. And when the lachrymal sac itself has been a good deal inflamed in the first stage of the complaint, a large quantity of mucus collects within it in the second stage, and may be discharged by pressure. Sometimes the subcutaneous abscess actually communicates with the cavity of the sac; a case, which Beer terms a spurious fistula of the lachrymal sac, the matter not being formed in that receptacle itself, but getting into it from the external abscess. As the skin is generally rendered very thin, these abscesses near the bridge of the nose usually burst by several openings. Beer remarks, that it is easy to learn whether the ulceration extends through the lachrymal sac; for when this has happened, the slightest pressure upon the superior part of the sac produces a discharge of pus and mucus from the external opening, and, if the lachrymal canals have already recommenced their functions, the discharge will also be mixed with tears. (See *Mackenzie on Dis. of the Lachrymal Organs*, p. 22.) The quantity of matter which flows out, is likewise so copious, that it is evident it could not have been all lodged between the skin and orbicularis palpebrarum muscle, but must have come partly out of the lachrymal sac. The use of a fine probe will remove any doubt which may be left. (Beer, *Lehre von den Augenkr.* b. i. p. 332—335.)

On the subject of the causes of this complaint, the preceding author delivers no remark worthy of notice. In speaking of the prognosis, he observes, that when the case is not neglected, nor wrongly treated in its first stage, and the inflammation has not extended to the lachrymal sac, the prognosis is favourable; for, after the subsidence of the inflammation, a temporary atony of the lachrymal puncta and ducts, an imperfect conveyance of the tears into the nose, and of course a slight oozing of them over the cheek, most troublesome in cold, wet weather, are the chief inconveniences which remain. But, when the lachrymal sac participates in the inflammation, the prognosis is much less favourable; because, when suppuration takes place, ulceration is apt to form an opening in the front part of the sac, or else, during the second stage, a large quantity of mucus may collect in the sac, and, if not skilfully treated, it frequently ends in a very obstinate blennorrhœa of that part. As Beer observes, this is a case which is often, though quite erroneously, named a fistula lachrymalis (b. i. p. 336).

The prognosis is also very favourable in the second stage of the complaint, as long as the sup-

uration is restricted to the integuments, and it is characterised by desquamation and scabbing; but the case is more serious, when a large collection of matter forms, and particularly when the abscess makes its way into the lachrymal sac. In these last circumstances, an obstinate blennorrhœa from the sac often follows, notwithstanding the fistulous sore be treated in the most skilful manner, and sometimes the matter spreads so far around, as to spoil and even annihilate, the lachrymal canals, and cause an irremediable dropping of tears over the cheek, during the rest of the patient's life. (Beer.)

The suppuration (says Dr. Mackenzie) may end in the total obliteration of the cavity of the sac. But when the sac is not thus annihilated, and the lachrymal canals are destroyed, it is necessary that the cavity of the sac should be obliterated by artificial means; for otherwise a form of disease will follow, which Beer denominates *hydrops sacci lachrymalis*, and Dr. Mackenzie, *mucocœle*.

"In most cases, a piece of folded linen, dipped in cold water, and applied to the parts affected, and the administration of gentle doses of sulphate of magnesia, will suffice for the treatment. In severe cases, it will be found necessary, not only to continue the cold applications, and to open the bowels, but to administer an emetic of tartrate of antimony, to purge freely, and even sometimes to take away blood from the arm." (Mackenzie, p. 24.)

In the second stage, a warm dry air, and a linen compress, are commended, with the exhibition of diaphoretics. In the two first of these means, I confess, that I should place little or no confidence. When the formation of matter cannot be prevented, poultices are to be used. Beer particularly cautions us not to leave the abscess to burst of itself, but to open it immediately a fluctuation can be felt, so as to prevent an ulcerated opening from taking place in the anterior part of the lachrymal sac. And if the surgeon has not been consulted before such a communication has been established between the sac and subcutaneous abscess, he should avoid all unnecessary disturbance of the parts with probes and syringes, and, at most, only wash out the abscess once a day with Anel's syringe, filled with luke-warm water and a little of the vinous tincture of opium. Beer also recommends introducing into the superficial abscess, but not into the sac, a small quantity of lint, dipped in the tincture. If the blennorrhœa of the sac continue, it is to be treated in the way which will be explained in considering the second stage of inflammation of that part.

*Inflammation of the Lachrymal Sac.*—According to Beer, the symptoms of the first stage are as follows:—In the corner of the eye, precisely in the situation of the lachrymal sac, a circumscribed, very hard, tender, swelling arises, of the shape of a bean, producing a lancinating pain when it is touched, and gradually acquiring considerable redness. The absorption and conveyance of the tears into the lachrymal sac, and thence into the nose, are completely interrupted; and of course the tears fall over the cheek. The nostril on the affected side is at first very moist, but soon becomes perfectly dry, the mucous membrane being a good deal affected. As the inflammation also constantly spreads to the orbicular muscle and in-

teguments in the corner of the eye, the complaint often presents an erysipelatous appearance, extending to the eyelids and down the cheek; but the circumscribed swelling, caused by the inflamed sac, is still not only capable of being distinctly felt, but even seen. It rarely happens, in cases of common inflammation, that, on the change of the first stage into the second, the nasal duct is rendered impervious by an effusion of lymph; but such an occurrence is more frequent when the inflammation is not of a healthy description, and the patient is scrofulous. Under these circumstances, the lachrymal canals may also be permanently obliterated. In weak, irritable constitutions, towards the end of the first stage of the inflammation a degree of symptomatic fever prevails, with severe headache, great redness and swelling of the whole inner canthus, involving the caruncula lachrymalis, the semilunar fold, the conjunctiva, the edges of the eyelids, and the lachrymal puncta.

Here, as in inflammation of every mucous membrane, at the very commencement of the second stage, a copious morbid secretion takes place, and accumulates in large quantity: for, either in consequence of the thickening of the mucous membrane, the adhesion of the sides of the nasal duct together, or there being no mixture of the tears, the secretion within the sac cannot escape either into the nostril, or out of the lachrymal puncta, and consequently it distends in a prodigious degree the anterior side of the sac, where it is uncovered by bone. Hence, the swelling is here very manifest, and a fluctuation may be felt in it, even before the suppurative stage has actually begun. According to Beer, whoever is induced by the fluctuation to open the lachrymal sac at this period, will certainly bring on a very hurtful suppuration of the part, exceedingly likely to render the excreting parts of the lachrymal organs completely unserviceable. At the beginning of the second stage, there is also a morbid secretion from the mucous membrane of the nostril and caruncula lachrymalis. Now, not only the swelling of the lachrymal sac increases more and more, but the redness acquires a deeper colour, the skin becomes more shining, the fluctuation still more evident; and at length, in the centre of the tumour formed by the lachrymal sac, a yellowish, soft point presents itself. In this state of things in order to prevent a true fistula, the surgeon should make an opening in the lachrymal sac, without the least delay; for, if the abscess be left to itself, the pus will at last make a passage for itself through the orbicular muscle and integuments; but it will only be a small fistulous opening, surrounded with callous hardness, and merely capable of letting some of the pus and mucus of the sac escape, so that the thicker part of the matter remains behind, and consequently, though the swelling diminishes after the formation of a spontaneous opening, it does not entirely subside. A quantity of blood is also remarked to be blended with the discharge from the sac. This last is the case, which Beer denominates a *true fistula of the lachrymal sac*. When the abscess bursts of itself, the fistulous opening in the sac is not always exactly opposite the aperture in the skin; and, though there is commonly but one communication with the sac, it sometimes happens that several small external openings are produced more or less distant from the sac. The diagnosis is easy enough; for, on pressing upon the upper portion of

that receptacle, mucus and pus, blended together, are immediately discharged from all the fistulous apertures. After the disease has lasted a good while, it not unfrequently happens, that tears are also voided from the fistulous opening; a circumstance, indicating the restored action of the lachrymal puncta and canals; but, according to Beer, such tears are never duly blended with the mucous and purulent matter. He further remarks, that, when the second period of the second stage, or the suppurative process is over, a morbid secretion of mucus still continues in the third period of the second stage, that secretion becoming whitish, thick, opaque, and only partly resembling pus. As, in consequence of its thickness, and the swelling of the mucous membrane of the nasal duct, the secretion cannot descend into the nose, it collects in the sac, and sometimes pushes off any piece of lint, or plaster, with which the external opening in the sac has been closed. At length, by means of judicious treatment, this third period of the second stage is also brought to a termination; the mucus is secreted again in due quantity; it becomes transparent like white-of-egg, and viscid; but white streaks may be for some time perceived in it. Afterwards the mucus becomes thinner, and, if the functions of the lachrymal puncta and ducts are not destroyed, it is thoroughly mixed with the tears. The opening in the lachrymal sac now either heals up of itself, or under skilful treatment; but, in general, a minute fistulous aperture still remains, from which the tears and mucus are occasionally voided, if the passage through the nasal duct be not free. However, if the small fistulous aperture should happen to heal up completely, the mucus and tears accumulate in the sac, and the patient is obliged to press them out through the puncta lachrymalia, several times a day.

When the surgeon is consulted early enough, and proper treatment is adopted, Beer sets down the prognosis in the first stage of the inflammation as very favourable. But, if the practitioner be called in later, it will not be in his power completely to disperse the inflammation, and prevent the morbid secretion, and accumulation of mucus in the lachrymal sac; the *Blennorrhœa*, of Beer, or the *dacryops blennoideus*, of Schmidt; a state, however, which soon gives way to judicious treatment. But, when the case is neglected, or wrongly managed at the period when the lachrymal sac is violently inflamed, a complete, or partial, closure of the nasal duct by adhesive inflammation is apt to be the consequence. And, the same effect may also be produced in the lachrymal canals, in which event, the absorption of the tears is for ever impeded, and the patient must remain the rest of his life afflicted with *stillicidium lachrymarum*.

With regard to the prognosis in the second stage of inflammation of the lachrymal sac, Beer considers it as very dubious, on account of the impairment of the functions of the excreting parts of the lachrymal organs; for, says he, no surgeon can exactly know, what may have been the result of the first stage, in relation to the perviousness of the nasal duct and lachrymal canals, and an officious examination of the parts with a probe, for the purpose of obtaining information, would be attended with considerable mischief. However, generally speaking, the prognosis is most hopeful at the first period of the second stage, just when the morbid secretion of mucus is beginning; the



suppuration may yet be moderated by right treatment, and the excreting parts of the lachrymal organs preserved. But, if the suppurative stage has already come on, much will depend upon the consideration, whether the matter has been originally formed in the lachrymal sac, has lodged there a good while, and the sac is ready to burst, or whether there is actually an opening in the sac opposite that in the skin, or, lastly, whether the openings do not correspond. In the first case, the suppuration yet admits of being regulated by judicious treatment, and the lachrymal sac can be punctured; but, in the other circumstances, the management of the case is far more difficult, especially when the patient's health is not good. However, the surgeon should be careful not to disfigure the patient with a large scar; and the aim should be to prevent atony of the lachrymal puncta and ducts, and a consequent stillicidium lachrymarum. These are the least serious evils to be apprehended from mismanagement; for, if the case be ill-treated, or neglected in the later stage of the suppurative process, necessarily attending a fistulous state of the sac, the lachrymal organs may be rendered quite useless, or even entirely destroyed, and the nasal duct obliterated, or obstructed by the effect of caries. In some few instances, indeed, the whole lachrymal sac is destroyed, or will require to be so by art, as will be presently explained. It is always a favourable circumstance, when the tears are seen to issue from the fistulous opening with the mucus and pus, as it is a proof, that the absorption and conveyance of the tears into the lachrymal sac are established again; and that now the only question is about the state of the nasal duct, which point cannot be determined, before the fistula is completely healed, and the third period of the second stage is entirely obviated. (*Beer, Lehre von den Augenkr. b. i. p. 356—367.*)

In the first stage, the indication is to endeavour to resolve the inflammation. "It is (as Dr. Mackenzie observes) by combating the inflammation, that we are to cure this disease, and not by attacking merely one, or even several of the symptoms. Dilatation, for instance, by the introduction of probes through the canals into the sac, and even into the nose, would only be subjecting the inflamed parts to a new source of irritation, and might thus produce effects, which would render a complete cure difficult, if not impossible." On the contrary, in the first stage, Dr. Mackenzie joins Beer in praise of antiphlogistic measures, and the application of cold lotions to the part.

In the second stage, when resolution is no longer practicable, emollient applications are the most beneficial, and all debilitating means are to be stopped, by the further use of which an incurable blennorrhœa of the lachrymal sac would be likely to be induced. And, as soon as the sac is so distended with mucus and matter, that the centre of the swelling begins to be soft, and a fluctuation is perceptible, the sac should be freely opened, so as to let its contents have a ready outlet. If, after this evacuation, there should be any deep-seated hardness of the lachrymal sac, Beer recommends the application of a camphorated hemlock poultice. Afterwards, the wound in the skin and sac is to have introduced into it a little bit of lint, dipped in the vinous tincture of opium, over which dressing a piece of diachylon

plaster may be placed. When under such treatment the suppuration diminishes, but a preternatural secretion of mucus yet continues, Beer introduces into the wound every day a piece of lint, on which is spread a little bit of the following ointment: *R Batyri recentis insulsi, 3 ss. Hydrargyri nitrico-oxydi, gr. x. Tutie pt. gr. vj. M.* And, on changing the dressings, some of the following lotion may be dropped into the inner canthus, and injected lukewarm into the sac itself: *R Subacetatis cupri, Potassæ nitratis, Aluminis, ā ā gr. iii.—vj. Camphoræ tritæ gr. ij.—iv. Aquæ distillatæ 3 ss. Solve et cola. Liquori colato adde Vini opii 3 j.—3 ij. Aquæ rosæ 3 iv. M.* Beer melts the three first articles together in equal proportions, and terms the composition the *lapis divinus*, of which he makes the lotion, and then adds the other ingredients. When, by means of such treatment, the mucous secretion from the sac has been brought into a healthy state, and all the induration has subsided, the period has arrived for the surgeon to think of taking measures for the reestablishment of the passage through the nasal duct, if it should not already have become pervious of itself, which, when the inflammation has been of a healthy kind, and the treatment judicious, very frequently happens. (*Beer, Lehre, &c. b. i. p. 369. 371.*)

*Chronic Blennorrhœa of the excreting Parts of the Lachrymal Organs.*—Dr. Mackenzie, whose essay contains a faithful account of Beer's opinions upon the present subject, describes the inflammation, with which this form of disease commences, as seldom considerable; and in serofulous patients, it is not unfrequently quite disregarded, no advice being taken until the lachrymal sac is much distended with mucus. By means of pressure upon the bean-shaped tumour, caused by such distension of the sac, a quantity of puriform mucus is forced out of the puncta lachrymalia, and overflows the eye; and so far are the lachrymal canals from being obstructed, that, excepting when any return of inflammation happens, they even absorb, and convey the tears into the sac. Pressure, however, will rarely make the contents of the sac pass through the nasal duct, on account of the thickened state of the mucous membrane, and therefore the nostril is generally very dry. "In the course of this tedious disease, the accumulated mucus varies much both in quantity and quality. For instance, the mucus accumulates more rapidly, and is much thicker after a good meal, than at other times. The secretion of it is very plentiful, but thinner than usual, when the patient continues long in a moist cold atmosphere. In this case the overflowing of the sac takes place so rapidly, that the compression of the orbicularis palpebrarum in the action of winking is sufficient to evacuate the sac through the canals to such a degree, that the whole surface of the eyeball is suddenly overflowed, and the puriform fluid runs down upon the cheek. After the patient has remained for a short time in a warm and dry atmosphere, the morbid secretion becomes sparing and ropy. We find, that this chronic blennorrhœa almost completely disappears in many individuals during warm weather; upon which the yet inexperienced patient and the inexperienced surgeon are apt to express a great, but a premature joy, for, on the very first change to cold and wet weather, the disease most frequently returns."

During chronic blennorrhœa, the lachrymal sac

is extremely liable to repeated attacks of inflammation, and sometimes a fistula, with a good deal of induration of the surrounding cellular substance is produced. Dr. Mackenzie represents this disease as the most frequent of all those, to which the excreting parts of the lachrymal organs are liable, and as consisting in inflammation of these organs, modified by scrofula, general debility, disorder of the digestive organs, or other constitutional causes, which prolong its second stage. "Even regarded locally, the present disease is seldom a primary affection, but is most frequently excited by catarrhal inflammation of the Schneiderian membrane, or by a long-continued disorder of the Meibomian glands. (Mackenzie on Dis. of the Lachrymal Organs, p. 37-40.)

Scarpa's opinions on the present subject are in some degree peculiar to himself; for he considers the affection of the Meibomian glands and inside of the eyelids, the *puriform palpebral discharge*, as he terms it, as constituting the first degree of all those complaints, which have usually gone under the name of fistula lachrymalis; the second degree or effect, being the tumour of the lachrymal sac; and the third, the fistula, or ulcerated opening in the latter part. Scarpa asserts, that the chief part of the yellow viscid matter, which accumulates in the lachrymal sac, is secreted by the lining of the eyelids, and by the little glands of Meibomius; and that the altered quality of this secretion has a principal share in the cause of the disease. He states, that the truth of this fact may at once be ascertained by everting the eyelids, and especially the lower one of the affected side; and by comparing them with those of the opposite eye. The former will always exhibit an unnatural redness of the internal membrane, which has a villous appearance all over the extent of the tarsus; while the edge of the lid is swollen; and numerous varicose vessels are distinguishable on it. The follicles of Meibomius are also turgid and prominent, and, when examined with a magnifying glass, not unfrequently appear to be slightly ulcerated.

"The villous structure, then, which the surface of the internal membrane of the palpebra assumes in these cases, becomes an organ secreting a larger quantity of fluid than usual, resembling viscid lymph, which, as before stated, being mixed with the sebaceous matter, copiously effused from the glands of Meibomius, constitutes the whole of the viscid fluid, with which the eyelids are imbued, and which is continually carried by the puncta lachrymalia into the sac, so as to fill, and also frequently distend it, until it forms a tumour.

"If, indeed, the lachrymal sac is emptied of this matter by means of compression, and the eye and internal surface of the palpebræ are carefully washed, so that none of the glutinous humour, pressed from the sac, may remain upon them, and the eyelids are everted half an hour afterwards, the internal surface, especially of the lower one, will be found covered with a fresh effusion of mucus mixed with sebaceous matter, which has evidently not flowed back from the lachrymal sac to the eye, but has been generated between the eye and the palpebræ." Another argument, brought forward by Scarpa in support of his theory, is, that if the morbid secretion of the eyelids be retarded, or suppressed, either accidentally, or by means of astringent applications, little, or none of the viscid secretion collects in the lachrymal sac,

or can be forced out of the puncta lachrymalia. He has also constantly observed, that the puriform discharge may be radically cured at its commencement, and before it has induced any flaccidity of the sac, by a timely correction of the morbid secretion from the inside of the eyelids, and keeping the lachrymal passage cleansed, by means of injections of simple water through the puncta lachrymalia into the nose. As for the internal membrane of the sac itself, he argues, that its structure does not qualify it for secreting a tenacious unctuous matter, like what is chiefly discharged from it, as it is entirely destitute of sebaceous glands, and can in reality only furnish a thin mucus. However, he admits, that if the sac happen to be inflamed and ulcerated, a turbid matter may issue from it with the tears; but, says he, this matter is true pus, and quite different from the curdy unctuous fluid, which takes place in the puriform palpebral discharge." (*On the Principal Dis. of the Eyes*, transl. by Briggs, ed. 2, p. 4-7).

The foregoing opinions of Scarpa have not met with universal assent, and, though there is probably, some truth in them, he may have overlooked too much the simultaneous affection of the mucous membrane of the lachrymal sac and nasal duct. To Scarpa's hypothesis, Himly and Flajani have made the following objections:—First, that they have observed the fistula lachrymalis, without the least morbid alteration of the eyelids, and Meibomian glands. Secondly, that every puriform discharge of the eyelids is not succeeded by obstruction of the nasal duct. Lastly, that the fistula lachrymalis is cured by means of the operation alone, without any attention being paid to the morbid state of the eyelids, when it exists. And Mr. Travers also regards Scarpa's account of the origin of the disease, independently of a permanent stricture, as hypothetical; for, if founded in fact, the distension of the lachrymal sac, and the regurgitation of the fluid on pressure, would attend every severe lippitudo, or ophthalmia with puriform discharge, which is not the case. If Scarpa's account were correct, Mr. Travers sees no reason why the fluid, once admitted, should be arrested, or regurgitate, instead of passing into the nose (see also Nicod, in *Revue Méd.* t. i. p. 155; and Lawrence on *Dis. of the Eye*, p. 708), and he thinks there is every reason to believe, that the fluid so discharged, is the proper secretion of the sac, and that cases are frequent, in which it is retained and cannot be expressed, owing to strictures both of the lachrymal and nasal ducts. (*Synopsis of the Dis. of the Eye*, p. 360). Some of the arguments with which Scarpa meets this reasoning are already anticipated, especially that which refers to the difference between the secretion of the sac itself, and that of the sebaceous glands of the eyelids. Also, in asserting, that the origin of the fistula lachrymalis generally manifests itself on the eyelids, before the lachrymal passages are affected, Scarpa declares, that he does not pretend thereby to exclude altogether the possibility of a case, in which the membranes of the nasal duct and lachrymal sac may not be thickened and ulcerated, independently of the disease of the eyelids. That this is the case, I think is evident from the account, already delivered of Beer's opinions respecting the consequences of inflammation of the integuments and other parts about the inner angle of the eye, as well as respecting the



effects of acute inflammation of the lachrymal sac itself. However, Scarpa admits the fact; and the question left is, whether he is right in assigning the morbid secretion from the inside of the eyelids as the most common cause of the swelling, ulceration, &c. of the lachrymal sac? That every puriform discharge from the eyelids is not followed by fistula lachrymalis, he allows, is unquestionable; and this, he conceives, most probably happens, because the lippitudo has not been entirely neglected, or because the secretion being less dense and viscid than usual, descends freely with the tears into the nose through the lachrymal canals, which are large and pervious. But, in the acute stage of purulent ophthalmia, he asserts, that the reason why the discharge is not conveyed into the sac is, that the inflammation and swelling actually close the puncta lachrymalia, and change their direction, so that both the puriform matter and the tears fall over the cheek and cannot descend into the sac.

For my own part I am disposed to believe that, whether the disease begin in the eyelids, or elsewhere, generally both their lining and that of the sac and nasal duct are also more or less affected; and, consequently, though Scarpa's theory may not be in every respect satisfactory, nor at all applicable to certain disorders of the excreting parts of the lachrymal organs, the practice to which his sentiments lead, will, in the generality of cases, which Beer denominates *chronic blennorrhœa*, be highly advantageous.

The local treatment of chronic blennorrhœa does not differ essentially from that of inflammation of the excreting parts of the lachrymal organs. But, every possible means must also be employed for improving the general health; for, otherwise, all local remedies will be unavailing. In scrofulous cases particular attention must be paid to diet and mode of living. In weakly persons the preparations of iron will be highly beneficial; and, when the disease is connected with disorder of the digestive organs the treatment recommended by Mr. Abernethy is that to which Dr. Mackenzie expresses a preference. The employment of Anel's syringe and probe is strongly reprobated. "I grant (says this author) that the application of certain substances to the mucous membrane affected is one of the most powerful means which we possess of correcting its disposition to chronic blennorrhœa. But he who believes that the best manner of applying these substances is to inject them with Anel's syringe, introduced through the puncta, is lamentably mistaken. He is, in fact, closing his eyes upon what he must know of the functions of the several parts of the lachrymal organs, and is doing that very thing which is calculated to prolong and exasperate the disease. Except at the time of a smart renewal of the inflammation, the puncta and canals, during this disease, continue in the exercise of their functions. Whatever fluid is, therefore, dropped into the lacus lachrymarum, will be taken up by the puncta, conveyed through the canals, and applied to the whole internal surface of the sac. Even ointments, placed within reach of the puncta, will be absorbed in the same manner. We ought then first of all to empty the sac by pressure, and, if possible, through the nasal duct into the nose. Having placed the patient upon his back, we drop into the lacus lachrymarum a small quantity of a

weak solution of corrosive sublimate. *R. Aq. ros. 3 iv. Hydrarg. bichlorid. gr. ss.—gr. j. Mucil. 3 j. Vini opii 9 j. M.* After remaining for a quarter of an hour in that position, he ought to rise, but without wiping away any of the collyrium which may remain. After another quarter of an hour, the eyelids are to be carefully dried, and a little of Janin's ophthalmic ointment applied with a camel-hair pencil to the caruncula lachrymalis and edges of the eyelids. All this is to be carefully repeated twice a day." Professor Schmidt recommends the following collyrium:—*R. Aq. rosæ 3 vj. Acid. nitrici 9 j. Alcoholis 3 j. M.* For the removal of the induration over the sac, gentle friction, with camphor, and mercurial ointment, is recommended. And, says Dr. Mackenzie, if the blennorrhœa depend upon chronic inflammation of the Meibomian glands, the diluted citrin ointment is to be applied every evening at bed-time. (*On Diseases of the Lachrymal Organs*, p. 43, &c.) In the first stage of what Scarpa terms the puriform discharge of the palpebræ, when the weeping is incipient, this author states that a cure may be effected without dividing the sac, or any other painful operation. His practice consists in restraining the immoderate secretion from the Meibomian glands and internal membrane of the palpebræ, and in cleansing the viæ lachrymales through their whole extent by means of injections of warm water, rendered more active by the addition of a little spirit of wine, and thrown into the puncta lachrymalia every morning and evening: a measure which, as already stated, is disapproved of by Mackenzie, Schmidt, &c. (See also *R. Middlemore on Dis. of the Eye*, vol. ii. p. 691.) Scarpa considers Janin's ophthalmic ointment, weakened with lard or fresh butter, as the best application for correcting the morbid secretion of the eyelids. A portion equal in size to a barley-corn is to be introduced upon the point of a blunt probe every morning and evening, between the eye and eyelids, near the external angle, and the edges of the eyelids are to be smeared with it. The eye is then to be shut, and the eyelids gently rubbed, so that the ointment may be distributed upon the whole of their internal surface. A compress and bandage should be applied, and the eyelids kept closed for two hours. At the end of this time the eye should be washed with the zinc collyrium. When there are superficial ulcerations at the edges of the eyelids, Scarpa applies to them either Janin's ointment or the unguentum hydrarg. nitrat., and, in very obstinate cases, the argentum nitratum itself. If the vessels of the conjunctiva are varicose, he drops into the eye the tinctura thebaica. (*Scarpa*, ed. 2, by Briggs, c. 1.)

The late Mr. Ware was earlier than Scarpa in pointing out the advantage of making applications to the inside of the eyelids, for the relief of certain forms of disease usually classed with fistula lachrymalis.

"When an epiphora (says he) is occasioned by an acrimonious discharge from the sebaceous glands on the edges of the eyelids, it must be evident that injections into the sac will be very insufficient to accomplish a cure, because the sac is not the seat of the disorder. The remedies that are employed must be directed, on the contrary, to the ciliary glands themselves, in order to correct the morbid secretion that is made by them; and, for this purpose, I do not know any application that

is likely to prove so effectual as the unguentum hydrargyri nitratis which should be used here in the same manner in which it is applied in common cases of psorophthalmia. It will be proper to cleanse the eyelids every morning from the gum that collects on their edges during the night, with some soft unctuous applications; and I usually apply to them two or three times in the course of the day, a lotion composed of three grains of white vitriol, in two ounces of rose or elder-flower water." *Additional Remarks on the Epiphora.*

Some interesting remarks have been made by M. Nicod, which perfectly accord with the sentiment already expressed, that whatever may be its primary seat, the chronic inflammation is not generally limited to the inside of the eyelids, but extends throughout the membranous lining of the sac and nasal duct; and that this circumstance, in conjunction with the altered and viscid nature of the secretions, accounts for their not readily descending into the nose, but regurgitating through the puncta. M. Nicod also relates cases exemplifying that the ointment applied to the inside of the eyelids actually passes with the matter into the lachrymal sac, and thence into the nose, so as to act upon and cure the chronic inflammation of the sac and nasal duct, as well as that of the Meibomian glands and lining of the eyelids. (See *Revue Médicale Historique*, &c. t. i. p. 156. 8vo. Paris, 1820.) The proceedings for adoption, when the nasal duct is obstructed, will now be considered.

*Obstruction of the Nasal Duct.*—That a permanent closure of this canal does not so frequently attend diseases of the lachrymal organs, as writers have generally imagined, must be evident from the remarks already delivered; and also that its perviousness, when interrupted partly by inflammation and thickening of its lining, and partly by the viscid curdy nature of the matter, may often be restored without thrusting any probes, tubes, or other instruments down the passage (measures more likely, under these circumstances, to do harm than good), is a fact which is no longer questionable. If the inflammation of the sac be treated at first on right principles, "the cases requiring operation will be very few." (See *Lawrence on Dis. of the Eye*, p. 711.) The treatment, necessary in such cases, must be already intelligible from what has been said in the preceding sections; the indication being the diminution of the thickened state of the mucous membrane, by means adapted to the acute or chronic form of the inflammation, and, in many cases, the correction also of the morbid state of the Meibomian glands and internal membrane of the eyelids. It is only when the treatment conducted upon these mild principles, is found ineffectual, that the surgeon should think of examining the state of the nasal duct, and learning, by the introduction of a fine probe into the passage, whether any permanent stricture or obstruction is present. This may take place as a consequence of acute or chronic inflammation; or it may be produced by extension of disease from the nose. It comes on occasionally in the latter way in strumous children. Inflammation begins in the Schneiderian membrane, and then creeps on to the lining of the sac; a case, in which the sulphate of quinine is particularly serviceable. (See *Lawrence*, 1 op. cit. p. 710.) I have seen several examples, in which a permanent obstruction of the nasal duct arose from syphilitic

disease of the nose, or the pressure of polypi. Supposing there is no direct opening through the skin into the lachrymal sac, one should be made with a lancet. A mere puncture will suffice, as a large incision, beginning just below the tendon of the orbicularis palpebrarum muscle, and extending in a semilunar form, nearly an inch downwards and outwards, as used to be the old practice, can here answer no rational object, the surgeon merely having occasion for a small direct opening through which he may conveniently pass a small probe, for the purpose of ascertaining the state of the nasal duct. "The probe (as Dr. Mackenzie observes) is to be introduced horizontally, till it touches the nasal side of the sac; it should then be raised into a vertical position, and its point directed downwards and a little backwards. Turning the probe upon its axis, we pass it from the sac into the duct; and as we continue to press it gently downwards, the instrument, if the sac is pervious, enters the nose. If its point meets with some obstruction, we must not immediately conclude that there is an obliteration of the duct. We must press down the probe a little more strongly, yet without violence, turning it round between the fingers, and giving it different directions. By these means the obstacle is frequently overcome, and the probe suddenly descends. If the obstacle remains as before, and is extremely firm, still this is not sufficient ground for us to conclude that there is a real obliteration," because, as the author proceeds to point out, the difficulty may arise from a mere thickening of the mucous membrane, and swelling and induration of its cryptæ. (*Mackenzie on the Lachrymal Organs*, p. 78.)

Beer is of opinion that the mechanical treatment with catgut, bougies, canulæ, &c., will only answer when attention is paid to rectifying the morbid state of the mucous membrane of the lachrymal sac by means of suitable applications, the use of which, he thinks, ought to commence first with the employment of catgut, which he preferred to canulæ, bougies, &c. And he adds, that even such treatment will only succeed, when the diseased state of the membrane of the sac is entirely a local complaint, and uncomplicated with an unfavourable condition of the health. In the beginning, if the probe can be introduced without any great trouble, and the lining of the duct is only trivially thickened, Beer moistens the catgut on its daily introduction into the passage, with the vinous tincture of opium, and injects into the sac a tepid lotion, containing subacetate of copper, nitrate of potass, alum, camphor, and vinum opii. When the probe meets with more resistance, the catgut is smeared with the unguentum hydrargyri nitratis, which is to be at first weakened, and afterwards gradually increased in strength. Some of the following lotion is to be injected down the sac twice a day.  $\mathcal{R}$  Aq. ros.  $\mathfrak{z}$  iv. Hydrarg. bichlor. gr. ss. gr. j. Mucil. pur.  $\mathfrak{z}$  j. Vinii opii  $\mathfrak{z}$  j. M. When any irregularities and indurated points are felt with the probe in the course of the nasal duct, Beer smears the catgut with an ointment, containing a small quantity of red precipitate, and directs friction with a little camphorated mercurial ointment to be employed every day round the external opening.

Beer joins the generality of writers in believing that a long perseverance in the mechanical means is necessary, in order to remove all disposition in the nasal duct to close again. (P. 176.)



Whenever the lachrymal puncta and ducts are obliterated, the practitioner need not trouble himself about the condition of the nasal duct; because, even if it were rendered duly pervious, this improvement would not continue long; as Beer's experience has fully convinced him, that, when the mucous secretion of the lachrymal sac is not blended with the tears, a closure of the nasal duct sooner or later ensues, and of course an accumulation of the mucus of the sac, a disease sometimes termed, under such circumstances, *hydrops sacculi lachrymalis*. And, in order to prevent this complaint in the state of things just now described, Beer is an advocate for the total obliteration of the cavity of the sac with escharotics. (B. ii. p. 181.)

Such is the practice of Beer, with the view of clearing away obstruction in the nasal duct, and restoring its natural diameter. Let us now consider what methods have been suggested by others. Beginning then with the screw, invented by Fabricius ab Aquapendente, for compressing the distended lachrymal sac, I need only remark with M. Nicod, that, as this plan was not directed against the cause of the disease, it is not surprising that it should have been unavailing, and ultimately banished from practice. In the year 1716, Anel invented a probe of so small a size, that it was capable of passing from the upper punctum lachrymale into the lachrymal sac and nasal duct, the obstructions in which latter passage it was intended to remove. Anel also invented a syringe, whose pipe was small enough to enter one of the puncta, and by that means to furnish an opportunity of injecting fluid into the sac and duct; and with these two instruments he pretended to be able to cure the disease whenever it consisted in obstruction merely, and the discharge was not much discoloured. "The first of these, viz. the passage of a small probe through the puncta (says Mr. Pott), has a plausible appearance, but will, upon trial, be found very unequal to the task assigned: the very small size of it, its necessary flexibility, and the very little resistance it is capable of making, are manifest deficiencies in the instrument; the quick sensation in the lining of the sac and duct, and its diseased state, are great objections on the side of the parts, supposing that it was capable of answering any valuable end, which it most certainly is not.

The next practice, deserving notice, is that of Laforest, who used to introduce into the termination of the nasal duct in the nostril a probe, with which he cleared away the obstruction in the passage. He also introduced into the same orifice a curved tube, which was left in the part three or four months, for the purpose of employing injections. This method was sometimes found not only troublesome and difficult, on account of the anatomical varieties, to which the termination of the nasal canal was liable, but subject to frequent failures. Hence, it never gained many advocates. Of late, however, it has found one in M. Gensoul, who, in most cases, employs escharotics through the inferior orifice of the nasal canal. He filled it in the dead body with fusible metal, which, becoming cold, formed a model for probes. These are bent nearly at a right angle, about nine or ten lines from their extremity; and near this curve there is a slight lateral inflection, the direction of which must be reversed for the two nostrils. This inflection corresponds to the projection of the nasal

process of the superior maxillary bone." (See *Dict. de Méd. et de Chir.* t. viii.)

Following up the principles of Anel, another French surgeon, Méjean, dilated the nasal duct with a seton, which was drawn up into the lachrymal sac by means of a thread, first introduced from the upper punctum lachrymale. But it was soon discovered, that what was gained on one side, was lost on the other; the lodgment of the thread in the lachrymal duct for several months, and the irritation of its orifice in changing the seton every day, not only causing inflammation of the punctum lachrymale, but even such ulceration and cicatrices, as sometimes destroyed the functions of the parts.

J. L. Petit, sensible of the inconveniences of Méjean's practice, and disgusted with the barbarous imitation of the ancients in cauterising the fistula, sac, and os unguis, conceived that, instead of these plans, or that of perforating the os unguis, as proposed by Woolhouse, it would be better to endeavour to restore the natural passage, by removing the obstruction in the nasal duct, which obstruction Petit regarded as the cause of the disease. His method consisted in opening the lachrymal sac with a small bistoury, introducing through the wound, sac, and nasal duct a probe, down into the nostril, and then using bougies for the dilatation of the passage. Pellier and Wathen recommended the introduction of a metallic tube down the nasal duct, and leaving it for a time in that situation, with the view of preventing the duct from closing again; and the use of a canula was preferred by Dupuytren.

Experience proves that a metallic tube will not serve permanently for the natural duct; after a few months the tube gets out of its place, rises too high, or sinks too low, or becomes obstructed. In some instances it causes inflammation; and, in other examples, severe pain and aching in the corner of the eye, not remediable unless the tube be withdrawn. Mr. Lawrence observes, that the necessity for such removal is not a very rare occurrence, as may be inferred from the circumstance of Baron Dupuytren having devised means expressly calculated for the extraction of the tube. (*On Dis. of the Eye*, p. 714.) M. Darcet records twenty-seven cases in which this became indispensably necessary. In some instances it glides into the nostrils, and the operation completely fails. M. Delpech knew it make its way through the roof of the mouth: the operation of taking it out is worse than the original one. (See *A. Velpeau, Nouv. Elem. de Méd. Opératoire*, t. i. p. 647.)

The desire of avoiding any puncture of the sac has influenced many practitioners besides Anel, and given rise to various ingenious inventions. Thus, in 1780, Sir William Blizard proposed, instead of injecting water, to introduce quicksilver through a small pipe, communicating with a long tube full of this fluid. The specific gravity of the quicksilver, when the sac was distended with it, he believed, would have more power, than water propelled through a syringe, to remove the lachrymal obstruction. (See *Phil. Trans.* vol. xx. p. 239.)

The late Mr. Ware, after trying Sir William Blizard's plan, gave the preference to Anel's syringe, with which he generally injected warm water, through the lower punctum lachrymale, into the lachrymal sac, and put a finger over the

superior punctum to prevent the fluid from escaping through it. With his finger, he also occasionally compressed the lachrymal sac, in order to assist in propelling the water down into the nose. He sometimes used the injection thrice a day, though, in general, less frequently.

"I in general begin the treatment by injecting some warm water through the inferior punctum lachrymale, and I repeat the operation four or five days in succession. If, in this space of time, none of the water pass through the duct into the nose, and if the watering of the eye continue as troublesome as it was before the injection was employed, I usually open the angular vein, or direct a leech to be applied near the lachrymal sac; adding here a caution, that the leech be not suffered to fix on either of the eyelids, lest it produce an extravasation of blood in the adjacent cells. About the same time that blood is taken away in the neighbourhood of the eye, I usually vary the injection, and try the effects either of a weak vitriolic, or anodyne, lotion. In some instances, also, when I have found it impossible, after several attempts, to inject any part of the liquid through the duct, I have introduced a golden probe, about the size of a bristle, through the superior punctum lachrymale, and attending to the direction of the duct, have insinuated its extremity through the obstruction, and conveyed it fully into the nose; immediately after which I have found, that a liquid injected through the inferior punctum, has passed without any difficulty: and by repeating these operations for a few successive days, I have at length established the freedom of the passage, and completed the cure. In other instances, I have recommended a strongly stimulating sternutatory to be snuffed up the nose, about an hour before the time of the patient's going to rest, which, by exciting a large discharge from the Schneiderian membrane, has sometimes also greatly contributed to open the obstruction in the nasal duct."

When the discharge was fetid, Mr. Ware sometimes found that the zinc lotion, injected into the sac, quickly corrected the quality of the matter.

In a subsequent tract, Mr. Ware observes, that if, after "about a week or ten days, there be not some perceptible advance towards a cure, or if, from the long continuance of the obstruction, there be reason to fear, that it is too firmly fixed to yield to this easy mode of treatment, I do not hesitate to propose the operation which is now to be described. The only persons, with respect to whom I entertain any doubts as to the propriety of this opinion are infants. In such subjects, I always think it advisable to postpone the operation, unless the symptoms be particularly urgent, until they are eight or nine years old.

"If the disease has not occasioned an aperture in the lachrymal sac, or if this aperture be not situated in a right line with the longitudinal direction of the nasal duct, a puncture should be made into the sac, at a small distance from the internal juncture of the palpebre, and nearly in a line drawn horizontally from this juncture towards the nose, with a very narrow spear-pointed lancet. The blunt end of a silver probe, of a size rather smaller than the probes that are commonly used by surgeons, should then be introduced through the wound, and gently, but steadily, be pushed on in the direction of the nasal duct,

with a force sufficient to overcome the obstruction in this canal, and until there is reason to believe, that it has freely entered into the cavity of the nose. The position of the probe, when thus introduced, will be nearly perpendicular: its side will touch the upper edge of the orbit; and the space between its bulbous end in the nose and the wound in the skin, will usually be found, in a full-grown person, to be about an inch and a quarter, or an inch and three eighths. The probe is then to be withdrawn, and a silver style of a size nearly similar to that of the probe, but rather smaller, about an inch and three-eighths in length, with a flat head like that of a nail, but placed obliquely, that it may sit close on the skin, is to be introduced through the duct, in place of the probe, and to be left constantly in it. For the first day or two after the style has been introduced, it is sometimes advisable to wash the eye with a weak saturnine lotion, in order to obviate any tendency to inflammation which may have been excited by the operation; but this in general is so slight, that I have rarely had occasion to use any application to remove it. The style should be withdrawn once every day for about a week, and afterwards every second or third day. Some warm water should each time be injected through the duct into the nose, and the instrument be afterwards replaced in the same manner as before. I formerly used to cover the head of the style with a piece of adhesive plaster spread on black silk, but have of late obviated the necessity for applying any plaster by blackening the head of the style with sealing wax."

On first trying this method, Mr. Ware did not expect any relief, till the style was left off. However, he found, that the watering of the eye ceased as soon as the style had been introduced, and the sight became proportionably more useful and strong.

The wound was only just large enough to admit the end of the probe or style; and this soon became a fistulous orifice, through which the style could be passed without pain.

Some, finding no inconvenience from the style, and being afraid to leave it off, wear it for years; many others disuse it in about a month, or six weeks, and continue quite well. The ulcerations, sometimes existing over the lachrymal sac, commonly heal, as soon as the tears can pass down into the nose; but Mr. Ware mentions two instances, in which such sores did not heal until bark, and small doses of the bichloride of mercury, had been administered.

Mr. Travers is strongly disposed to doubt, whether any permanent benefit was ever derived from letting the style remain in the passage. When an abscess over the sac has been opened, this gentleman, instead of the introduction of a style into the ductus nasalis, recommends simply the examination of the duct with a fine probe. "If the probe passes without resistance into the nose, the case requires no further operative treatment; the integument recovers its healthy condition under an emollient application; the discharge gradually diminishes and the wound heals. If, on the other hand, upon examination with the probe, introduced, through the wound into the sac, resistance is offered to its passage into the nose, no more favourable opportunity will be presented for overcoming such resistance. This, therefore, should be accom-



plished, but to this the operative process should be limited, and the wound should be suffered to heal without further disturbance.' When there is what Mr. Travers terms a stricture in the nasal duct, and the passage of the probe is more firmly resisted, he admits that some means must be employed for keeping the duct pervious, after it has been reopened. He never interferes with the integuments, except in the case of abscess discolouring the skin, and threatening to produce a fistula; and for the purpose of restoring the passage, he uses a set of silver probes, about five inches long, of various sizes, flattened at one end, and slightly bulbous at the point. When there is no obstruction, these, he says, may be introduced with perfect facility from either of the puncta lachrymalia into the nostril. 'If the punctum be constricted, it is readily entered, and dilated by a common pin; and upon withdrawing it, by one of the smaller probes. The direction and relative situation of the lachrymal ducts, the sac, and nasal canal, point out the proper course of the instrument. It is confirmed by its advance, without the employment of force, and the sensation conveyed by the free and unencumbered motion of its point. Until the point is fairly within the sac, it is necessary to keep the eyelid gently stretched and slightly everted: the upper lid being drawn a little upward towards the brow, the lower, as much downward toward the zygoma. The point carried home to the sac, and touching lightly its nasal side, the lids may be left at liberty while a half-circular motion is performed by the instrument; the surgeon neither suffering the point to recede, nor, on the other hand, allowing it to become entangled in the membrane. The probe now rests in a perpendicular direction, upon the eyebrow, towards its inner angle, and, in this direction it is to be gently depressed, until it strikes upon the floor of the nostril, where its presence is readily ascertained by a common probe passed beneath the inferior turbinated bone. The probe, of smallest dimensions, is of sufficient firmness to preserve its figure in its passage through the healthy duct, but it is too flexible to oppose any considerable obstruction. For the stricture of the lachrymal ducts, it is of sufficient strength. Very many cases of recent origin, and in which the stricture has no great degree of firmness (Mr. Travers says) are completely cured by three or four introductions of the probe into the nostril, at intervals of one or two days. I have seldom met with a stricture so firm as not to yield to the full-sized probe.' When the resistance is not altogether removed after this plan has been tried some days, Mr. Travers introduces a style, having a small flat head, a little sloped, through the punctum lachrymale into the nose, and leaves it in the nasal duct for twenty-four hours. If worn longer, he says, that it causes ulceration of the orifice. A day or two is to elapse before the style is again introduced, which must now be passed through the other lachrymal duct. On the intervening days, tepid water should be injected with Anel's syringe. (*Synopsis of the Diseases of the Eye*, p. 369, 370, 372, 374.)

Supposing the nasal duct to be obliterated, for a considerable part of its extent, by a firm substance, what practice should be followed? Ought the formation of an artificial passage to be attempted? On this point modern practitioners differ; but, as the expedients, adopted for this purpose,

cannot be judged of previously to their description, it will be better in the first place briefly to notice them. As Pott has remarked, the upper and hinder part of the lachrymal sac is firmly attached to the os unguis, a small, and very thin bone, just within the orbit, which bone is so situated, that, if it be by any means broken through the two cavities of the nose and orbit communicate with each other; consequently, the os unguis forms the partition between the hinder part of the lachrymal sac, and the upper part of the cavity of the nose; and it is by making a breach in this partition, that the formation of an artificial passage has been attempted. In Pott's time, the cautery had long been disused for making an aperture in the os unguis, and various instruments were recommended for this object, such as a large strong probe, a kind of gimlet, a curved trocar, &c., each of which, says this practical writer, if dexterously and properly applied, will do the business very well: the only necessary caution is, so to apply whatever instrument is used, that it may pierce through that part of the bone which lies immediately behind the lachrymal sac, and not to push it too far up into the nose, for fear of injuring the os spongiosum behind, while it breaks its way. Pott always used a curved trocar, the point of which was turned obliquely downward, from the angle of the eye, towards the inside of the nose. The accomplishment of the breach was known by the discharge of blood from the nostril, and of air from the wound, upon blowing the nose.

As soon as the perforation had been made, Pott introduced a tent of lint, and afterwards a piece of bougie, or a leaden canula.

Ware preferred a nail-headed style, about an inch long, which was worn for as long a time as was thought necessary to establish the freedom of the communication.

Unfortunately for the scheme of making an artificial passage, nature was generally so busy, that she completely frustrated the aim of the surgeon by gradually filling up the new aperture again. Hence, some practitioners were not content with drilling a hole through the os unguis, but actually removed a portion of this bone, either with the forceps proposed by Lamorier in 1729 (see *Mém. de l'Acad. des Sciences*), or with cutting instruments, amongst which the most celebrated is the sharp-edged kind of canula devised by Hunter. While this was being applied, however, it was necessary to support the os unguis with something passed up the nose, and a piece of horn was found to answer very well.

I do not feel it necessary to enter further into the details of these methods of forming an artificial passage between the lachrymal sac and nostril. I have never seen a case in which I should have deemed such practice advisable; and that the necessity for it must be rare, may be inferred from what Mr. Travers has observed, viz. that he does not believe the perforation of the os unguis ever really required. (*Synopsis*, &c., p. 379.) Beer's remarks are also decidedly against the practice; for he states, that, in order that the new opening may not be closed with lymph, it must be made too high up to serve the purpose of a drain, through which the mucus can descend by its own gravity. He has not met with a single case, either in his own practice, or amongst the patients whom he has had opportunities of seeing under other practitioners,

where the perforation of the os unguis had a successful result. On the contrary, in one healthy lad, the operation, which had been done by an experienced surgeon, was followed by the destruction of the nasal process of the upper maxillary bone, one of the ossa nasi, and all the bones contributing to the formation of the passage from the orbit into the nose. (See *Lehre von den Augenkr.* b. ii. p. 182.) Hence, Beer thinks, that the patient had better either submit to the inconvenience of being obliged to empty the distended sac by pressure several times a day, or let the cavity of the sac be obliterated by means calculated to excite the adhesive inflammation in it. But if the lachrymal puncta and ducts, as well as the nasal duct, are obliterated, Beer conceives that there is no alternative; because, if the cavity of the sac be left, the case, which he terms *hydrops sacculi lachrymalis*, will ensue, whenever the fistula is closed.

*Of Hernia and Hydrops of the Lachrymal Sac.*—The diseases, described by Beer under these appellations, are not discriminated in this country, although they are characterised by widely different symptoms, and require opposite methods of treatment. In the case of hernia, or simple relaxation, the lachrymal sac forms a tumour which never surpasses the size of a common horsebean, the integuments are of their natural colour, the tumour is soft and yielding to pressure, by which the contents of the sac are readily discharged through the puncta, or nasal duct. Hydrops grows to the size of a pigeon's egg, is purplish from the beginning, very hard, and incapable of being emptied by the strongest pressure. Hernia is cured by compression, and the application of astringents to the relaxed parts; hydrops requires the incision of the sac. In hernia, the nasal duct is natural; in hydrops, it and sometimes the puncta are obstructed.

*Stillicidium Lachrymarum.*—According to Beer, the valuable treatise of Schmidt is the only work, in which the important practical distinction is drawn between *stillicidium lachrymarum* and *epiphora*; the immediate cause of the first complaint being some impediment to the passage of the tears from the lacus lachrymarum into the lachrymal sac; while the other affection consists in a redundant and extraordinary secretion of the tears. The curable form of *stillicidium*, here to be noticed, arises from relaxation of the lachrymal puncta and canals, in consequence of previous inflammation of the parts. The puncta are widely open; but, in other respects, have quite a natural appearance. When touched with Anel's probe, they do not contract, as in the healthy state. The tears, which from time to time fall over the cheek, are not in considerable quantity, only trickling from the inner canthus by drops at intervals; and the nostril on the affected side is found to be rather drier than natural.

Erysipelatous inflammation of the eyelids and parts over the lachrymal sac, and the purulent kinds of ophthalmia, frequently cause this sort of *stillicidium*. The latter cases, indeed, the more readily produce the disorder, inasmuch as the semilunar fold of the conjunctiva is relaxed and swelled, so as to push the puncta out of their right position for the due performance of the absorption of the tears, and obstruct this function more than would be the case, if the diminished action of those orifices and the lachrymal ducts were the only thing concerned.

Beer delivers an exceedingly favourable prognosis, observing, that the complaint often disappears of itself on the approach of warm dry weather, and may be readily cured, by means of astringents. Amongst other remedies specified by this author, I need only mention a solution of the sulphate of iron, to which a small quantity of camphorated spirit, or tincture of opium, has been added. It is to be dropped out of a pen into the inner angle frequently in the course of the day, the patient lying upon his back for some time after each application, so as to let the remedy have more effect upon the parts. (See *Lehre von den Augenkr.* b. ii. p. 41—43.)

Mr. Travers mentions a constricted state of the lachrymal puncta and canals, which is curable by the introduction of a small probe. (*Synopsis*, &c., p. 366.) All modern writers agree, that the obliterated puncta and canals can never be restored.

[The following remarks of Mr. Bowman (taken from the Ophthalmic Hospital Reports, October 1857 and January 1858) contain everything new which has been introduced into this branch of surgery. "In the Medical and Chirurgical Transactions for the year 1851 is a paper on a new method of treating certain cases of epiphora, in which I showed the advantages of laying open the lachrymal puncta, on the side towards the conjunctiva, when they had become everted and dry, thus carrying backwards the orifice to a point where the tears could enter the canal. Of this method I shall only say that subsequent experience has confirmed my opinion and rendered this the established practice.

Both before and since the above date, my attention has been largely given to the treatment of lachrymal obstructions—on account of their frequency, their intractable and obstinate nature, and the exceedingly unsatisfactory results of the modes of treatment in common use. Indeed, from the peculiar and complex construction of the parts concerned, from their small size and tortuous disposition, there is no subject in the whole range of surgery which has been more troublesome to our predecessors, or that more invites the study of those who would fain leave science more advanced than they found it.

As if to sum up the difficulties which surround the cure, or even relief, of the more serious cases of chronic obstruction of the sac, there has arisen within a few years the practice of laying it open from top to bottom, and altogether destroying it with the heated iron, a plan said to be effectual, but, if so, by the more complete closure and obliteration of the organ diseased." (See below, treatment of Mr. Desmarres.) "I would now refer to cases of chronic inflammation of the sac, with mucus or pus, or both at once, or at different times, occupying its cavity, either impacted there, or discharging more or less freely under pressure, either forwards, into the nose by the nasal duct, or backwards, on to the eye, through one or both of the canaliculi.

The various expedients hitherto in use for relieving this condition, without inserting a style or tube through the skin into the sac and down the nasal duct, to be worn for a certain time, may be said to have signally failed, though occasionally attended by partial or temporary benefit. Such expedients are leeches, blisters, injections of warm water or various astringents, the frequent passing of such



hair probes, as the puncta will admit, together with suitable constitutional treatment. The inflammation in those cases often varies in intensity, subsiding and reappearing, and such subsidiary means do often add to comfort. The patient, too, by frequently pressing out the mucus, may often succeed in abating his annoyance and keeping it in check. But, nevertheless, it almost always happens that the distress continues, and is very apt sooner or later to end in abscess.

The insertion of a style or tube through an opening made in front of the sac below the *tendo oculi*, has been the last and common resource in obstinate cases, where the disease has worn out the patience of the sufferer and the surgeon. It is an expedient, so objectionable in itself, as never to be resorted to till the last moment. It is unsightly, especially in females; it is painful, and the patient has constantly to wipe away the discharge escaping by the orifice. The puncture made to admit the style is also frequently followed by the formation of an abscess outside the sac, spreading under the orbicularis muscle and apt to grow into that serious complication, a sinuous ulcer, for the cure of which free division, and sometimes excision, of the overlying skin is necessary. During several years, in which I was in the habit of using the style, I studied its inconveniences and devised a remedy for some of them. In particular, I found it desirable to make the first opening large enough to allow of the free escape of the discharges from the sac, by the side of the neck of the style; for, if the orifice were made too small, an abscess between the sac and the skin was very prone to follow. But this large preliminary opening was apt to allow the head of the style to bury itself in the sac, an inconvenience not always obviated by a thread secured by plaster to the forehead, and I therefore came to use, in the first instance, a style so long as to rest on the floor of the nose, while the head just stood outside the orifice in the skin. The length was adapted in each case to the requisite depth of the parts, ascertained by a probe, the styles being made of extreme length and shortened, at the moment, by cutting pliers, and the lower end smoothed on a hone. As the inflammation following the puncture subsided, and the orifice gradually contracted with the progress of the cure, the length of the style was from time to time diminished, so as to keep the head upon the skin. But I have now in ordinary cases altogether abandoned the use of the style inserted by the skin. It is found necessary, by those who use the style, to continue it for periods varying from six weeks to six months, and some patients seem to wear it permanently. If the condition of the parts allows of its removal, either the orifice heals or remains fistulous. If it heals, and a relapse of the sac inflammation occurs (no unusual thing) the whole process has to be repeated: a fistulous opening is a continual annoyance. The expedient to which some surgeons have been led—of introducing a style or tube by the skin, and burying it in the sac and nasal duct, healing the skin over it, has been an attempt to escape from the annoyances of the external opening, but such metallic substances usually act sooner or later as foreign bodies, causing abscess and the utmost difficulty in extracting the offending cause. Of this I have had several examples.

The inconveniences of the style are indeed such that it is seldom resorted to till the last moment,

when pus has formed in the sac, or perhaps an abscess is threatening or has burst, the surgeon and patient being almost equally unwilling to have recourse to it, and wasting their time on the temporising and palliative measures first alluded to, which seldom effect a cure, or do more than keep the annoyance in check.

Influenced by these considerations, and having in view the perfectly innocent result of laying open the punctum where it was everted, I began as early as 1851, to slit it up as far as the caruncle in all cases of lachrymal obstruction, and have since, by degrees, arrived at a method of treating almost all such obstructions without opening the skin at all. In fact, I have found it possible to treat the greater number of cases, mechanically, through the upper or lower canaliculus thus opened at the punctum, by passing probes of suitable size downwards into the nose, thus commanding the entire length of the passages, and not being limited, as by the old method of the style, to occlusions of the nasal duct. In this way I have arrived at some facts, not previously ascertained, as to the history of these obstructions, and have adapted the treatment to them respectively. I have avoided the inconveniences of the opening in the skin, and have established at the very commencement of the treatment a permanent opening, unseen and attended by no inconvenience, through which the use of the treatment by probes can, at any time, be at once resumed in the event of relapses.

In the course of my investigations, I have kept constantly in view the analogy of these obstructions with those of the urinary passages; they are in many respects closely allied and mutually illustrative; and I have borrowed from our experience of urethral strictures, some hints applicable to the treatment of those of the tear-ducts. Before the proposal to slit up the punctum, some anatomists may have been aware that the canaliculi were capacious ducts, large enough to admit an ordinary probe; but, certainly, surgeons took no account of that important fact. They have been syringed, and probes have been passed down them (I had done it a hundred times myself), but the instruments employed were only such minute ones as the puncta would admit, namely, of the size of a horse-hair. It may be even true that such probes have been passed into the nose, but their effect, even then, can have been only such as would be produced on an urethral stricture, if the surgeon were restricted to the use of the smallest urethral bougie; they may have passed the stricture, but can have done little to dilate or cure it.

When I first began to slit up the puncta I became aware that the canaliculi were naturally capacious enough to admit a probe of one-twentieth of an inch diameter or more, and finding, not unfrequently, that strictures existed in the canaliculi, sometimes about the middle, but oftener close to the sac, I had a series of probes constructed, reaching from a fine hair-probe (No. 1) to one of one-twentieth of an inch diameter (No. 6). For convenience in use, I have three probes, the six ends of which give the six sizes required, and the larger of which are so bent as to facilitate their passage through the nasal duct, as hereafter to be noticed.

In the great majority of cases of sac-obstruction, a simple epiphora precedes for a considerable period the more inflammatory stages; there is regurgitation only of tears at first, afterwards of mucus and of

pus; the two latter being often rather sudden in their appearance, and often following immediately on a cold or catarrh or some stomach-derangement. The moment the secretions from the lining of the sac become too thick to escape easily, either through the canaliculi or nasal duct, they appear at once to aggravate the inflammation by mechanical distension; and I was enabled to assign much benefit to the opening of the punctum, merely on the ground of the greatly increased facility, with which the discharge could then escape on to the eye, either spontaneously or on slight pressure. The punctum too, having, no doubt, the attributes of a sphincter, is often highly sensitive, and its lips turgid and angry, when the passages are inflamed; and great immediate relief to the whole disease seems often to follow its division—much, perhaps, of the same kind as that which follows the division of the sphincter ani in irritable fissure of the rectum.

The punctum is most conveniently slit up as follows:—

The patient sits in a chair and leans the head against the chest of the surgeon, who stands behind and bends over. For dividing e.g. the left lower punctum, the ring finger of the left hand is placed on the skin over the lower edge of the orbit and fixes it there, while tightening or relaxing the lower canal by a sliding movement of the skin upon the bone, the punctum being at the same time everted. The right hand now inserts the No. 1 probe while the canal is relaxed, and then places the probe between the hinder finger and thumb of the left hand, which holds it in the canal, and further everts the punctum by turning the probe downwards on the cheek, while the ring finger stretches and fixes the canal by a sliding movement of the skin outwards, toward the malar bone. A fine, sharp-pointed knife held in the right hand now slits up the canal on the everted conjunctival aspect, from the punctum, as far as the caruncle, and the probe is raised on its point out of the canal, to make sure that the edge of the punctum has not escaped division. Care should be taken not to slope this little incision obliquely through the tissues it severs, as there is then a broader surface exposed and greater chance of union by the first intention. To avoid this, it is in all cases desirable to pass a probe across the line of incision, on each of the few ensuing days, to break through the adhesions if they form, and to secure patency. If the punctum is slit up when already inflamed and discharging pus, there is much less disposition to this primary union than when it is done for simple epiphora.

Having slit up one or both puncta, as may seem desirable, the canals are at once probed to ascertain whether they are of full size. Where the fluids of the sac regurgitate towards the eye, there is usually no contraction that may not be at once overcome by a full-sized probe (No. 6): but it is well to have noted beforehand, whether regurgitation occurs from both puncta, and in the first instance to be content, in ordinary cases, with slitting up the lower punctum, inasmuch as this usually suffices for the cure, and it is through this that the passages can be most conveniently probed in their whole extent, down to the nose.

In examining the canal for stricture, some experience and tact are requisite to avoid errors, just as in the examination of urethral strictures. The in-

strument should be handled very delicately, and the probe held by the surgeon in the same way as when the puncta have to be slit, and he should of course have in his mind's eye at the moment the anatomy of the parts with which he is dealing—no force should be used. If No. 6 will not pass, No. 4 or No. 2 may be tried, and if these fail, it is better to postpone further proceedings, till a few days have elapsed and the slit in the canal is permanently established. Speaking loosely of the general result of a great many cases, I may say that I have not found any stricture in the canals in more than one-fourth, and that the common situation of the stricture has been close to the sac, less frequently about the middle part of the canal. The stricture of the middle parts is commonly in old cases, where there is rigid thickening of the coats, and probing by instruments successively larger suffices to dilate it. The canal should be stretched lengthwise as the probe reaches it, as its passage is thereby facilitated; for it is easy to fold the canal before the point of the probe. The greatest care is to be taken to proceed gently and not too rapidly; as, if a false passage be formed and the wall of the canal torn, the injured part is liable to become more rigidly occluded.

If the exploratory probe is arrested at the point, where the canals coalesce and join the sac, the fact may be known, by noticing that the skin near the tendo oculi is moved when the probe is moved and an elastic resistance is experienced; whereas, if the probe has entered the sac, it hits against the inner bony wall, and the skin is motionless. Where the sac is not distended, attention to this point is particularly necessary, and it is also requisite that the canal should be held on the stretch by the finger on the cheek, otherwise the outer wall of the sac may be pressed against the inner, and give a wrong indication, for the opposite walls are very near each other. Care must also be taken, when an obstacle is encountered, to turn the point of the probe in different directions, urging it gently forwards in each, for otherwise it may merely be caught in a fold of membrane at the orifice of the sac. If there is decided obstruction still, the probe may be forced here, and if it does not then at once pass into the sac (and particularly if, the sac being distended, there is no regurgitation by the canal), I have recourse to the canula lancet described in the *Annales d'Oculistique* of 1855-6, and, after piercing the obstruction, immediately pass the largest-sized probe (No. 6).

Such strictures of the canals, when once they admit a No. 6 probe, are treated by its repeated use at suitable intervals, in conjunction with the treatment of the passages below, and therefore they need not be further separately dwelt upon.

I have now to describe the subsequent steps of the treatment. In all cases I prepare to explore the nasal duct, by pushing down the No. 6 probe into the nostril. When the sac discharges pus or mucus, this always has to be done again and again, in order thoroughly to open the duct, and even where the sac is not inflamed, it is satisfactory to have passed the probe once.

The passage of a probe or style in the old method, through an orifice in the skin, is not always an easy task. There is frequently a firm closure of the nasal duct, requiring the use of considerable force to overcome it, and a surgeon with-



out experience is apt to be timid, or to make pressure in a false direction. In fact, with the old style or probe, which was always straight, it was often impossible to find the lower orifice of the sac, and the rude force exerted was apt to make the end of the style scrape the surface of the bone and detach the membrane from it. When the probe is introduced in my method, from the canal, it enters the sac behind the tendo oculi, and is in a better position for finding, as it were, the orifice of the nasal duct. But to make this proceeding as easy as possible, I have my larger probes (Nos. 5 and 6, which are the only ones used for this purpose) slightly curved at each end in two different directions, within the terminal inch or inch and a half, while the central part (or that held by the finger and thumb) is straight, and they are cylindrical in their whole length. The effect of this is, that when the probe is inserted into the sac, and brought into a vertical position, a slight rotation of it on its long axis makes the lower point, which is in search of the orifice of the duct, describe a small circle; and by slightly varying the inclination of the probe, and making gentle pressure at the same time, with slight rotation, the point never fails to enter the duct. The right and left probes have opposite curves, to suit the inclination of the duct.

The probe is known to have entered the nostril by the depth to which it has passed, compared with the external position of the nostril, and also by its coming in contact with the floor of the nose. It is allowed to remain there for a few minutes, or is immediately withdrawn according to circumstances.

In an ordinary case of chronic inflammation of the sac, I consider the cure well begun, and often half accomplished, as soon as a full-sized probe has thus passed into the nose through the whole course of the natural channels. To repeat the probing is a very simple process, the enlarged punctum being always ready to admit it, and the proceeding being usually more easy each time it is practised. I repeat the probing every day, every other day, every three or four days, or every week, according to the progress of the case, and accidental circumstances. It usually becomes at once easy for the patient to press mucus or pus from the sac, as it is secreted, both by the canaliculus and nasal duct; he is enjoined to do this very frequently, and hot fomentations are used if required. It is common to find in a few days, that no more pus is formed, and in a few weeks that mucus ceases to accumulate. In many cases the relief to the epiphora is immediate, and the patients are made at once much more comfortable, losing all that distress that has been occasioned by the distension of the cavity of the sac, and the congestion of its lining membrane.

Rather more than a year ago, I contrived a mode of inserting a style by the canaliculus and leaving it for a certain time in the passages, in order to open them on the principle of the old style. The style was made to taper rather suddenly at one end, and it was bent at about a right angle, so that the thick part should be placed vertically in the sac and nasal duct, and the thin part horizontally in the canal. The length of the thick part was adapted in each case by the surgeon, so as to extend from the point at which the canal enters the sac downwards as far as the floor of the nostril, on which it rested, being thereby prevented from falling too low and burying itself out of sight.

The proper length was ascertained previously by measurement by a probe. The horizontal part was in like manner adapted to reach to a point of the canal midway between the caruncle and the punctum, and a bend was given to it, making it lie exactly within the canal, concealed from view in the channel formed by the slitting up of that passage. The material was silver, and the ends, after being cut to the requisite length, were carefully rounded, and the thin one tipped with sealing-wax.

These bent styles, when suitably adjusted, I found could be generally worn with very little inconvenience for a few days, and admitted of being readily removed and re-inserted, and I still employ them when the stricture is dense and obstinate, or when a rapid opening of it is required. But they sometimes occasion trouble and become a source of irritation, and they may even produce ulceration of a portion of the canal, if badly fitted or if left in too long—as, for example, when the patient has absented himself during the treatment. I, therefore, prefer to treat the obstructions in almost all cases by the intermittent use of the probe, as already described, and especially as the results of that method are so satisfactory. I do not recommend the bent styles for general adoption. In speaking of the rapid relief or ease of cases thus treated, I must not omit to say, that of course I do not neglect such general and local means as are familiar to all, and which were at first enumerated. They are useful as aids, but without the surgical interference would be unavailing. Nor do I wish to have it thought that all cases get well at the same rapid rate, or that relapses never occur. Unfortunately these cases of obstructed ducts generally occur in subjects more or less debilitated, scrofulous, or otherwise unhealthy, and there may be complications of disease of neighbouring parts, or of the Schneiderian membrane. But all these inconveniences belong to the old method even more than to mine, the advantage of which is, as I conceive, that it effects the opening of the passages in the most simple way conceivable, and with the least possible interference with the natural structures. It therefore seems preferable, not merely in itself, but also inasmuch as it is able to be employed in the required degree and extent, and in that only, at a period of the disease however early, and under all contingencies of relapse; and therefore, if generally adopted, it may be expected to alleviate the severity and diminish the number of these distressing affections, which have been hitherto hardly less troublesome to the surgeon than to the patient.

I must also state that there are cases of an aggravated nature, which have passed beyond the stages at which the above simple treatment is available—"where abscess has formed, where the sac has enormously dilated and thickened, where bone is diseased, where styles have been previously worn, and fistulous orifices exist. My hope is, that such cases will gradually now become less frequent."

"To facilitate the slitting up of the punctum, a minute director may be substituted with advantage for No. 1 probe. It has been made by Mr. Weiss, at the suggestion of Mr. Critchett, and consists of steel coated with gold by the electrotype process. It is sufficiently thick in the stem to give it firmness, and one end is reduced to a very fine size,

and grooved to within a line of the extremity, which is of the size of No. 1 probe. It is used in the way described above.

I may take this opportunity of saying once again, how cautious it is necessary to be in the manipulations upon the canaliculi, particularly when they are the seat of stricture, and how desirable to proceed gradually from one step to another, not neglecting subsidiary points of treatment. I may also state that when one canaliculus is strictured and the other open, I prefer to proceed with the treatment of the sac and nasal duct through the open canaliculus, leaving the other alone; for a stricture of one canaliculus is often for itself insufficient to cause any epiphora, and if the sac inflammation and the stricture of the nasal duct can be cured by probes conveyed through the open canaliculus, the patient is relieved effectually, even should the other remain strictured, which it often does not. In such instances, however, I always slit up both puncta."

Mr. Bowman's treatment of lachrymal obstructions is the one generally employed. Cauterization of the lachrymal sac with the actual cautery (*M. Desmarres' method*, pp. 393-414, vol. i. ed. 2) has been tried in some forty cases, none of which were satisfactorily cured.] *C. Bader*.

See *Mém. de l'Acad. de Chir. t. v. edit. 12mo.*, in which are several essays on fistula lachrymalis: viz. one by *M. Bordenave*, entitled "Examen des Réflexions Critiques de M. Molinelli, insérées dans les Mémoires de l'Institut de Bologne, contre le Mémoire de M. Petit, sur la Fistule Lachrymale, inséré parmi ceux de l'Acad. Royale des Sciences des Paris, année 1734." Another essay, by *M. de la Forest*, styled "Nouvelle Méthode de traiter les Maladies du Sac Lachrymal, nommées communément Fistules Lachrymales." A third by *M. Louis*, called "Réflexions sur l'Opération de la Fistule Lachrymale." *J. L. Petit*, *Traité des Mal. Chir. t. i. p. 289, &c. 8vo. Paris, 1774.* *A. Bertrandi*, *Traité des Opérations*, p. 297. 8vo. Paris, 1784. *Anel* has described his plan of treatment in various works: "Obs. singulière sur la Fistule Lachrymale, dans laquelle l'on apprendra la Méthode de la guérir radicalement." Turin, 1713, in 4to. "Nouvelle Méthode de guérir les Fistules Lachrymales." Turin, 1713, in 4to. "Suite de la Nouvelle Méthode," &c. *Ibid.* 1714, in 4to. "Dissertation sur la Nouvelle Découverte de l'Hydropisie du Conduit Lachrymal." Paris, 1716, in 12mo. And, lastly, *Anel* has published, in the *Mém. de l'Acad. des Sciences*, année 1713, "Précis de sa Nouvelle Manière de guérir les Fistules Lachrymales." *Mejean*, in *Mém. de l'Acad. de Chir. t. ii. p. 193. 4to.* *Palucci*, *Methodus curandæ Fistulæ Lachrymalis*, Vindob. 1762; a tube preferred. *Richter's Anfangsgründe der Wundarzneikunst*, b. ii. kap. 14. *Pott's Obs. relative to Fistula Lachrymalis*, 8vo. Lond. 1758. *Sir W. Blizard*, *A New Method of Treating Fistula Lachrymalis*, 4to. Lond. 1780. *Ware* on Epiphora and Fistula Lachrymalis, 8vo. Lond. 1792-95. *Scarpa*, sulle principali Malattie degli Occhi, capo 1. *Wathen's New and Easy Method of applying a Tube for the Fistula Lachrymalis*, Lond. 1781, and 2d. ed. 1792. *Sprengel*, *Geschichte der Wichtigsten Chir. Operationen*, p. 105. *Nicod*, *Mém. in Révue Méd. Historique*, &c. livr. i. et ii. 8vo. Paris, 1820. *Fournier*, *Dis. de l'Appareil des Voies Lachrymales*, Montpellier, 1803. *J. L. Angely*, *De Oculo Organisque Lachrymalibus ratione Etatis, Sexus, Gentis, et Variorum Animalium*, 8vo. Erlangæ, 1803. *J. A. Schmidt*, über die Krankheiten des Thränenorgans, 8vo. Wien. 1803. *Reil*, *Dis. de Chir. Fistulæ Lacrymalis Curatione*, Berol. 1812. *Flajani*, *Collezione d'Osservazioni*, t. iii. *Desault*, *Œuvres Chir. t. ii. p. 119.* 8vo. Paris, 1801. *J. C. Rosenmüller*, *Partium Externarum Oculi Humani, imprimis Organorum Lachrymalium, Descriptio Anatomica; iconibus illustrata*, 4to. Lips. 1810. *C. H. T. Schreger*, *Versuch einer Vergleichenden Anatomie des Auges und der Thränenorgane des Menschen und der übrigen Thierklassen*, 8vo. Leipz.

1810. *Beer*, *Lehre von den Augenkrankheiten*, b. ii. 8vo. Wien, 1813-17. *Wm. Mackenzie*, *Essay on the Dis. of the Excreting Parts of the Lachrymal Organs*, 8vo. Lond. 1819; and in *Treatise on Dis. of the Eye*, ed. 2. 8vo. Lond. 1835. *B. Travers*, *Synopsis of the Diseases of the Eye*, p. 228-359, &c. 8vo. Lond. 1820. *W. Lawrence*, on Dis. of the Eye, chap. 29. 8vo. Lond. 1833. *R. Middlemore*, on Dis. of the Eye, chap. 22. vol. ii. 8vo. Lond. 1835. *Ph. v. Walther*, ueber die steinigern Concretionen der Thränenflüssigkeit, in *Journ. für Chirurgie von C. Graefe*, b. i. p. 163. 8vo. Berlin, 1820. *M. le Baron Dupuytren*, in *Leçons Orales de Clinique Chir. t. iii. art. 9.* 8vo. Paris. 1833. [*Mackenzie*, on the Diseases of the Eye, ed. 4. 1854. *Desmarres*, *Traité Théorique*, etc., ed. 2. 1855. *Ophthalmic Hospital Reports*, 1855: *Bowman*, *Med. Chir. Trans.* 1851, and *Ophthalmic Hospital Reports*, set 1857, and Jan. 1858.]

**LAGOPHTHALMIA** (from *λάγος*, a hare; and *ὀφθαλμός*, an eye). *Hare's Eye*, *Oculus Leporinus*.—A disease in which the eye cannot be completely shut. The following complaints may arise from it—a constant weeping of the organ, in consequence of the interruption of the alternate closure and opening of the eyelids, which motions so materially contribute to the propulsion of the tears into the nose; blindness in a strong light in consequence of the inability to moderate the rays which fall on the eye; on the same account the sight becomes gradually weakened; there is incapacity to sleep where there is any light; and irritation, pain, and redness of the eye, from its being exposed to extraneous substances in the atmosphere.

An enlargement or protrusion of the whole eye, or a staphyloma, may obviously produce lagophthalmia. But affections of the upper eyelid are the common causes. Now and then lagophthalmia depends on paralysis of the orbicularis muscle. A cicatrix is the most frequent cause.

When lagophthalmia arises from a paralytic affection of the orbicularis palpebrarum, the eyelids may be rubbed with a liniment containing the tinctura lyttæ, or the linimentum camphoræ. Electricity or galvanism may be tried, together with bark, the shower bath, &c.

When the affection arises from spasm of the levator palpebræ superioris, the surgeon may try a blister on the temple, rub the eyebrow or eyelid with the tinctura opii, or a solution of belladonna or atropine, and prescribe antispasmodic remedies.

When lagophthalmia arises from the contraction of a cicatrix, its relief is to be attempted on the same principles as in ectropion.

[**LARYNGOSCOPE**. The discovery of the laryngoscope was announced before the Hunterian Society by Dr. Benjamin Babington, in March, 1829, when he exhibited his instrument, which consisted of an oblong piece of looking glass set in silver wire, with a long shank. Previous to this, the idea of illuminating the cavities of the body was conceived by Bozzini, of Frankfort, in 1807, who described a reflector for examining the posterior nares. About 1833, Selligie, an ingenious mechanic, contrived a mirror for seeing the larynx, and in 1838, Beaumes of Lyons another for seeing the larynx and back of the nostrils. Liston was in the habit of using a speculum to look at an ulcerated glottis, which he made known in 1840 (*Practical Surgery*, p. 417). In 1844, Warden invented a prismatic speculum for the glottis, and in 1846, Mr. Avery had possessed instruments



for looking into the throat, posterior nares, bladder, and other cavities. Garcia was the first person who employed the laryngoscope to study the human voice, and was the first to practise autolaryngoscopy (*Proc. Royal Society*, 1855). His researches gave the first impulse to laryngoscopy, and induced Turck to take up the subject in the summer of 1857, in the General Hospital at Vienna, and at the end of that year Czermak followed, who not only perfected the instrument, but obtained for it a universal public recognition. Dr. Babington therefore was the discoverer of the laryngoscope and the first to apply it; Bozzini first practised rhinoscopy, and Garcia autolaryngoscopy.

The laryngoscope consists of a little mirror, of a circular or square form, with the angles rounded off, attached to a flexible metallic stem, which is fixed into a handle of wood or other substance. The size varies from a few lines to an inch or more in diameter, and glass is now commonly preferred. In using the laryngeal mirror, the fauces must be illuminated by means of a large reflecting mirror sustained upon the forehead by means of an elastic band, or placed in front of the eye attached to a spectacle frame. Its centre should be perforated. The light to be employed for illumination should be either that of the sun or of a good moderator or Argand gas lamp. When the latter is employed the room should be darkened. In using artificial light, the lamp should be placed upon a table to the left of the patient, whilst the surgeon sits opposite to him, with the reflector fastened before his eye. The rays of light are received in the reflector, and thence conveyed to the throat of the patient, whose mouth is widely open and on a level with the surgeon's eye. When the requisite degree of steadiness is obtained, the laryngeal mirror is gently warmed over the lamp, and its temperature estimated on the cheek or back of the hand; the patient's tongue is now held out of the mouth, with a towel or napkin between the finger and thumb, and the laryngeal mirror is gently introduced into the mouth and placed against the middle of the soft palate and uvula, its reflecting surface looking forwards and downwards. The rays of light thrown into the mouth from the large reflector are received in the laryngeal mirror, and thence reflected into the larynx and surrounding parts, the angle of reflection being equal to the angle of incidence. The back of the tongue, with its large follicles, first comes into view; then the valleculæ or fossæ between it and the anterior or glossal surface of the epiglottis; next, the apex and laryngeal surface of the epiglottis; and then the interior of the larynx, in which we see an extremely movable antero-posterior fissure, bounded by two brilliant pearly borders, which palpitate with surprising rapidity. This last is the *glottis*, and is formed by the inferior thyro-arytenoid ligaments, or, as they are now generally called, the *true vocal cords*, in contradistinction to the false, which are formed by the superior thyro-arytenoid ligaments or muscles, which are above the glottis. Beyond the glottis the trachea comes into view, the rings of which are distinctly visible far down during deep inspiration. In some persons the bifurcation is readily seen. The glottis is seen to assume in various persons a lanceolate, lozenge, or barrel, elliptic, oblong, or triangular shape, and may

possess great activity in motion, or very little. When the mirror, therefore, is introduced into the mouth, the patient should ejaculate *Ah!* in a prolonged or short note, which permits of closure of the glottis, and the appreciation of the healthy state of the vocal cords, according to their amount of approximation.

The laryngoscope has been in use, chiefly in the hands of a few persons, for the last four years, and has already accomplished some remarkable results. It has shown that in *acute laryngitis* the lining membrane of the larynx is of a bright and vivid scarlet redness, with tumefaction varying in amount, but generally prominent on the false vocal cords, which sometimes wholly conceal the true cords. The membrane covering the latter partakes of the same vivid redness, and it extends into the sub-glottis and trachea. The laryngeal surface of the epiglottis and its free borders are of a scarlet red colour, and the boundaries of the larynx are equally inflamed. It is the approximation of the swollen false vocal cords which generally gives rise to the whistling or hissing respiration and the most urgent dyspnoea, and not the closure or narrowing of the true glottis, as has been generally supposed, although sometimes the glottis is spasmodically narrowed. The excessive danger of this complaint is proved to be the almost complete closure of the rima glottidis, from the tumefaction of the surrounding parts, especially of the false cords, which become infiltrated with serum, unless the inflammation is quickly subdued. This we are now in the habit of accomplishing by the application of a solution of nitrate of silver, of from two to four scruples to the ounce of water, and applied by means of a large-bellied curved camel's-hair brush, or a laryngeal fluid pulverizer, aided by the laryngeal mirror. With this is combined the other treatment recommended in the subsequent article on Diseases of the Larynx. The topical application may be renewed every six or eight hours until the urgent symptoms have subsided. *Edema of the Larynx* must be henceforth the designation of a condition heretofore applied to the glottis, for the laryngoscope has revealed to us the complete immunity of the true glottis from this condition, and that the cedema is sometimes wholly confined to the upper boundaries of the larynx, involving the aryteno-epiglottidean folds, and not extending to the rima; sometimes and most commonly it involves the folds mentioned and the false cords as well, and extends as far as the glottis; and occasionally it involves the membrane covering the false cords alone, producing a dangerous form of obstruction. Now and then it is confined to one side of the larynx. These forms of swelling constitute what we have denominated *supra-glottic cedema*, as they occur above the true glottis. Whereas another form of cedema occurs below the glottis, to which we have given the name of *sub-glottic cedema*. If we regard the *rima glottidis* as double, one placed horizontally above the other, the upper one between the upper or false vocal cords, and the lower or true rima between the lower or true vocal cords, we shall have a limiting boundary between the two forms of cedema, the ventricles in reality forming the point of separation between the two. This division gives the precise position of the cedema anatomically, more especially as the true glottis

is never involved in the œdema, and therefore the expression of œdema of the glottis, as ordinarily applied, is actually a misnomer. In the supra-glottic form of œdema, the laryngoscope reveals two tense, smooth, and rounded swellings, immediately behind the epiglottis, and sometimes partly concealed by the cartilage. These swellings may be globular or oval, meeting in the centre, with a sulcus between them, generally more prominent in front. If one side only is affected, there is observed a prominent swelling projecting across the larynx. According to the extent and stage of the œdema, is a view permitted of the true vocal cords or the parts beyond the glottis. The œdema reaches its highest degree in the false vocal cords, where the strata of areolar tissue are but loosely covered by the mucous membrane, and hence is explained the nature of the urgent dyspnœa which is ready to strangle the patient. The consistence of the swelling can be determined sometimes by the introduction of the finger into the mouth. In the sub-glottic form of œdema, on the other hand, a distinct swelling is seen on one or both sides of the sub-glottis, *below the true vocal cords*, which latter are seen generally to possess their natural colour. In an instance which we had the opportunity of inspecting, in the person of a girl aged fourteen, under the care of Mr. Erichsen, in University College Hospital, the œdematous swelling was seen to occupy the left side of the sub-glottis below the left vocal cord, and extending across to the opposite side, occupying in addition the posterior part of the sub-glottis, corresponding to the larger width of the cricoid cartilage. In another example, in a woman aged thirty-seven, under our care at the West London Hospital, the sub-glottic œdema was double, meeting in the centre, but allowing of an aperture anteriorly. The voice was lost in both of these cases, and the breathing was more stridulous and wheezing than in the supra-glottic form, possessing at the same time a peculiar laryngeal or croupy hoarseness about it. There is, moreover, intense dyspnœa, laryngeal cough, and much mucous secretion. Constitutional remedies must be relied upon, such as tartar emetic and acetate of ammonia, with some anodyne. Inhalation of hot steam, poultices to the neck, and small doses of mercurials to absorb the effused material, which proves to be lymph beneath the mucous membrane, thus differing from the supra-glottic form, wherein the œdema is caused by serum. We have collected some eighteen instances of sub-glottic œdema, recorded elsewhere, and although it is a rare form of laryngeal disease, it must not be forgotten in our diagnosis of dangerous cases, for the reason that, when it becomes necessary to relieve the breathing by means of an operation tracheotomy must have the preference over laryngotomy. Indeed, experience is already demonstrating that tracheotomy must ultimately become the general rule in all cases of laryngeal disease, to allow of complete and perfect rest to the parts of the larynx involved. When supra-glottic œdema is present, the swollen parts must be scarified by means of small curved instruments, devised by ourselves, and used with the aid of the laryngeal mirror. This must be continued with the other treatment described in the next article. If the relief is not sufficiently decisive from the

scarifications, a curved bougie must be introduced rapidly into the larynx, to squeeze out the effused serum.

In many cases of long standing *Hoarseness and Aphonia*, supposed to be due to chronic laryngeal disease, the laryngoscope has revealed the presence of one or more laryngeal growths or polypi, chiefly of an epithelial nature. Nothing, perhaps, has so strikingly demonstrated the value of the laryngoscope, as the diagnosis of such growths and their successful removal after years of suffering. Their supposed rarity in the larynx, as compared with the throat, was due to the impossibility of making them out during life, and hoarseness even of many years' duration, with occasional attacks of aphonia, was not suspected to depend upon the presence of polypi. A glance at the hospital museums of London and elsewhere will show the existence of a fair number of preparations. We have inspected all in the metropolis, and those at present preserved in the London museums number thirty-one, eleven occurring in children, three in youths, and seventeen in adults. The situation they occupy in the great majority of cases is above and below the *origin* of the true vocal cords, larger and more disseminated above, smaller and more compact below. The root of the epiglottis above the vocal cords, and the sub-glottic space anteriorly below the cords, have the preference over any other part of the larynx for their development, and this can be readily understood when it is remembered that all the explosive effects of coughing, hemming, and similar acts, vent themselves upon that part of the larynx more than any other, during the succussion which the air undergoes. Next to the spots mentioned, the anterior free borders of the vocal cords give rise to the tumours; the inner surface of cricoid cartilage, below and between the arytenoid cartilages, comes next in point of frequency; and lastly the ventricles of the larynx. Occasionally, but more rarely, they spring from the false cords, and aryteno-epiglottidean folds. The following are examples which came under our notice:—a gentleman, aged thirty-seven, was the subject of hoarseness and varying aphonia for twelve years, supervening upon an attack of yellow fever. Hoarseness followed profuse salivation for this disease. In the open air his voice was a whisper, and indoors it was stronger, and possessed a rough and hoarse laryngeal sound. The laryngoscope revealed the presence of two distinct, fleshy, pedunculated polypi, attached to the vocal cords, nearly as large as peas. One was situated between the two cords anteriorly, whilst the other was attached to the anterior free border of the left vocal cord. The latter was removed by means of the laryngeal écraseur, an instrument suitably curved, with a loop of steel wire at the end, for catching the pedicle and cutting it off, on drawing the wire home. The former was removed two days later with the same instrument, and an immediate cure followed, for the mechanical obstruction to the closure of the glottis, so necessary for perfect phonation, was removed. A second case occurred in a gentleman, aged forty-two, subject to hoarseness and dysphonia for ten years. The voice possessed a hoarse whisper, as if the trachea were tied. The true nature of his complaint had never been suspected until the laryngoscope revealed the presence of a polypus the



size of a pea, situated immediately below the origin of the true vocal cords. In speaking this would glide between the vocal cords, and so prevent their approximation. In December, 1862, the pedicle was caught in the wire of the *écraseur*, and the tumour was detached, in the presence of several gentlemen. The result was marvellous, for the voice instantaneously became altered and sonorous, the chest filled with air, and the patient felt as if suddenly possessed of increased bodily power and energy. We have been successful in several other cases in removing growths from various parts of the larynx, which have been placed upon record elsewhere. Perhaps the most remarkable of all these was a large, flat, cystic polypus springing from the right ventricle of the larynx, hanging downwards between the lips of the glottis, giving rise to aphonia for many years, in a woman aged thirty-eight. Latterly suffocation had been imminent, and the dyspnoea was so great that tracheotomy would soon have been required. When the nature of the complaint was made out with the laryngoscope, the centre of the tumour was fortunately caught in the loop of wire of the laryngeal *écraseur*, and forcibly torn from its attachment to the ventricle. A few drops of blood slowly exuded, and the patient spoke immediately after in a hoarse but low-toned voice. In many cases of apparently long-standing chronic disease of the larynx, the symptoms will be found to depend upon the presence of one or more growths in the larynx, as shown in the laryngeal mirror, and it then becomes necessary to remove them, for there is the liability to their increase in size or degeneration into malignancy. It may be as well to mention here that, in our attempts at removal, it is preferable to do so if practicable at the one operation, in preference to taking away portions at various times, because the risk is strong in the latter case of degeneration into epithelioma.

The laryngoscope makes known the presence of ulcers in various parts of the larynx and trachea; loss of substance of the true vocal cords giving rise to aphonia; necrosis of the cricoid and arytenoid cartilages; and occasionally destruction of the free portion of the epiglottis. Of the last we have seen seven well-marked examples in the living, and the London museums contain twenty-one specimens wherein the whole or greater part of this cartilage was destroyed. In many examples of throat disease, the symptoms are found to depend upon a pendent position of the epiglottis, which not only prevents a good view of the interior of the larynx, but interferes with the function of respiration. This pendent position of the epiglottis, we have found to be present in eleven per cent. of mankind, most probably congenital in many persons, for we have seen it in the mother and her young child. This percentage was deduced from an examination of some eight hundred healthy persons of all ages and both sexes. No doubt it aggravates any throat or laryngeal affection where it may supervene, although it occurs idiopathically in many instances. In cases of functional aphonia, the vocal cords and other parts of the larynx are seen to be healthy, the symptoms depending upon loss of or impaired nervous power. Whereas in organic aphonia, again, the lesions observed are inflammation of the vocal cords, whether acute or

chronic, induration and thickening of their structure, supra-glottic oedema, or more rarely the sub-glottic form, ulceration of the vocal cords, with sometimes considerable loss of substance, and the presence of growths and tumours as already described. The same conditions are found to be the cause of hoarseness, which is likewise due to a swelling of the false cords, and occasionally to a varicose condition of the veins of the larynx. The voice likewise becomes altered, although not lost, under certain circumstances, and the causes are made out with the laryngoscope. A young man, aged twenty-one, came under our notice, with what we have called diplophonia, which was the result of a wound of the left vocal cord, with a penknife which had penetrated the neck. The cicatrix of the wound was clearly discernible in the laryngeal mirror, and as there was imperfect approximation of the vocal cords, his voice became double, being in one part of his speech a deep bass and the other tenor. Deformities of the larynx are also recognised with the laryngoscope, such as malformations of the epiglottis or deficiency of the cartilage; absence of one of the aryteno-epiglottidean folds, or of both vocal cords, instances of all of which have come under our observation.

The laryngoscope is of great assistance in the detection and diagnosis of the presence of foreign bodies in the pharynx and larynx, and materially aids in their extraction. We have had three cases under our notice where pins were lodged in the pharynx and one in the larynx. In the latter the patient was a gentleman aged sixty-four, who drank a glass of water which contained a pin, and in endeavouring to eject it from the mouth, it slipped into the larynx and produced the most alarming symptoms of suffocation, with attacks of spasm similar to those in acute laryngitis. He was seen two hours afterwards, and with some difficulty an examination was made with the laryngoscope, when the pin was seen traversing the larynx from before backwards, one end, the head, occupying the trenchant angle of the thyroid cartilage, and the other transfixing the left arytenoid cartilage. The larynx was intensely congested, of a bright scarlet redness, and oedema was about commencing. The true vocal cords were purple, the right only acting spasmodically, whilst the left was loose and flaccid. With one assistant to hold out the tongue, and another the head, the laryngeal mirror was introduced, and with a pair of reliable forceps, the pin was fortunately seized the first time the instrument was introduced, and extracted. All the symptoms immediately subsided. We were enabled on another occasion to discern a piece of walnut shell impacted below the glottis of a boy of thirteen, in whom tracheotomy had been performed by Mr. Paget; it was not then removed, but was subsequently expelled by coughing. We are not aware of any other instances besides the two mentioned wherein foreign bodies were observed in the larynx with the aid of the laryngoscope.

We were enabled to determine, in a case of acute inflammation of the epiglottis, that the disease did not involve the interior of the larynx, being confined solely to the cartilage and its proper folds. For determining the true nature of the lesions in chronic laryngitis, whether specific or otherwise, follicular disease of the throat and larynx, affections of the trachea, certain stages of

croup and diphtheria, malignant disease of the larynx, and tumours of the fauces, the laryngoscope is invaluable. Its use, although at present confined to a few, will in time become general, both in the hands of the physician and the surgeon. The one great thing necessary is a good moderator lamp, or an Argand gas lamp, which can be lit when required; for when a good light is obtained, the examination of the patient becomes a matter of ease and certainty after a moderate amount of experience.]

*George D. Gibb.*

**LARYNGOTOMY** (λάρυγξ and τέμνω). [The operation of opening the larynx. This may be undertaken either to fulfil a temporary purpose, or in order to maintain a permanent opening.]

There are very many circumstances which may call for laryngotomy. When air does not get free entrance to or exit from the lungs, in consequence of some obstruction in the windpipe; when, from the presence of disease, it is desirable to give rest to the functions of the upper part of the larynx; when some foreign body has to be removed from, or some medicament to be introduced into the cavity of the larynx.

Laryngotomy may have to be performed when it is necessary to carry on artificial respiration more effectually than can be accomplished in the ordinary way, as in asphyxia from the inhalation of gases, or in drowning; in spasm of the glottis, arising from any cause, as in chronic laryngitis, pressure on the recurrences, spasmodic croup, or peripheral irritation. In the swelling of the lips of the glottis, which takes place in the progress of some laryngeal ailments, and especially in oedematous laryngitis, in affections of the epiglottis or vocal cords, in polypus or other growths of the laryngeal cavity, and in the paralysis of the larynx which sometimes follows blows, laryngotomy may be called for. Many surgeons prefer tracheotomy to laryngotomy in cases of inflammatory affections of the larynx accompanied with effusion into the lips of the glottis, in order to keep the artificial opening quite beyond the seat of the disease; but as in such cases the effusion, which is the cause of the obstruction, does not extend below the true vocal cords, the opening in laryngotomy must be always below the level of the mischief. In chronic laryngitis, again, the ulcerative action may pass so far down as to render it more desirable to open the trachea. Laryngitis has had to be performed in some rare cases of glossitis in which other means had failed to reduce the swelling; in tonsillitis and pharyngitis also, as well as in tumours of the pharynx, which have pressed on and closed the opening into the windpipe; in retro-pharyngeal abscess, which cannot be evacuated, and whose pressure on the upper part of the windpipe is dangerous; in some cases of fracture and displacement of the cartilages or bones of the larynx; in wounds (especially gunshot) of the neck, followed by rapid emphysematous or oedematous swelling, dangerous to the respiration;—in all these cases the operation of laryngotomy has been practised, and will be at times demanded.

The comparative advantages of laryngotomy and tracheotomy, with the cases adapted for each, is considered in the article **TRACHEOTOMY**; but it may be here remarked, that when the exact seat of operation is a matter of indifference, laryngotomy will be

preferred, from the greater ease and rapidity (and this is sometimes a matter of the most vital consequence) of its execution, and the comparative freedom from danger and inconvenience attending it—advantages which are not altogether neutralised by the more restricted opening obtained, and the greater irritation which is occasionally caused by a tube worn in the aperture.

The operation of opening the larynx is a very old one. It has been ascribed to Asclepiades of Rome, although its establishment as a regular operation is undoubtedly due to Fabricius-ab-Aquapendente.

It was Vicq d'Azur who in 1776 introduced the ordinary operation in which the crico-thyroid membrane is opened. He made the incision in the membrane transversely, while now-a-days it is usually made longitudinally. The space here operated on is very limited, especially in women and children, while even in the adult male it measures on an average less than an inch. It is, however, very superficial and easily reached.

When the operation of laryngotomy is about to be performed, the patient should be placed in the recumbent position, with the head thrown back as far as the freedom of respiration will allow. A child may be held in the lap of an assistant, with the head supported on and pressed to his breast. The incisions must be strictly in the middle line between the sterno-hyoid and sterno-thyroid muscles, and should pass down at once to the membrane, which is to be opened with the point of the knife, and by a slight jerking movement. The membrane may be cut either vertically, horizontally, or crucially. The tube which is best adapted for keeping the opening patent is one curved on the flat. A small branch (the crico-thyroid) of the superior thyroid artery, which traverses the membrane somewhat nearer the edge of the thyroid than the cricoid cartilage, may be kept out of the way by the nail or if it is cut in the operation, and it bleed freely, a ligature may be applied.

Some operators prefer opening the crico-thyroid membrane by means of a trocar, but many strong and well-founded objections are made to such a practice. The point of the instrument is apt to slip off the windpipe and wound parts lying in its neighbourhood; it is liable to penetrate or seriously injure the posterior wall of the windpipe, and it has been sometimes found not to have entered the canal at all, but to have passed downwards between the cartilages and mucous membrane. Greater speed and simplicity, and having a tube at once introduced into the air-passage, are the advantages claimed for the trocar.

The very limited aperture afforded in the above operation being insufficient for many of the purposes for which the larynx is opened, caused the suggestion of other operations.

Boyer, in 1820, modified the above operation by splitting the cricoid cartilage and a few rings (3 or 4) of the trachea from above downwards in the middle line, after having opened the crico-thyroid membrane, as in the operation before described. This procedure has been termed *Laryngo-tracheotomy*. The great elasticity of the cricoid, arising from its being an entire ring, makes it readily close after being incised in this operation, and hence comes the difficulty which attends the introduction of the tube at that part of the wound—a difficulty which, however, does not attend the



passing of the tube in the tracheal portion of the opening.

Again, Desault proposed to split the thyroid cartilage upwards in the mesial line, in order to enlarge the opening, and also to give more direct and easy access into the cavity of the larynx in cases in which, from the lodgment of foreign bodies or the presence of tumours, that was especially desirable. If this operation is performed, the utmost care must be taken to keep accurately in the middle line, as from the insertion of the vocal cords irreparable injury may follow any divergence therefrom. When the thyroid is ossified, its division is far from easy, and if its mucous membrane is much swollen, it may so protrude as to close the opening.

Lastly, Vidal de Cassis, and after him Velpeau, on the suggestion of Bichat, introduced an operation which is not now employed, but which demands passing mention. The proposal was to open the hyo-thyroid membrane, by a transverse incision close below the border of the hyoid bone, and so gain access into the upper part of the larynx.

This last operation may be termed the supra-thyroid. There are few cases in which it would enable us to remove foreign bodies or tumours which could not be got at from the mouth, and the fear of causing an incurable fistula is very considerable. Whether the incision be made vertically or transversely, the epiglottis will probably protrude and have to be held aside before the interior of the larynx can be inspected. Vidal thought that in œdema of the glottis and in croup, this operation was especially indicated, but in these views he has not been supported.

When the larynx is opened in any of the ways which have been detailed, there is considerable spasmodic cough and uneasiness for some time, till the mucus and blood have been expelled, but so soon as the respiration has been restored, the relief obtained is great and apparent. A tube can be worn without fear for very lengthened periods after laryngotomy, notwithstanding the opinion to the contrary long entertained.

There is one source of embarrassment and danger which occasionally attends both laryngotomy and tracheotomy, and which, though little suspected or recognised, yet demands attention. In necrosis of the cartilages of the windpipe the mucous membrane often gets much thickened and separated from the underlying parts, and thus it may happen (as it has happened on several occasions) that the opening made has not penetrated the canal of the windpipe at all, but has merely passed through the parts lying external to the mucous membrane, and the tube has been forced down into the space left between the mucous membrane and the walls of the windpipe, increasing greatly the danger of suffocation.

The proper size of tube to be employed in laryngotomy, as well as the precautions to be observed after operations on the windpipe, will be detailed in the article TRACHEOTOMY.] *G. H. B. Macleod.*

[LARYNX, SURGICAL DISEASES OF. As the organ of the voice and the channel of respiration, the larynx fills a most important place in the economy, and its affections demand the careful consideration of the surgeon. Composed of a complicated and delicate arrangement of cartilages, muscles, and nerves, and lined with a membrane

much exposed to irritation, the diseases of the larynx are frequently of a very serious character, and, from the rapidity of their progression, require prompt and energetic treatment. The recent introduction into practice of the laryngoscope or larynx speculum, has afforded much insight into the character and progress of laryngeal disease, by enabling us to investigate the interior of the windpipe and to apply with more precision to its various portions those medicaments which may be required. It appears, however, doubtful how far the laryngoscope can assist us in the management of those acute forms of disease to which the larynx is obnoxious, and in the treatment of which every possible aid is so anxiously sought. The use of the instrument is not devoid of irritation to a patient in the enjoyment of ordinary health, and necessitates the acquirement of a certain amount of habit before such uneasiness disappears; and, as in the case of patients suffering from acute disease there is usually much dyspnoea and morbid sensibility, the inconvenience which attends the use of the instrument is greatly augmented, and as we have no time to habituate the parts to the presence of the speculum, it follows that in acute affections, we must not be too sanguine as to the benefit this most useful instrument may bring us. In chronic cases, however, its advantages are considerable. (See LARYNGOSCOPE.)

A consideration of the arrangement and attachment of the mucous membrane lining the larynx serves to throw much light on the nature and extent of several of its leading diseases. Its being continuous with the lining membrane of the pharynx and gullet on the one side, and the windpipe and air tubes on the other, renders apparent the mode in which various affections invade the larynx from above or below. Having formed the loose aryteno-epiglottidean folds around the superior orifice of the larynx, the mucous membrane is but loosely connected with the interior of the organ till it comes to cover the true vocal cords, where, while it assumes a more delicate structure, it becomes firmly adherent to subjacent tissues. It is at the lips of the glottis that the looseness and extensibility of the mucous membrane is most apparent, and it is there that this feature comes to exercise the most important influence in disease. At all points beneath the mucous membrane, except those at which it is adherent, lies very loose areolar tissue, which during health permits (especially at the lips of the glottis) of the freest motion, but in certain diseases comes to allow of rapid and great infiltration. The effusion into this sub-mucous tissue plays a most important part in laryngeal affections, and it is of much consequence to observe that it cannot extend further down towards the trachea than the true vocal cords in consequence of the close adhesion between the membrane and these structures, a fact to which attention was drawn above. The position of these cords defines accurately the inferior limit of such effusions.

A further consideration has to be borne in mind. In consequence of the firm and unyielding character of the structures lying external to the sub-mucous tissues, any swelling which attends effusion into the areolar tissue will tell on the dimensions of the canal within, towards whose cavity they have no difficulty in bulging, while enlargement outwards is strenuously opposed.

Lastly, it is to be remarked that the lining

membrane of the larynx is numerously studded with muciferous follicles, which, in certain morbid conditions of the membrane, become the seat of ulcerous action, while in health they serve the important office of supplying a lubricating and protecting fluid.

Having premised these few general remarks, it may be stated that the surgical affections which will fall here to be considered, are inflammation in its various forms and in some of its most prominent results, nervous affections, and morbid growths and injuries. It is proposed to take up the subject of foreign bodies in the air passages, in the article TRACHEA.

1st, then, of inflammation of the larynx, or *Laryngitis*, the *Cynanche Laryngea* of Cullen.

This disease, although subdivided into as many as nine varieties by Dr. Cheyne, may conveniently be considered as being either acute, sub-acute, or chronic.

The various forms of this disease were long confounded, and notwithstanding the references to it which occur in the writings of several ancient authors, it was not till the beginning of this century that in any of its forms it attracted much notice. Such neglect has, however, been amply atoned for within the last fifty years, and now the literature of this subject is very extensive and valuable.

It is in the mucous membrane and in the areolar tissue lying beneath, that the distinctive characters of the three forms of laryngitis are met with. In the acute form of the disease, the morbid appearances are almost entirely confined to the mucous membrane. It was from observing this, that Cruveilhier designated this as "*Mucous Laryngitis*." The red, tumid, and softened state in which the membrane is found, points to the inflammation which has been present, and although there are not such evident morbid appearances found in the sub-mucous structures as in other forms of laryngitis, still these tissues do not altogether fail to participate in the disease, and thus we find occasionally, and especially when the disease has been of great intensity, a certain amount of infiltration into these structures; still it is unquestionably in the mucous membrane itself that the chief and characteristic changes produced by acute laryngitis are met with.

In the second or subacute form of laryngitis, again, the mucous membrane comparatively escapes, while serious morbid conditions are found present in the areolar tissue beneath. According mainly to the rapidity and intensity of the inflammatory action, effusions of serous, sero-purulent, or purulent matter will take place. The more rapid the morbid action, the more serous in character will the effused fluid be. From the seat and pathological character of this species of laryngitis, various appellations for it have been derived. Cruveilhier terms it "*sub-mucous laryngitis*," others "*œdematous laryngitis*," and others "*œdema of the glottis*."

In chronic laryngeal inflammation, again, both the mucous membrane and the sub-mucous tissues are implicated. The effusion which occurs takes place more slowly and is more plastic; hence comes the thickening of the membrane. Ulceration, too, is not uncommon, and even graver disasters occur in the cartilages and the overlying textures.

In consequence of inflammation, the quantity and character of the mucous secretion of the larynx becomes notably changed, and the sensibility of its lining augmented. In some inflammatory

conditions purulent matter is expectorated, and blood is not uncommonly mixed with the secretion, especially when ulceration has become established. False membranes, however, are not liable to form in the air-passages of adults as we find them in the trachea in the croup of children, although in some chronic inflammations casts of bronchial tubes have been expectorated, which have given rise to very absurd ideas as to their nature. The increased sensibility of the mucous membrane is evidenced by the uneasiness caused by the performance of the functions of respiration and speech, and the spasmodic action which seizes the muscles in consequence of the irritation set up, all of which gives rise to some of the most distressing attendants on laryngitis.

The Causes to which laryngitis may be attributable are very numerous. The act of respiration is liable to place irritating agents in contact with the mucous lining of the larynx. In this way gases, fluids, and pulverised matters of various kinds are brought into contact with it, while extremes of temperature, damp, and other exciting causes of disease gain free and direct access. The close sympathy moreover existing between the external surface of the body and the air passages renders exposure to sudden changes of temperature peculiarly noxious to the laryngeal membrane.

All such exciting causes however, act directly, but there are other less direct influences which originate secondary or consecutive disease within the larynx. It is in this sense that laryngitis in one of its forms (the sub-acute) so frequently attends the exanthemata and especially scarlet fever. So too it accompanies or follows typhus fever, erysipelas, inflammation of the tonsils or the parotid, pharynx or trachea (in these latter cases occurring from the extension of the disease through continuity of texture). It is as a consecutive affection, too, that œdematous laryngitis occurs in connection with aneurism of the arch of the aorta, or any tumour pressing on the venous trunks, and that in its chronic form it arises during the evolution of syphilis, mercurial cachexia and tubercle of the lungs.

There are several conditions which strongly predispose to the establishment of laryngitis. Intemperance, especially if combined with oft-repeated exposure to cold and damp, frequent over-exertion of the voice, and derangements of the gastric and biliary functions, have always been justly recognised as predisposing to inflammatory affection of the larynx.

Laryngitis is especially a disease of adult life, and was hence termed by Pinel "*angina trachealis adultorum*."

It will be apparent that when inflammation seizes the larynx, two functions will be liable to suffer, the voice and the respiration, and it is from the effect on these functions that the most characteristic features of the disease are derived. It is, too, from interference with such a vital function as the respiration, that the chief danger of laryngitis arises. As the respiration becomes more and more embarrassed, the due arterialisation of the blood in the lungs gets in like proportion prevented, and hence effects are produced which, influencing in the first place the functions of the lungs and brain, through them acts perniciously on the whole system. The lungs become congested and then loaded with serous exu-



dation, and the brain, no longer supplied with its stimulus of red blood, gets torpid and dormant.

We do not frequently meet with ulceration in acute and sub-acute laryngitis, but it is a common condition in the chronic form of the disease. When it arises in connection with syphilis, it not unfrequently spreads downwards from the velum and palate to reach the larynx, and passing even further along the air passages, invades the trachea. In syphilitic ulceration, the usual seat of the sores is the laryngeal surface of the epiglottis, and the upper part of the larynx, while in the ulceration which accompanies Phthisis pulmonalis, the ulcers are found on the true vocal cords, and over the cricoid cartilage. When the ulceration is due to syphilis, the sores are usually larger, irregular and shallow, and covered with a dirty adherent slough. Ulcers of a small deep circular shape are also occasionally met with in the larynx, and these sometimes penetrate and destroy the cartilages. Such sores heal by contraction and not by granulation.

Laryngitis in all its forms is a source of very great anxiety to the surgeon. In the acute and sub-acute forms it is peculiarly a cause of apprehension, from the suddenness of the seizure in many cases, the rapidity of the progress, the fearful nature of the symptoms, the fatality which attends it, and the terrible agony of the death. The patient in the more acute forms of laryngitis dies by a slowly induced asphyxia, or by a paroxysm of spasm; while in the chronic variety of the complaint he dies of spasm, or of irritation and exhaustion.

*Acute Laryngitis* in the words of Ryland "is perhaps the most formidable of the inflammatory diseases to which the human frame is liable." The symptoms are those of general fever and local inflammation. The symptoms of the general fever require no description, those which are directly due to the local lesion will be briefly enumerated. The early symptoms are attributable to impeded respiration, the later to interference with the arterialisation of the blood.

At the outset this treacherous disease often appears to be nothing but a severe "sore throat." When this is followed by pain, especially excited by pressing the larynx against the spine; by a feeling of constriction in the upper part of the windpipe, and difficulty of swallowing (often an early symptom), anxiety and alarm are occasioned. As the swelling of the lips of the glottis increases, the respiration will become more and more impeded, and eventually raucous and stridulous, or hissing breathing, together with a drawing downwards of the larynx at each inspiration, will mark the more advanced stages of the affection. The voice becomes partially or wholly suppressed, and an irritating cough troubles the patient. The increasing dyspnoea augments the alarm. The features and attitudes of the patient graphically portray the terrible struggle which is going on. The prominent eyeballs, expanded nostrils, livid lips, pale leaden face and labouring chest, are very expressive. In violent paroxysms death makes its onset. The pulse, at first quick and irritable, becomes feeble and intermittent. The surface becomes cold and bathed in perspiration, and delirium renders, if possible, more terrible the last moments of the poor sufferer.

After death we find distinct injection of the mucous membrane of the larynx and epiglottis, and

also some amount of sub-mucous effusion. The swollen, tense, and inflexible epiglottis can sometimes be seen and generally can be felt with the finger. When acute laryngitis passes into the sub-acute or chronic form, it is very generally fatal, and that in a few hours, or perhaps not for a week, the duration being uncertain, and in a great measure dependent on the constitution, habits and age of the patient, the intensity and violence of the attack, and the activity of the treatment.

The *diagnosis* is usually easy. The history of the seizure, the adult age, the accompanying fever, the hissing inspiration and free expiration, the cough, the seat of the pain, the sound of the voice, the difficult deglutition, and the drawing down of the larynx during inspiration. Further the condition of the epiglottis as revealed to the eye or touch, the absence of disease of the lungs and of general swelling of the neck, and finally the ability to open the mouth widely, will serve to distinguish laryngitis from asthma, phthisis, spasmodic affections, foreign bodies in the air passages, abscesses external to the windpipe, and tumours at the root of the lungs or in the neck.

*Prognosis.* This disease is always highly dangerous, and often fatal, hence the prognosis should be very guarded. The state of the respiration and the condition of the blood will be the chief key to the future progress and result.

The *treatment* of this form of laryngitis must be early and energetic, in order to be effectual. It comprises the employment of anti-phlogistic measures, both locally and constitutionally. Unless these are put in force before effusion has occurred, they will do more harm than good. Leeches freely applied to the upper part of the larynx, followed by fomentations or hot cloths with turpentine; or if more rapid effects are desired, the application of the strong liquor of ammonia, or flannel, or a sponge wrung out of hot water, will answer the immediate end; but these measures produce a state of matters unfavourable to any operation on the windpipe, which the progress of the case may subsequently demand, by the swelling and infiltration of the tissues external to the larynx, which they leave. General blood-letting, so strongly recommended by Dr. Cheyne and others, and the use of mercury and antimony, have been almost entirely abandoned in the early management of these cases. If the patient be plethoric and come to us with a flushed face and bounding pulse, general bleeding and antimony may undoubtedly be required, but in the majority of cases these measures do no good, while actual harm may arise from the persistent depression and weakness caused by the bleeding, and the vomiting so often set up by the antimony. This remark is the more true as the surgeon does not often see his patient in the stage when general bleeding can be of any possible benefit. Mercury, again, is too slow of action, except in such doses as would be most hurtful during the later stages of the complaint. Local remedies must undoubtedly be our chief reliance.

If the disease goes on unchecked, and if spasms and dyspnoea become urgent, the sooner the windpipe is opened the better. This most necessary though often neglected step, to be effectual, should be accomplished before the functions of the lung and brain have become seriously impaired. If let as a last resource, it is simply useless. According to Mr. Lawrence it should be done "so soon as

the symptoms enable us to determine the nature of the disease," and though in some few cases it has succeeded even at the last moment, yet its success will be more and more put in jeopardy the longer the delay. So soon as the windpipe is opened below the obstruction, and air readmitted into the labouring lungs, the great source of immediate danger is overcome, and time is afforded for remedies to act on the swelled and infiltrated tissues. In order to reduce the effusion, mercury in small doses, and counter-irritation to the sides of the larynx and to the back of the neck, as well as to the upper part of the chest, come into use, the latter measure being especially called for if bronchitis succeed the laryngitis, as is too often the case.

The effects which have followed the local application of strong caustic solutions in cases of acute laryngitis, have been such as not to warrant the employment of this mode of treatment.

It need hardly be added that all depletive measures, and the administration of mercury, must be avoided in that consecutive form of acute laryngitis which follows asthenic complaints, or when the patient's constitution is bad or depressed, or the disease rapidly takes on a low asthenic form in consequence of a prevailing epidemic.

*Sub-acute, Asthenic, or Oedematous Laryngitis.*—The "angine infiltro-laryngée" of Sestier, "laryngite sous-muqueuse" of Cruveilhier.

In each of these designations, except the first, the pathological features of this affection are expressed, and these have been already explained.

In sub-acute laryngitis, the signs of inflammation are but little pronounced. The mucous membrane of the larynx and the epiglottis seems often little reddened or injected, at other times it assumes the dark hue indicative of low inflammatory action. Here the sub-mucous tissue gets loaded with effused fluid, consisting of either serum alone, or serum mingled in varying proportions with pus or blood.

Although probably recognised from remote periods it was not till the beginning of this century that this form of laryngitis attracted much notice in modern times, but since attention was prominently drawn to it many have contributed to its investigation.

It is to the rapid and great effusion into the sub-mucous areolar tissue of the larynx that oedematous laryngitis owes its extreme danger and fatality. The narrow chink of the glottis cannot at best admit of much curtailment, and when the lips of the glottis become tumid and project into the canal of the windpipe, a formidable mechanical obstacle exists to the entrance of air into the lungs. In proportion to the rapidity and extent of the effusion will be the danger, as, when the obstacle forms slowly, the lungs adapt themselves in some measure to the diminished supply, but when the orifice is rapidly closed, the effects are very serious indeed.

The effusion referred to is chiefly apparent at the edges of the glottis, on the laryngeal surface of the epiglottis and behind the thyroid cartilage, and it is sharply limited below by the vocal cords. It is this form of laryngitis which is seen to attend erysipelas and low inflammatory affections of the throat, and it is such cases, especially if protracted, which are attended with purulent or semi-purulent effusions.

The symptoms are at first referred to the throat and the respiration. There is little pain even upon

pressure, and almost no general fever till the later stages, when a low irritative form of fever appears. The dyspnoea, however, soon becomes urgent, even more so than in acute laryngitis, on account of the greater effusion. There is an irritating hawking cough, and a constant endeavour to remove thereby, or by deglutition, some adherent mucus, which the patient supposes obstructs the air-tube, and is the cause of his uneasiness. The voice gets hoarse or suppressed, and while inspiration is much interfered with, expiration is comparatively easy. Dysphagia is not always present. The epiglottis, though not always swollen, can frequently be felt to be so when the finger is introduced into the throat. When swollen, it has been well likened to a cherry, so round, hard, and red does it become. The glottis, too, can sometimes be felt tense and tumid, from infiltration.

Death, which is frequently due to sudden spasm, takes place much in the same way and in the same time, as was stated to be the case with regard to acute laryngitis.

When sub-acute laryngitis is a primary affection, it may come on very suddenly; but when it is secondary or consecutive, it may become established much more slowly. Middle-aged persons of a plethoric and weakly habit of body, are those most liable to be attacked.

The statistics of Valleix and Sestier show how fatal an affection this is. Of 40 cases related by the former, 31 died; and of 168 recorded by the latter, 127 died. The disease, when it follows erysipelas, low fever, or diffuse inflammation, is almost certainly fatal. The constitution and state of health of the patient and the rapidity of the seizure will also throw light on the *prognosis*.

The *diagnosis* is not usually difficult. The throat affection appearing in adults during or after a low asthenic form of inflammation or fever, its being marked by a feeling of obstruction, which the patient vainly tries to overcome by swallowing and hawking; its not being accompanied by pain or acute inflammatory fever, the recognition of the enlarged and tumid epiglottis by the finger, and the increasing obstruction to the respiration, and, ultimately, the interference with the due arterialisation of the blood. From true croup and spasmodic croup it is distinguished by the age of the patients affected, by the inspiratory efforts being alone affected, and by the results of digital examination. Aneurisms of the great vessels at the root of the neck giving rise to somewhat similar laryngeal symptoms may be recognised by careful auscultation, and the signs of pressure on surrounding parts which such tumours occasion.

The key to the treatment lies in the due recognition of the source and cause of danger, and the adynamic nature of the affection. Patients affected with this form of laryngitis are generally so weak and depressed that they cannot admit any delay in the treatment, and consequently very prompt attention is called for. As general remedies, blood-letting cannot be employed beyond the application of a few leeches to the throat, but purgatives and blisters (to the side and back of the neck, or upper part of the chest) at the outset may be tried, not, however, with any great hope of success, as safety lies in bronchotomy alone. Tartar emetic is not now employed, and mercury cannot be used in the cachectic subjects we have generally to deal with. If at all of use, it can only be after the brunt of



the ailment has passed, and the effusion alone remains to be got rid of. The antiphlogistic treatment can only do good during the stage which precedes effusion, but effusion having taken place assumes the relation of a local mechanical obstacle to the respiration, and it must be overcome by making an artificial opening below, to allow air to enter the lungs. The sooner after the recognition of the true cause of the obstruction, the operation alluded to is performed, the better. The dangers of such an operation are trivial in comparison with the benefits obtained. By it, if early performed, immediate relief is got, so far as the most distressing symptoms are concerned, and the urgency of the danger is allayed, while rest is given to the morbid parts, and time allowed for remedies to act, and those ulterior changes are prevented in the lung and brain which are so much to be apprehended.

Lisfranc introduced, and several surgeons have practised, a plan of incising or puncturing the pharynx and glottis in order to free them of the effusion. A narrow bistouri is used for this purpose, and the punctures are made numerous and small. Gargles are afterwards used, to encourage the evacuation of the fluid. This plan may possibly be tried in cedematous laryngitis, if the practitioner can remain by his patient, and be ready to perform bronchotomy if two repetitions of the proceeding at an interval of two hours bring no relief. If the symptoms are urgent, such delay is not, however justified by the success hitherto of the manœuvre referred to. There is no danger, as some have supposed, of excessive bleeding from such punctures as those alluded to. Legroux succeeded in relieving the swelling by scarifying the mucous membrane with his finger nail sharpened and passed into the throat.

To perform bronchotomy when the disease has advanced so as to implicate the functions of the lungs and brain, is only to compromise the reputation of an operation which is invaluable when undertaken at the proper juncture. The more rapid the progress of the symptoms, the sooner should the opening into the windpipe be made, as the lungs will, in such cases, be the sooner embarrassed. The statistics of Sestier show that, while four-fifths of the whole number of cases died when no operation was performed, more than one third recovered (and all were very severe cases) when it was carried out.

It has been recommended by Bayle and Thuillier to substitute for bronchotomy, a tube introduced into the trachea through the swelled glottis. The difficulty of accomplishing this, the evil likely to be produced by the presence of a foreign body in such a situation, and the questionable nature of the security against the immediate danger which it would bring, have caused this proposal to be little regarded. The same remark may be made with reference to the suggestion to promote the absorption of the fluid present in the lips of the glottis, by the direct pressure of the finger applied from time to time; and in this country no reliance is placed in so rapid and terrible a form of laryngitis, on the topical application of solutions of caustic, as advocated by Dr. Green, who uses a solution of the crystals of nitrate of silver of the strength of two scruples to a drachm in the ounce of water. Many large blisters applied to the neck, chest, and shoulders, have in some cases rapidly

diminished serous effusion into the tissues of the glottis.

If the patient be so fortunate as to get through the immediate danger of sub-acute laryngitis, it occasionally happens that he falls into another of scarcely less hazard. The purulent inflammation of the tissues is apt to set up sloughing, and this leads to slow exhaustion and death. The cartilages may necrose and "phthisis laryngea" become confirmed. Local medication is employed in such deplorable and almost hopeless circumstances, in order to loosen the sloughs, and by the administration of a generous diet and stimulants, every attempt is made to sustain the system during the process of cicatrisation.

*Chronic Laryngitis* is the most common of all the forms of laryngeal affections, and may vary in severity from an illness so slight as hardly to attract attention, to one of the most severe and formidable nature.

Chronic laryngitis may result from neglected catarrh, or be the sequence of acute inflammation. It is, however, most commonly seen as the effect of some frequently renewed irritation, as oft-repeated colds, frequent exposure to sudden alterations of temperature, injuries of the throat, repeated over-exertion of the voice, the inhalation of irritating dust or gases.

Intemperance, scrofula, the abuse of mercury, debilitating diseases, and derangements of the digestive organs, strongly predispose to it, and it is a frequent accompaniment of tubercular disease of the lungs, and of syphilis.

The effects are mainly visible in the mucous membrane and the cellular tissue beneath, in the slighter forms, and in the same tissues and in the cartilages also in the more severe. When the mucous membrane is constantly irritated and kept in a state of congestion it gets thickened, interstitial lymphic deposit takes place into it and into the areolar tissue beneath, and thus the whole region of the back of the pharynx, the glottis and epiglottis and downwards, as far as and sometimes even beyond the true vocal cords, becomes permanently altered and diseased in structure. The mucous membrane gets into a swelled, irritable, and softened condition, with granular patches upon it. The enlarged follicles become the seat of ulceration; the sub-mucous cellular tissue becomes infiltrated with semi-purulent, or it may be tubercular matter, dissecting abscesses penetrate and destroy the surrounding parts, and occasionally burst into the œsophagus, but more commonly on the external surface, and that often by long tracts, which afterwards may become fistulous; the perichondrium of the cartilages becomes inflamed, and ultimately the cartilages themselves get eroded and become carious or necrosed, having frequently been partially or wholly ossified before dying; and thus is established, by slow but sure degrees, the terrible disease to which the appellation of "phthisis laryngea" has been not inappropriately given.

The ulcers met with in chronic laryngitis are sometimes of a small round irritable character, but more frequently they are large and of irregular shape. They may occupy any part of the upper portion of the larynx, and extend downwards even into the trachea. Syphilitic ulceration spreading from the fauces is usually confined to the upper part of the larynx; while as a consequence of idiopathic

inflammation it occurs most frequently on the lips of the glottis, and when in connection with pulmonary consumption it is most common in the trachea. Thick cord-like cicatrices may result from ulcerative action in the windpipe, and cause considerable contraction.

The expectoration which accompanies chronic laryngeal inflammation is at first scanty, but soon becomes profuse, more or less purulent, fetid, and streaked with blood. Portions of necrosed cartilage are occasionally expelled with the sputa, together with phosphatic concretions which form in the diseased larynx. If pieces of dead cartilage, or such concretions as have been referred to, in place of being extruded, become lodged in the windpipe after being loosened, they may cause even fatal results, and in all cases much irritation will be occasioned by them.

The symptoms of chronic laryngitis vary much with the severity of the seizure, and the extent of surface implicated. Its presence may be alone signified, in the slighter forms of the affection, by a husky and hoarse voice, a dry wheezy cough, and some amount of dyspnoea. Pain on pressing the larynx against the spine, or on moving it from side to side, will also probably be complained of.

The more changed from its normal condition the mucous membrane becomes, the more will the calibre of the canal be restricted, and the breathing and voice suffer embarrassment. The inspiration becomes sibilant in the more severe forms of the disease, and complete aphonia may arise. Deglutition is occasionally interfered with, especially when ulceration is present on the anterior surface of the epiglottis. The disease may extend downwards and implicate the lungs, causing tubercular deposit there. Such implication is not always easily determined, from the confusion of sounds heard through the stethoscope; however, by percussion, the existence of tubercular matter may be recognised.

Death in chronic laryngitis may take place by spasm, or by the supervention of an attack of the acute or cedematous form of the disease, or by symptoms similar to those of phthisis, viz. wasting and hectic.

The *diagnosis* will rest on the history of the attack, the changed hoarse whistling voice, the hissing inspiration, the peculiar cough, the tenderness produced by pressure on the upper part of the windpipe, the pain or uneasiness caused by deglutition and by speaking, the absence of acute inflammatory fever, but the presence of considerable constitutional irritation or hectic. When there is ulceration at the upper orifice of the larynx or on the epiglottis, then the pain on deglutition will be very considerably augmented, and at all times there is a fixed pain at the upper part of the larynx, and usually a rejection of fluids by the nose. When ulceration attacks the vocal cords, the voice will be rendered hoarse, or be altogether suppressed.

The differentiation of chronic laryngitis from aneurismal and other tumours pressing on the recurrent nerves is to be sought by observing the effect which their pressure occasions on blood-vessels, gullet, or lungs, and by auscultation and percussion of the upper part of the chest. We thus obtain evidence of the existence or not of aneurism, or other tumour, occupying the place where lung tissue should be. In few cases can any confusion exist between chronic laryngitis and an

access of asthma, but the state of the voice will serve as a well-marked distinction. In asthma it is little, if at all, changed; in laryngitis it is very markedly affected. Further, the paroxysm of asthma comes on for the most part suddenly, and leaves the patient as it found him, in comparative health, while the other affection becomes established slowly, and increases in intensity, remaining long, and leaving the person affected in a deplorable condition. There is, besides, the probable previous occurrence of the asthmatic attack, and there is its recurrence, all serving to distinguish the two diseases beyond the possibility of confusion.

The *prognosis* of chronic laryngitis will mainly depend on the stage which the affection has reached, its severity, and the powers of resistance to its effects possessed by the patient. In its milder forms chronic laryngitis is removable, but it is very liable to return, while in the more advanced and severe degrees it is an incurable and very destructive malady. When ulceration has made much way, and abscesses form, producing those general symptoms which have been not inappropriately termed "phthisis laryngea," the case is well-nigh hopeless.

The *treatment* aims chiefly at overcoming the local symptoms, but the constitutional effects must also be managed. The treatment must be varied according to the severity of the disease, its cause and its subject.

Perfect rest to the affected part is of very great consequence. Talking should be prevented as much as possible, and the most soluble food must be used, so as to render deglutition as easy as can be. Any special source of local irritation, as those connected with occupation or such like, must be removed, and exposure to cold carefully avoided. Removal to a mild climate becomes often necessary, and in all cases is highly beneficial. Any derangement in the general health, any pernicious habit by which the larynx is irritated, any irregularity in the secretions, must be corrected; and in general tonics, nourishing food, and it may be the use of mineral waters, will be indicated. If the cause of the disease has been syphilis or the abuse of mercury, then iron or the iodide of potassium must be used, but the administration of mercury for the cure of syphilitic laryngitis must only be thought of when the patient is strong and able to bear it. Further, when the effusion attending the affection has been considerable, it may be desirable, if the patient be vigorous, to use mercury cautiously in order to hasten the removal of such effusion. If used with proper circumspection, great good may be got from this drug in such cases.

Sedatives and antispasmodics, such as opium, belladonna, valerian, camphor, stramonium, ether, and hyoscyamus, given internally, are occasionally useful in allaying cough, relieving spasm, and quieting irritation, but the benefit attending them is generally only very temporary. Drs. Stokes and Graves recommend the external use of belladonna (in the form of plaster) to the throat in order to relieve the spasm.

*Local remedies.* Occasionally the application of a small number of leeches to the sides of the larynx relieves the pain and cough; and counter-irritation by croton oil or tartar emetic or turpentine to the same part, or to the back of the neck,



and a seton in the last named region, has been found useful. The actual cautery too has been employed to fulfil the same end, and small caustic issues to either side of the larynx. Astringent gargles, as those of alum, tannic acid, or sulphate of zinc (which last was Bennati's favourite prescription), are occasionally of much use, and inhalations of hot steam or of medicated vapours of various descriptions, iodine, balsams, tar, turpentine, stramonium, narcotics and sedatives, have been thought to soothe at least temporarily. But the disease now under consideration is one which generally demands the adoption of more decided measures. The best results have been obtained from the local application of strong solutions of nitrate of silver. Trousseau and Billoc tried many other salts, but the use of none was followed by such good results as the salt of silver. It may be used in the form of powder (12 to 72 parts mixed with sugar), minutely divided and drawn into the air passages after being carried as far as the glottis in a reed or hollow glass tube; yet its diffusion is so difficult to obtain in this manner, and its action is so violent, that most surgeons prefer the more manageable form of solution. Employed in this form it can be introduced either by means of Bretonneau's sponge probang or by Trousseau's curved syringe, which has a finely perforated nozzle. A weak solution is found practically to do harm, as it only irritates and stimulates, but a solution of the strength of a drachm to the ounce of distilled water produces a very decided and often lasting effect in causing a change of action in the membrane. The probang charged with some of the solution above mentioned is passed into the larynx (for few credit the possibility of passing the vocal cords), and in this way the caustic is applied directly to the diseased surface. It is best to begin by applying it to the pharynx alone, and then every two or three days to the larynx, till the parts become somewhat used to the application, after which it may be applied daily, the repetitions being, however, in each case regulated by the effects. The cauterisation of the pharynx and tonsils is often productive of much good in affections confined apparently to the larynx. How it acts in such cases is not easy to explain.

If, however, the disease be far advanced, the necessity of obtaining perfect rest to the part becomes imperative, and this is often unattainable to the required degree without making an artificial opening into the air passages below the seat of the malady. The constant cough and the hawking prevent rest, and the fear is great of sudden and fatal spasm. The more pressing danger is allayed by bronchotomy, and time is then obtained for the use of remedies to cure the disease.

To be of use bronchotomy should be performed early, before the patient's strength has been too much exhausted. Finally, it is always to be remembered that the fatal termination of chronic laryngitis is frequently due to the supervention of the acute or the cedematous forms of the disease, and our measures must be taken with a clear knowledge of such a risk.

*Laryngeal Cartilages*, diseases of. Some of these affections have been already referred to when reviewing chronic laryngitis. The cartilages of the larynx frequently ossify in old age, and are in consequence rendered the more liable to injury. This ossification may be very complete, so that the

whole windpipe, including the thyro-hyoid membrane, may be rendered quite rigid. Exostosis of the cricoid and arytenoid cartilages have been observed, and in one case at least such a tumour has partially obstructed the œsophagus.

Necrosis and caries may attack and destroy these cartilages, the former disease being, however, more common than the latter. In chronic laryngitis, when abscesses form or ulceration extends to the cartilages, the perichondrium being first affected, separates from the underlying cartilages, and the cartilage thus stripped of its organic connection, dies. Trousseau found the cartilages necrosed in more than the half of the cases of chronic laryngitis he examined. Sedillot, too, has shown that sometimes necrosis attacks these cartilages after severe fevers.

When dead, the cartilage acts as a foreign body, and may occasion much irritation before it is removed. Sometimes it escapes piecemeal, through openings existing into the interior of the larynx; sometimes an abscess works its way to the surface, and allows of the discharge of the fragments externally. If detached and falling inwards, it may cause suffocation, in consequence of its obstructing the larynx, or from the collapse of the windpipe, permitted by a removal of all support. Bronchotomy may be called for in some instances, in consequence of the obstruction set up by these fragments.

Caries is most common in the rings of the trachea, but it is rare in the cartilages of the larynx. It is occasioned in the same way as necrosis, and may cause most annoying fistulous tracts to form in the neck. In cases of caries, rapid and fatal asphyxia may result in consequence of œdema of the glottis setting in.

It has been proposed to cut down and remove necrosed or carious cartilage in the larynx, but as yet this proposal has not been put into practice. Fragments can frequently be removed by the fistulous tracks leading to them, but the disease in general is too hopeless to warrant much interference.

*Nervous affections of the Larynx.* Spasm of the glottis may occur either in the adult or in the child, and frequently occasions very serious results. In the adult such an affection is generally connected with hysteria, but it may result from pressure caused by various tumours on the inferior laryngeal nerves. Bronchocele, cancerous and scrofulous tumours of the neck, and aneurism of the great vessels, may thus act. Spasmodic affections of the glottis, too, may result from irritation of neighbouring or distant parts, as inflammation of the œsophagus or bronchi, or even of the soft parts, irritation of the nerve centres, or of the digestive or uterine organs. Thus the source of irritation may be both distant and obscure. The treatment of such an affection must vary with its cause, which must be diligently sought for and mitigated or removed. To relieve the immediate symptoms, cold affusion, fomentations to the fore part of the neck, stimulants to the nostrils, slapping the cheeks smartly, will usually avail. Opening the windpipe can only be thought of in very severe and intractable cases in which the cause is ever active, and cannot be removed. Anti-spasmodics and sedatives will be indicated if the attack can be foreseen, and is of such a nature as can be thought amenable to such remedies. In

all cases the secretions must be regulated, and fresh air and the administration of chalybeates or other tonics will in most cases be beneficial.

Nervous aphonia is occasionally met with in females, depending on some temporary irritation of the nervous system, and it is to the removal of such irritation that our treatment must be directed. The sudden manner in which the seizure comes and goes is its leading characteristic. This affection is sometimes dependent on a relaxed condition of the throat, and demands stimulant and astringent gargles, or the topical use of nitrate of silver, while, in all cases we employ general measures to strengthen and tone the system after having removed any specific derangement which may be present.

In children, spasmodic affections of the glottis are often very serious. Such an affection is variously designated "spasmodic or false croup," "laryngismus stridulus," "thymic asthma," "crowing disease," &c., &c.

Those affected are usually below four years of age, and are attacked for the most part suddenly on awaking from sleep with dyspnoea, so severe as to threaten instant death. This ends in a crowing noisy inspiration as recovery takes place. Sometimes we have no difficulty in discovering the cause of the seizure, but at other times we find nothing to guide us. Some unusual bodily or mental irritation is the common cause; an irritation in the gums, in the digestive organs, or in the brain. Fear or sudden impressions of any vivid kind may also occasion it. Weakly children, as those recovering from some depressing complaint, are those most liable to be attacked. Some authors have ascribed it universally to disease of the brain, others to the thymus gland or enlarged scrofulous glands at the root of the neck pressing on the recurrents or the veins, and thus causing a direct effect on the glottis, or congestion, and it may be, effusion on the brain. However, we well know that spasmodic croup does not always recognise such serious causes as these, but may be due to temporary influences which leave no permanent evil behind.

The attack of spasm may pass off as suddenly as it came, and may not return, but most usually it recurs at irregular intervals, if the cause continue in activity, and it may even end in general convulsions. It is apt to be mistaken for a foreign body in the air passages. The absence of fever and premonitory symptoms, its suddenness, its irregular intermittent character, all cause it to resemble a foreign body present in the windpipe, but there are other points in which they manifestly differ, and these will be found discussed under the head TRACHEA.

The symptoms which have been above referred to, taken in connection with the child's age, the absence of any catarrhal symptoms, the freedom of breathing between the attacks, and the presence of some efficient cause, will point out the true nature of the affection. In its treatment cold affusions to the head, while the lower part of the body is placed in hot water, and friction is employed to the limbs, striking the nates smartly while the child is held somewhat forward, will probably remove the spasm, but artificial respiration by the mouth, if such can be accomplished, or after opening the windpipe, if that be considered necessary, may be required to effect complete restoration.

After the immediate danger of the attack is over, and in order to provide against a repetition, the general health must be improved, and we must search for and remove the cause of the affections whatever it be. The bowels must be carefully regulated and kept free, and the gums examined. Change of air, good soluble food of an unirritating and easily assimilated character, and the administration of tonics, and especially iodine and iron, will in general prove serviceable.

*Larynx, morbid growths in the.* Hydatids, cartilaginous tumours, warts and venereal papules are occasionally developed in the larynx. Polypous growths, or growths simulating polypi in shape, are also met with. These last occur most frequently in young male subjects, and are invested with considerable interest. They may be either of the mucous or fibrous description, and vary much in size and shape. They may be round or lobulated; single or in clusters. Occasionally medullary cancer is found in the larynx, assuming shapes similar to that of polypous growths. Laryngeal polypi, though sometimes attached by broad bases, are most frequently met with narrow and long stems. The mucous polypus consists of an hypertrophy of the mucous membrane, while the fibrous springs from the sub-mucous tissue, and either ruptures the overlying membrane, or carries a layer of it on its surface.

Laryngeal polypi cause danger by the mechanical obstruction they occasion in the windpipe, and this they the more readily accomplish from their most common site being the neighbourhood of the glottis. They also occur on the vocal cords, in the ventricles of the larynx, and at the root of the epiglottis. When present in the larynx, polypi cause embarrassment to the respiration, a change in the tone of the voice and in the sound of the breathing, and sometimes they give rise to much more serious effects by changing their position suddenly (when attached loosely) and closing the chink of the glottis. Suffocation will follow such an accident, if the efforts of the patient fail to remove the impediment. If he is successful in freeing the orifice, the former state of the respiration is at once restored. The movement of these tumours within the larynx is occasionally perceived by the patient, and their presence can sometimes be demonstrated by means of the laryngoscope when the patient is placed in a good light, the tongue well depressed, and a forced expiration made. In such cases the tumour may occasionally be seen for a moment to project by the side of the epiglottis. Roux and others have moreover succeeded in exploring these tumours with the finger. These methods of diagnosis may be put into requisition in any suspected case, and if portions of the growths are expectorated, as they sometimes are, then there can be no hesitation felt as to the nature of the obstruction.

It may be added that some patients affected with laryngeal polypus, have by making rapid efforts of inspiration and expiration produced a valve-like sound, and a hoarse cough and a sibilant inspiration are not uncommon accompaniments of the affection. The symptoms occasioned by the growth will however vary with its site. Polypi are not however always easily recognised or distinguished from other affections in which there is obstruction to the respiration. Sometimes they



grow very insidiously, and death takes place without the true ailment having been discovered.

Polypous growths in the larynx, if left alone, invariably prove fatal. The solitary case or two in which they have been spontaneously expelled can hardly be considered to invalidate this statement. The rule then is to remove them. This can sometimes in favourable cases be accomplished by the mouth. The tumour has been seized as it presented itself by the side of the epiglottis, and its pedicle cut or twisted so as to allow of its entire removal, the point from which it grew being afterwards touched with a strong solution of nitrate of silver.

Most commonly the windpipe has to be opened in order to allow of the growth being reached, and this opening is made in whatever part of the tube best suits the site of the polypus. Ehrmann recommends us to perform tracheotomy in the first instance in such cases, and having thus secured free access of air to the lungs, to split the cricoid cartilage, and prolong the incision as far upwards as may be required to remove the tumour; the latter part of the incision and the removal of the growth being, however, postponed till the fatigue and exhaustion of the first proceeding is recovered from. Having reached the growth, we may either remove it by excision, or cauterise it if it has a broad base.

Warty cauliflower-like excrescences, similar to those so often seen on the vulva, occur in the larynx, and are of venereal origin. They give rise to obstruction, but have no other distinctive sign. If remedies addressed to the constitution fail to remove them, they must be got at in the same way as was described with regard to polypi. Cartilaginous tumours, if they obstruct the windpipe, must be removed in like manner.

*Larynx, Injuries of the.* The larynx generally participates in the severe injury which the pharynx receives from the accidental inhalation of hot steam, or flame, or the attempt to swallow caustic solutions or boiling water. The most common of these untoward events is that in which children try to drink from a kettle or tea-pot containing boiling liquid. In such a case (and the same is true of caustic solutions) a spasmodic action of the pharyngeal muscles almost immediately rejects the fluid by the mouth and nose, so that little or none passes downwards, but part is thrown into the upper part of the larynx, which part of the windpipe generally alone receives immediate injury.

So soon as the violent pain caused by the act has subsided, there is usually an interval before the influence of the injury becomes fully apparent, and then violent inflammation and sub-mucous effusion sets in, and ere long threatens suffocation. The inflammation may ultimately invade the bronchi and lungs, but in the first instance the danger arises from the inflammation and effusion in the upper part of the windpipe. The mucous membrane of the mouth and tongue is in such cases raised into blisters, and presents to the eye a white or ash-coloured appearance; afterwards it becomes sloughy, soft, and easily detached.

In the treatment of this accident, some command over the inflammation has been said occasionally to have been obtained by the use of leeches and blisters to the throat; and Mr. Wallace, of Dublin, and others in imitation of him, have advised

calomel and opium to be given from the outset, in small oft-repeated doses; but as the first mentioned remedies have been by no means universally beneficial, and as their employment greatly interferes with the performance of the important operative step immediately to be referred to; and further, as in such cases the difficulty and pain of swallowing is considerable, and the time too limited for any advantage to be obtained from calomel and opium (at least as regards the immediate danger), the true and only reliable remedy, if the symptoms are formidable, is bronchotomy. This should in all severe cases be performed at once, and not delayed till its performance is of no avail. When the immediate and pressing danger is thus overcome, we may employ remedies to subdue the inflammation and its consequences with more hope, perseverance and success. Sestier strongly advocates cold agents introduced into the mouth, hot mustard pediluvia, and afterwards calomel and opium to remove effusion.

The treatment of those cases in which steam, caustic solutions, or flame have been drawn into the gullet and windpipe, is precisely the same as that which has been just related.

Violent contusions of the larynx, as by a blow, may cause very serious symptoms, in consequence generally of the spasm of the glottis which is set up. Urgent dyspnoea may then arise and demand bronchotomy.

Paralysis of the larynx may in like manner arise from violence or result from irritation in the digestive organs or nervous system. If the cause is corrected, the laryngeal affection will disappear.

The cartilages of the larynx and the hyoid bone may be fractured by violence, or the latter may be dislocated. Fractures may be followed by severe inflammation and embarrassed deglutition and respiration. The fractured part is to be "set" by manipulation, and the effects treated according to their nature. Dislocation of the hyoid is put right by throwing the head backwards so as to stretch the muscles, and then, gradually relaxing the lower jaw, and at the same time manipulating gently, so as to restore the normal relationship of the bone. If from any cause the fractured or dislocated portions cannot be easily restored, and if dangerous pressure is produced on the windpipe, the trachea may have to be opened in order to overcome this danger.

*Wounds of the Larynx.* Wounds of the larynx may be of any of the various kinds into which wounds are divided, but incised wounds, self-inflicted or caused by a murderer, are those which most usually fall under the notice of the surgeon.

Punctured wounds of this region are however occasionally met with, and are chiefly dangerous on account of the inflammation and emphysema which may follow them. The constant movement of the windpipe in respiration is very apt to destroy the parallelism between the wound in the canal and that in the overlying parts; and the cellular tissue external to the windpipe is so loose that emphysema is readily produced.

Incised wounds, if they are placed above the hyoid bone, will enter the mouth and probably wound the tongue. Suicidal wounds are generally situated between the hyoid bone and thyroid cartilage. They are for the most part oblique in direction and frequently neither extensive nor

deep, if the resolution or strength of the patient fail at the moment of their infliction. But even slight wounds, if improperly managed, may be followed by very disastrous results. The position, depth, and extent of these wounds will of course vary greatly, according to the nature of the weapon used, the mode of its employment, and the position of the head at the time of its application. Only the superficial parts may be divided, or the larynx and œsophagus may be fairly cut through, and it is a remarkable fact that this last terrible injury may be inflicted without the carotids being cut, as has been evidenced in several cases. This is in a great measure to be explained by the fact that suicides generally throw the head back and the neck forward, thus putting the vessels out of the way, while they cut high in the neck; but even low down the trachea has been fairly divided, and the œsophagus opened, without the carotids suffering.

Occasionally we have to deal with many wounds in the throat of suicides, and it is in such cases that we are apt to have partial or complete detachment of the cartilages, the resistance of which to the knife frequently limits the depth of such wounds. Transverse wounds of the windpipe are apt to gape much from the action on the lips of the wound of the muscles which pass from the hyoid bone and jaw to the sternum, and which are here divided. This gaping is not so marked in wounds of the upper part of the throat, but the edges of wounds situated in that region have a great tendency to turn inwards, so that the surgeon has much difficulty in keeping them in accurate apposition.

Even superficial wounds of the neck may, according to the experience of Dieffenbach, prove fatal, by setting up diffuse inflammation, and the passage of purulent matter into the anterior mediastinum.

Even in those cases in which the great vessels escape, considerable and even fatal hæmorrhage may attend incised wounds of the throat. In wounds placed high in the neck, the lingual artery may be cut, and lower down the thyroid vessels may yield much blood. The blood if not prevented may trickle into the air passages, and though the danger of such an occurrence has been much exaggerated, yet if the patient is weak so that he cannot reject the fluid by coughing, as a strong person can and does, it may fill up the air tubes and cause suffocation. In proportion to the size of the opening into the windpipe, will the escape be of air from the tube. When the wound is small, and the parallelism between the opening in the windpipe and that in the soft parts is lost, extensive emphysema may result. A want of due sensibility in the glottis may result from such wounds as are now under review, and as a consequence of this the food escapes into the larynx, even although there be no wound of the œsophagus. This diminished sensibility is only another evidence of that general lowering of the vitality of the part which occurs some time after the infliction of the injury, and which results from the general weakness which so often follows these wounds.

The effects produced by wounds of the larynx will depend greatly on their position, depth, extent, and direction. When placed high up in the hyothyroid space, the pharynx is opened, the epiglottis probably partially or wholly detached, and the

vocal cords wounded or divided. In such cases there will be embarrassed deglutition, the escape of alimentary matters by the wound, the voice suppressed, and finally there may be great annoyance or even fatal effects from the falling down of the epiglottis. In consequence of the profuse escape of the saliva, there is usually great thirst. Occasionally the patient has been placed in imminent danger, and in a few cases even death has resulted from detached portions of mucous membrane or cartilage closing the aperture of the windpipe. Wounds placed high in the neck are liable to be followed by inflammation and sub-mucous infiltration, so that the swelled glottis may cause suffocation. This, however, is manifestly an after-result.

The treatment of wounds of the throat demands first, the suppression of hæmorrhage. This can be usually accomplished by the use of the ligature and pressure. Mr. Erichsen recommends in cases of general venous oozing, which these means fail to command, to introduce a large silver tube into the aperture in the windpipe, and then to plug the wound round this tube. This is to be retained till the bleeding has ceased. In all cases we must place the patient in an equable temperature (as near 80° Fah. as possible) and cover the wound up with a piece of muslin, or, as Liston recommends, a woollen muffler to act as a respirator, and guard against pulmonary inflammation which in such cases is so apt to arise and prove fatal. Keep the head and shoulders high, and the former somewhat, but not too far, bent forwards by means of bands attached to the night-cap and a waist belt. No attempt is to be made to close the wound till all oozing has ceased. If this precaution is neglected, and blood gain admission into the bronchial tubes, the patient being weak and unable to reject it, slow suffocation may be produced. If the blood has accumulated to a dangerous extent in the air-tubes, it may be removed by suction, as Roux first practised. All oozing having ceased, and the lips of the wound becoming glazed, the wound may be closed to some extent by introducing a wire suture or two at either extremity and leaving the centre portion open in the first instance for the escape of blood and mucus, and afterwards closing this part also by secondary adhesion. The centre portion thus left open, must be carefully kept clean by an attendant. In superficial wounds, adhesive plaster will probably afford all the support required, but in deep wounds it is not sufficient. Early adhesion is very rarely obtained in wounds of the throat, from the constant movements of the part, and the escape of fluid by the wound; while diffuse inflammation and emphysema, as well as the imprisonment of secretions, are apt to follow this premature closure.

In some cases, it is desirable to pass the sutures through the contiguous cartilages, in order to secure a good hold, and in all cases much care is required to prevent the turning inwards or the overlapping of the edges of the wound during cicatrisation.

If the epiglottis is nearly detached and cannot be kept in place, it must be removed, however grave its want may be considered. If emphysema occur, and embarrass the breathing, it must be got rid of by punctures or small incisions. If the patient has himself inflicted the wound, he must be carefully watched to prevent his interfering with the dressings. Inflammation must be guarded against, and treated if it arise; but from the loss



of blood which, in such cases, has been usually sustained, there is generally more need of stimulants being administered than any agencies which will depress. Many suicides having been intemperate in their habits, and suffering from mental depression at the moment when they attempt the act of self-destruction, are very prone to fall into a state of prostration. The pulse must be our chief guide as to the measures called for.

If in consequence of external or internal swelling or the impaction of viscid mucus, the breathing becomes embarrassed, then we must open up the wound again, or, what is better, open the trachea below, by which means freedom will be given to the respiration, and the original wound will be allowed to heal without any interference. In all cases we must watch any threatening of bronchitis, which is a common consequence, or the advent of delirium of the busy or furious type.

If food taken by the mouth escape by the wound, we must pass a large catheter or the elastic tube of a stomach pump into the stomach, making sure, by applying the flame of a candle, that it has not entered the windpipe, and introduce food by this to support the strength. The tube had better be removed after use, unless its introduction is very difficult. It may, if thought desirable, be introduced by the nostril. If there be a wound of the gullet, then in the first instance, at least, the tube should be passed through it. Occasionally we cannot feed by the mouth at all, but must have recourse to enemata. The tongue should be frequently moistened, to relieve the urgent thirst which so generally torments the patient and he should be instructed how to close the wound in the neck with his fingers if he has difficulty in ejecting his sputa. Tracheotomy, it may be remarked, is occasionally demanded at a later date, if in consequence of the projection inwards of the granulations at the wound, any serious obstruction to the breathing should ensue.

After wounds of the larynx, especially gun-shot wounds, and such as have been accompanied by loss of substance, fistulous openings are apt to remain. In some rare cases the wound in the windpipe and gullet has failed to heal at all, and the patient has continued ever after to breathe and be fed by the aperture in his neck. This is, however, rare, as such fistulous openings as follow wounds in the windpipe are usually very small, and are often attended with but little inconvenience. It is in the hyo-thyroid space that, according to Velpeau, such fistulæ are most apt to occur, and it is there that the escape of food is most likely to take place.

When an aerial fistula exists there will of course be an escape of air by the opening, and partly in consequence of the vicarious action thus established, and also to some extent in consequence of other changes which follow the partial disuse of the larynx, the canal of the larynx gradually diminishes in calibre till it is all but closed. In cases of fistula, the voice is modified or destroyed, and the respiration is carried on in an imperfect manner through the false passage. The constricted condition of the glottis just referred to, constitutes one of the greatest difficulties in the treatment of old fistulous openings. Unless steps are first taken in such a case to dilate the canal, it would be dangerous to attempt to close the fistula, seeing that air would not then have access to the lungs.

Small, narrow, and oblique fistulæ hardly demand interference, as they cause little harm or inconvenience, and for reasons already given, old fistulæ accompanied with contraction of the larynx, hardly admit of operation. It is in the case of recent fistulæ, which are a source of annoyance, that the surgeon most justly and hopefully interposes his aid. These openings may be variously closed.

1. In small fistulæ, caustic or the hot iron and pressure may succeed in bringing about a cure. These means demand perseverance and care for their successful issue.

2. Prolonging the superior and inferior angles of the opening, rawing the edges simply, or at the same time dissecting them up from the underlying parts, and finally uniting them by suture. The inferior prolongation of the opening made by the surgeon should be left open to allow fluids to drain off, and so prevent them interfering with the adhesion of the rest of the aperture.

3. By means of a flap raised from the immediate neighbourhood of the opening and twisted so as to cover the aperture, the fistula may likewise be closed.

4. Velpeau dissects a small flap up as in the last case, and rolling it on itself with the raw surface inwards, either in a long or broad shape as the case demands, inserts it like a cork into the opening, and retains it there till it adheres to the edges of the fistula, which have been prepared by rawing for such adhesion.

5. Roux's "occlusion by substitution" is yet another method by which laryngeal fistulæ may be closed. The chief aim here is to obviate any risk of emphysema. The external orifice is freely incised transversely, and the flaps dissected back. These flaps if healthy are retained, if thin or unhealthy removed. The mucous membrane is next separated from around the inner edges of the fistula for a short distance and left so. The lips of the external opening are then carefully united; and lastly an artificial opening is made through the tissues close at hand, through which a fragment of gum elastic bougie of a size sufficient to close the internal orifice is introduced, so as to fill that opening in the mucous membrane. In this way all escape of air is prevented, the external aperture of the fistulous canal cicatrises, and as granulations form, they close round the bougie so as finally to close the internal orifice of the canal, then the bougie is withdrawn.

If the case be not adapted for operation, or the patient will not submit to interference, then perfect cleanliness and the use of a respirator over the aperture should be enjoined.

For foreign bodies in the larynx, see TRACHEA.]  
G. H. B. Macleod.

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**LEUCOMA** (from λευκός, white). Leucoma and albugo are often used synonymously to denote a white opacity of the cornea.

A recent albugo, the consequence of ophthalmia, is of a clear milky colour; but, when of ancient date, it becomes pearl-coloured. It may generally be dispersed by the means employed for the relief of the first and second stages of acute ophthalmia; viz. general and topical blood-letting, with internal antiphlogistic medicines, and topical emollients for the first; and slightly irritating and corroborant applications for the second stage. As soon as the inflammation has subsided, the latter should be employed; for, by exciting the absorbents to remove the coagulating lymph deposited in the cornea, they restore the transparency of this membrane.

But, though this may often be accomplished in the recent state of albugo, it is more difficult when the long duration of the disease has paralysed the absorbents of the affected part; or when the deposition of a dense tenacious substance into the cornea has subverted its organisation. (*Scurpa*.)

The recent condition of the disease, without disorganisation of the structure of the cornea; its occurrence in young subjects whose absorbents are readily excited by external stimulants; are circumstances favourable to the cure. In children the albugo, arising from the small-pox, and insulated in the centre of the cornea, often disappears of itself in the course of a few months.

Dr. Mackenzie recommends a solution of from two to ten grains of lunar caustic, or from one to two grains of oxymuriate of mercury, in an ounce of distilled water; red precipitate salve of various strength; or a finely levigated powder, consisting of ʒ j. of red precipitate, and ʒ j. of white sugar. The powder is to be blown into the eye with a quill; the salve is to be introduced behind the upper eye-lid, and rubbed on the cornea by moving the lid with the finger for some minutes. The solution may either be dropped in by means of a camel-hair pencil, or injected with a syringe. Hydriodate of potass salve, the bile of various animals, and oil of walnuts have all been employed.

We are able, as Dr. Mackenzie observes, by various applications to quicken the action of the absorbents in the removal of specks, especially if



the applications in question be employed at the proper time. If we commence their use too soon, that is to say, before the cause of the opacity is subdued, we shall torment the patient unnecessarily, and impede the cure. "For instance, suppose that, in a case of albugo, arising from scrofulous corneitis, and still attended with considerable vascularity, the practitioner forthwith begins to attack the opacity of the cornea with stimulating powders, and solutions of irritating or caustic substances; not only would he fail in effecting his object, but run a great chance of rendering his patient totally blind. But, if he began by combating the inflammation, which still lingered in the eye, and that chiefly by constitutional remedies; not merely would he witness the dispersion of the redness, but he would find the cornea begin to clear, and day after day, a little more of the effused lymph being removed, the patient's vision would proportionably improve." In general, the internal and constitutional remedies, which do good in cases of specks of the cornea, are those which operate in removing the ophthalmiæ in which the opacities have originated, and the same observation is also true in regard to local remedies. At the same time, there are both general and local means peculiarly adapted for hastening the absorption of opaque depositions in the cornea. Some opacities yield only to country air and generous diet. (See *Mackenzie on Dis. of the Eye*, p. 584. ed. 2.)

The same experienced practitioner notices also the usefulness of a blister kept open behind the ear or on the nape of the neck, and of repeatedly scarifying the inner surface of the eyelids. The vascular albugo he has found incurable, until the vessels proceeding to it had been divided, and the gums made sore with mercury.

All the expedients proposed for the inveterate albugo or leucoma from a cicatrix, consisting of scraping or perforating the layers of the cornea, and exciting ulceration, are unavailing. For, though the enlargement of the cornea should be lessened by such means, its diaphanous state could not be restored; or should the patient perceive a ray or two of light immediately after the operation, the benefit would only be transient; for, as soon as the wound had healed, the opacity would recur. The formation of an artificial ulcer might prove useful, if leucoma depended on a mere extravasation of lymph; but the disease arises from the deposition of an opaque substance, and the disorganisation of the texture of the cornea, conjointly.

(See *Scarpa sulle Malattie degli Occhi*, 8vo. Venezia, 1802. *Richter, Anfangsgründe der Wundarzn.* b. iii. *Essays on the Morbid Anatomy of the Eye*, by J. Wardrop, Edinb. 1808. chap. xi. *Wm. Mackenzie, on Dis. of the Eye*. 8vo. ed. 2. Lond. 1835.) [See also article CORNEA. and Dr. Stellwag von Carion (*Die Ophthalmologie*, &c. 1853.)

C. Bader.

[LEUKÆMIA. LEUCOCYTHEMIA. — Blood containing an excess of white corpuscles. This diseased condition was described and designated by Dr. J. H. Bennett (*Lond. and Edin. Monthly Journal*, 1851-52), and also by Professor Virchow of Berlin. The blood contains an increased quantity of white corpuscles, varying in dimensions, but many of full size, with one or more nuclei; also, a diminished number of red corpuscles, without any necessary variation in the proportion of fibrine,

which may be in deficiency or excess, according to the circumstances of the case. The normal proportion being 2·8 per 1000 (moleschott), or about one in 300. On examining a drop of blood in leukæmia, procured from the finger, from a slight increase to an excess of five times the usual number of white corpuscles have been observed, or they may equal or exceed the red corpuscles in number. The blood in which this peculiarity occurs, is often pink coloured, of low specific gravity, containing a small proportion of solid constituents, but without any decided change in the proportion of the solids in the serum. The quantity of white corpuscles is sometimes so great that, drawn from a vein, it flows white or with white streaks somewhat like pus. An excess of white corpuscles may exist for months or even years, with a continually augmenting increase and corresponding decrease of red corpuscles. When the blood is in a state of hyperinosis, on coagulation the white corpuscles communicate to the buffy coat a peculiar dull whitish appearance, and render it more friable under pressure. They also give to the colourless coagulum often found in the heart and large vessels, a dull creamy, instead, as when less numerous, of the usual gelatinous and fibrous appearance. Or, being extremely adhesive, and aggregated together by molecular stult of fibrine, or being more numerous, they may form a purulent looking layer. The red clot also contains them. Virchow remarks that they have a tendency to accumulate in considerable masses, whenever there is a retardation of the stream of blood, so that in the dead body the greatest number is always found in the right breast. They are also found to be more numerous in the blood of the splenic veins.

In a great majority of the subjects of leukæmia, a diseased condition of the spleen has been observed, sometimes coincident with disease of the lymphatic glands, and occasionally of the liver. In a small proportion of the cases only has intermittent fever been traced as a precursor.

The more prominent symptoms which attend leukæmia are—great debility, often so as to incapacitate the patient from rising from bed, although the face is not expressive of commensurate illness; progressing atrophy; pallor of the surface, and anæmia, but frequently not excessive; pain or weight in the left side, followed by progressively increasing abdominal tumor from enlargement of the spleen; and often much tenderness and pain, apparently from adhesions; frequently, enlargement of the lymphatic glands; sometimes dyspnoea; œdema, with general serous exudations; and generally towards the close of life, a "genuine hæmorrhagic diathesis" (*Virchow, lib. cit.* p. 169), with occasional slight fever, purpuric spots, and hæmorrhages, especially epistaxis, but sometimes apoplexy. Death sometimes occurs suddenly from œdema of the lungs.

Virchow regards the disease as a permanent and progressive leucocytosis; and Dr. Wilks states that the enlargement of the spleen consists of hypertrophy, with increase of function, and not adventitious deposit and loss of function, the lymphatic glands being similarly hypertrophied; thus the latter authority draws a most important distinction between this disease and a form of anæmia attending diseased spleen and lymphatic glands from a morbid deposit in those glands, but where

the white corpuscles of the blood are not augmented.

That the organisation of the blood is deeply affected in leukaemia, seems to be indicated by its *post mortem* examination. Scherer obtained blood from the body after death, in two cases, and submitted it to examination. It did not coagulate thoroughly, but formed a gelatinous semi-conglobulated thick mass, with a surface at first blackish, and on exposure to the air it became more or less red and assumed a marbled appearance. In one case it had a slightly acid reaction, and coagulated perfectly, when boiled with water. The filtrate contained many remarkable substances which do not occur in healthy blood. In the one case: 1. Gluten, or a substance closely allied to it. 2. A peculiar organic matter forming an intermediate link between the albuminous bodies and gluten. 3. Hypoxanthine amounting to 3 or 10 grains to 4 ounces of blood. 4. Formic, acetic, and lactic acids. In the second case, there was no gluten, but hypoxanthine, leucine, uric, lactic and formic acids were found; most of which substances appertain to the splenic juice. (*Day's Physiological Chemistry*, 1860, p. 248.)

The treatment of this disease has hitherto proved eminently unsuccessful, nearly every case observed having proved fatal. Quinine has frequently been administered on the ground of a malarious origin. Iodine has also been extensively employed; but the remedy which appeared to offer the best prospect of success is bromine. One grain of the latter has been given three or four times a day. Under these remedies the health has sometimes improved, and the splenic tumor diminished, but the symptoms have nearly always returned and pursued their fatal course.

*Leucocytosis.* A term lately introduced to represent a transitory condition in which an increased proportion of the colourless corpuscles of the blood appears to be dependent upon an affection of the lymphatic glands. (*Virchow's Cell. Pathology*, p. 167.) Erysipelatous and diffuse phlegmonous inflammations, and also typhoid diseases unattended with any local development of fibrin, but early conjoined with swelling of the lymphatic glands, are attended with an increase of the colourless corpuscles. In such cases the cells are represented as smaller than in leukaemia, their nuclei being proportionately large, and the cell wall often so closely approximated as to give them the appearance of free nuclei. The blood is at the same time hypinotic. Virchow believes that in such cases the enlarged glands furnish to the blood, through the lymph, a larger number of cells, and that in proportion to the predominance of these white corpuscles the formation of the red corpuscles is obstructed.]

H. Ancell.

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**LIGATURE.** In the article HÆMORRHAGE, it has been explained, that the immediate effect of a tight ligature on an artery, is to cut through its middle and internal coats, a circumstance that tends very much to promote the adhesion of the opposite sides of the vessel to each other. Hence, I think with Dr. Jones, in opposition to Scarpa, that the form and mode of applying a ligature to

an artery should be such as are most certain of dividing the above coats of the vessel in a regular manner. A broad flat ligature does not seem likely to answer this purpose well; because it is scarcely possible to tie it smoothly round the artery, which is apt to be thrown into folds, or to be puckered by it, and consequently, to have an irregular bruised wound made in its middle and internal coats. (Jones.) A ligature of an irregular form is likely to cut through these coats more completely at some parts than others; and if it does not perfectly divide them, though adhesion may yet take place, it is a slower and less certain event, and secondary hæmorrhage more likely to follow. The fear of tying a ligature too tight may often lead to the same disadvantages. These and many other important circumstances are noticed in the article HÆMORRHAGE.

The principles which should guide the surgeon in the use of the ligature, were not known until the late Dr. Jones published his valuable treatise on Hæmorrhage. As an able surgeon has observed, "He has banished (at least in this country) the use of thick and broad threads, of tapes, of reserve ligatures, of cylinders of cork and wood, linen compresses, and all the contrivances which, employed as a security against bleeding, only served to multiply the chances of its occurrence." (Lawrence, in *Med. Chir. Trans.* vol. vi. p. 162.)

In the article AMPUTATION, I have noticed the method of cutting off both ends of the ligature close to the knot, on the face of the stump, with the view of lessening the quantity of extraneous matter in the wound, and promoting the complete union of the divided parts, without suppuration. This plan was tried by Mr. Lawrence. "The method I have adopted," says this gentleman, "consists in tying the vessels with fine silk ligatures and cutting off the ends as close to the knot as is consistent with its security. Thus the foreign matter is reduced to the insignificant quantity which forms the noose actually surrounding the vessel, and the knot by which that noose is fastened. Of the silk which I commonly employ, a portion sufficient to tie a large artery, when the ends are cut off, weighs between  $\frac{1}{10}$  and  $\frac{1}{8}$  of a grain: a similar portion of the thickest kind I have tried weighs  $\frac{1}{10}$  of a grain, and of the slenderest  $\frac{1}{80}$ ."

The kind of silk twist, which is commonly known in the shops by the name of dentist's silk, and which is used in making fishing-lines, is the strongest material, in proportion to its size, and therefore the best calculated for our purpose, which requires considerable force in drawing the thread tight enough to divide the fibrous and internal coats of the arteries. This twist is rendered very hard and stiff by means of gum, which may be removed by boiling it in soap-and-water; but the twist then loses a part of its strength. The stoutest twist, which Mr. Lawrence has used, is a very small thread, compared with ligatures made of inkle. The quantity of such a thread necessary for the noose and knot on the iliac artery, weighs  $\frac{1}{10}$  of a grain; or, if the gum has been removed, about  $\frac{1}{20}$ . But the finest twist, kept in the silk-shops, is strong enough, in its hard state, for any surgical purpose; and the noose and knot, according to Mr. Lawrence's statement, would not weigh  $\frac{1}{40}$  of a grain.

It further appears, from the report of this gen-



tleman on the subject, that there is no danger of these ligatures cutting completely through the vessels, as some surgeons have apprehended; and that, although he has not yet ascertained what becomes of the pieces of ligature after the wound is united, he has never seen abscess nor any other bad symptoms occasioned by them. At the time when Mr. Lawrence wrote, he had employed this method of securing the arteries in ten or eleven amputations, in six operations on the breast, and in the removal of two testicles. The cases all did well, excepting a man who lost his thigh, and who died of an affection of the lungs. (See *Lawrence on a New Method of Tying the Arteries in Aneurism, &c.*, in *Medico-Chir. Trans.* vol. vi. p. 156, &c.)

The foregoing method was tried by myself in several amputations, which I performed in 1815, at Brussels, and in a larger number of cases by my friend, Mr. Collier. Our ligatures, however, though small, were not so small as those judiciously recommended by Mr. Lawrence; and, on this account, no accurate inferences can be drawn from our examples.

This subject was noticed by Mr. Guthrie as follows:—"Some military surgeons, both French and English, have lately adopted the practice of cutting off both ends of the ligatures, close to the knot on the artery; uniting the parts, if possible, over them, and allowing the knots to find their way out as they can. The edges of the wound, in some instances, have united thoroughly in a few days; and when the knots have come off the ends of the arteries, they have caused small abscesses to be formed, which point at the nearest external surface, and are discharged with little uneasiness. I know, that many cases, treated in this manner in the campaign of 1813, ended successfully, and healed in as short a time as the most favourable ones by the usual method; and at Montpellier, in June 1814, Mons. Delpach, Professor of Surgery in that University, showed me at least twenty cases in which he had practised, and was still practising, this method with success. I have seen, however, in two or three instances some ill-looking abscesses formed by them, and I suspect some disagreeable consequences will ensue, if this practice be continued.

"I consider this improvement as very valuable in all cases, that will not unite by the first intention. The ligatures, if there be many, form into ropes, are the cause of much irritation, and are frequently pulled away with the dressings: by cutting them off, these evils are avoided, and the knots will come away with the discharge." (*On Gunshot Wounds*, pp. 93, 94.)

Mr. Roux tried the plan in three operations on the breast: the cases did well; and no ill consequences arose from the presence of the bits of thread under the cicatrix. (See *Relation d'un Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie Angloise avec la Chirurgie Française*, Paris, 1815, pp. 134—136.) Mr. Fielding, of Hull, admits that this method occasions less irritation in the first instance, than the usual mode of leaving one or two ends of silk attached to the knot, and bringing them out of the wound, and that union by the first intention is thus more certainly effected; but he assures us that, in a great variety of cases, in which he has adopted the practice, the knots of silk were not absorbed, and

were ultimately thrown off unchanged, after a slow suppuration, attended with pain and irritation for several weeks or months. (See *Edinb. Med. Chir. Trans.* vol. ii. p. 341.) Ligatures of silk-worm-gut, according to his experience, do not lead to the above inconveniences. (See AMPUTATION, ANEURISM, and HÆMORRHAGE.)

According to Mr. Liston, "Ligatures, of whatever substance, do now and then remain hid for a long time; but, very generally, they occasion trouble. They, perhaps, after the cure has been thought complete, give rise to irritation, pain, inflammatory swelling, and formation of matter; abscess after abscess ensues; one knot comes out after another; and ultimately all the offending bodies may be expelled; but the perfect recovery is thus very long protracted. In all wounds, likely to heal at an early period, the one end of the ligature on the small vessels had best be cut off close to the knot, and the other left only of such length as to project but little from the surface of the integuments. They should be brought out at one or other end of the incision, and, if possible, the whole, or the greater number, at the most depending extremity. In such wounds as it is not advisable, or possible to bring together, both ends of all the ligatures may be cut off close to the surface of the wound. (*On Practical Surgery*, p. 24. 8vo. Lond. 1837.)

Dr. Reese also concurs with Mr. Guthrie. "Where resolution (says he) is not expected, nor desirable, the practice is less exceptionable; and in certain amputations and gunshot wounds, where the escape of these knots is easy from the exposed condition of the stump, this method may be safely adopted. But in wounds made by the surgeon for securing arteries, which are deep-seated, and where union by the first intention is often important, the old method is greatly to be preferred. Some of the most distinguished surgeons in this country, after having repeatedly tried Mr. Lawrence's plan, with attention to all the minute particularity which he so judiciously enjoins, as regards the size and material of the ligature, have laid it aside altogether, and prefer always to leave the end of their ligatures hanging from the wound or stump. Among these is Professor Mott, of New York." (See *Reese's Amer. ed. of this Dictionary*, vol. ii. p. 130.)

The method of cutting off both ends of the ligature close to the knot, may now be said to be generally abandoned, and only adopted in a few cases where the wound cannot be brought together, or must inevitably suppurate freely.

The silk-worm-gut, preferred by Mr. Fielding, was first suggested as an advantageous material for ligatures, by Dr. M'Sweeny, of Cork (see *Edinb. Med. and Surgical Journ.* vol. xiv. p. 597.); and I have great pleasure in here mentioning his claims to the proposal.

Although, in the present state of surgery in England, less importance is attached to the materials, than to the size, consistence, and form of ligatures, I deem it right to insert the remarks of Drs. Reese and Jamieson, of the United States, on what has been termed the *animal ligature*. "To our distinguished countryman, Professor Physick, of the University of Pennsylvania, is undoubtedly due the honour of having first introduced, in 1814, what is known as the *animal ligature* into surgical practice. His ligatures are

made of chamois leather, and he and the late Dr. Dorsey usually rolled their ligatures on a slab to make them hard and round. The advantages, proposed by the ligatures of Dr. Physick, are that, being made of animal matter, the knot, which is all that is left in the wound, will serve long enough to obliterate the artery, and be speedily removed by the absorbents, thus avoiding the difficulty arising from a foreign body, however minute. These ligatures have been used in this country to great extent, and Sir Astley Cooper has demonstrated their superiority in his own operations. (Sir Astley Cooper has since relinquished them.) Dr. Hartshorn used strips of parchment for his ligatures. My friend, Dr. H. G. Jamieson, Professor of Surgery in Washington Medical College, Baltimore, has for a series of years been employing the animal ligature in an extensive surgical practice; a number of his operations I have witnessed. He has used it in many amputations of the limbs and the mamma: he has tied the carotid, the iliac, the femoral, the radial, the posterior tibial, the spermatic, and other arteries, with the *buckskin ligatures*; and, in no instance, had secondary hæmorrhage occurred; and he states that he has never seen anything of his ligatures, and, of course, the wounds have generally healed by the first intention." (See *Amer. ed. of this Dictionary*, art. LIGATURE.)

Dr. Jamieson's principles are entirely different from those which influence all the most distinguished practitioners in Great Britain, and which appear to me to have been the means of rendering secondary hæmorrhage, after the application of a proper ligature, rather an uncommon event. Dr. Jamieson is an advocate for tying the artery with a very soft buckskin ligature, and a little broader than the thickness of the skin, taking care not to tie it too tight. He states, as the result of his observation and experiments upon sheep, dogs, and other animals, that a capsule will surround the ligature, if the capillary vessels be not much disturbed; or the vessel will be surrounded by an abundance of lymph, and the ligature dissolved. Like Scarpa, he prefers flat ligatures; but, by the use of buckskin, has no need to remove the ligatures on the fourth day, as the Italian professor had. (See *Dr. Reese*, Op. cit.; and *H. G. Jamieson*, in *Medical Recorder*, No. xxxvii. January, 1827.)

If any surgeons here were likely to become admirers of flat tape like ligatures, I would remind them of the evils formerly attending their use in the London Hospitals, and of Dupuytren's observation:—"It has been proved," says he, "that the efficacy of the action of ligatures is independent of their flat form, because, however broad they may be, they assume a roundish shape when tightened." (See *Clinique Chir.* t. iv. p. 398.)

Dr. Veitch, while doing duty, in the years 1803-4-5, as surgeon of the Royal Naval Hospital, at Plymouth, had frequent occasion to remark the danger of large flat ligatures, then employed for the stoppage of bleeding; and his reflections led him to try very small ones, so that the quantity of extraneous matter in the wound, and in contact with the secured blood-vessels, might be reduced. "This improvement (says Dr. Veitch), which extends itself to all the operations in surgery, I carried to an extent that no one has usefully exceeded; not only by the diminution of foreign matter in securing the divided

arteries, but by the distribution of these ligatures in the wounds, inflicted by the operations of surgery, and which distribution of the ligatures, combined with their form, brought this part of surgery as near perfection as it is capable of being. The sufferance of foreign matter in the wound, by cutting off the dependent ligatures, and allowing the knots only to remain on the arteries, and attempting to heal the wounds over them, has not been found to answer. The mode of arresting hæmorrhage, which I adopted, was carried into effect before the book of Dr. Jones was published, and without any knowledge of his experiments. I was not aware, at the time I so successfully employed the single round ligatures, of the change that the artery undergoes by their action, and which knowledge led Dr. Jones very properly to recommend a round ligature; but, I may here remark, that such recommendation was not sufficiently explicit; for it left the surgeon at liberty to introduce as much foreign matter in a round, as had previously been done in a flat form, in securing arteries, &c. My experience and reasoning led me to recommend a small ligature; and its nature and form were not left to conjecture, but, clearly laid down; and the introduction of this practice to surgery, by which its limits have been extended, is, I think, unquestionably due to me." Dr. Veitch transmitted his first Essay on the Ligature of Arteries to the editor of the *Edinb. Med. and Surg. Journ.* in 1805, though it was not published till 1806; Dr. Jones's work came out in 1804. I am glad to have this opportunity of mentioning the claim of Dr. Veitch to the honour of the above-mentioned very important improvement. (See his *Obs. on the Ligature of Arteries, Secondary Hæmorrhage, and Amputation at the Hip-joint*, 8vo. Lond. 1824.) The evils of *reserve ligatures* are so generally known, that no chance exists of their ever being resorted to again by any well-educated surgeon. M. Delpech, once a zealous advocate for them, entirely relinquished them many years previously to his lamented assassination, and became firmly convinced of the advantages of following the practice dictated by the results of Dr. Jones's investigations. Some surgeons adopt the practice of removing neither end of the ligature, when a large artery, such as the carotid, external iliac, or subclavian is tied. But if care be taken to apply the ligature with due tightness, this method can never be advisable.

Mr. Guthrie considers a ligature, composed of one thread of dentist's silk, well waxed, to be sufficiently strong for any artery of moderate size; and is of opinion, that two threads will be found strong enough by the most cautious. "The advantages (says he) to be derived from the application of a small ligature, from the least possible disturbance of the surrounding parts, and from absolute quietude, whilst the healing processes are going on, must be so obvious as to require no further observation." Mr. Guthrie has adduced several cases in which secondary hæmorrhage was the consequence of motion of the limb at too early a period, and of undue interference with the ligature. "When secondary hæmorrhage occurs to any extent (he observes) either through ulceration of the artery, or from extension of ulceration, or sloughing of surrounding parts to it, a ligature must be placed upon it nearer to the heart, and as



far above the mischief, which has taken place, as the collateral circulation will permit." He adds, however, that "many secondary hæmorrhages may be restrained, and ultimately suppressed by moderate pressure; and the ligature should only be had recourse to, when the application of pressure appears to be, or has been proved to be, insufficient for the purpose." (See *G. J. Guthrie on the Diseases, &c. of Arteries*, pp. 163—166.)

The great difficulty in such circumstances arises from the general inability of the parts to bear pressure, without an extension of gangrene being the result. Great caution and skill must be used, therefore, in the adjustment of it; for much circular constriction of the part will surely have the most fatal consequences.

According to Mr. Guthrie, "the reflux blood from the lower end of a great artery, after its division, will be of the colour of venous blood: it will flow also like blood from a vein. After the lapse of several days, it will assume more and more the character of arterial blood, but will not obtain the same degree of impulse, which is so remarkable when it proceeds from the upper extremity of the artery." (Op. cit. p. 137.) Many years ago, Sir Astley Cooper operated for a popliteal aneurism, and, after applying two ligatures to the femoral artery, divided the vessel in the interspace: the lower ligature slipped, and a violent bleeding arose from the distal end of the artery: but so dark was the colour of the blood, that it was at first conjectured to come from the vein.

These observations are intended by Mr. Guthrie to refer chiefly to the wounds of middle portions of the femoral and brachial arteries; and not to wounds of the radial and ulnar, where branches form direct communications between one vessel and the other; and the blood has not to pass through the capillaries to reach the distal part of the wounded vessel.

These statements, if found to agree with general experience, will be practically useful, as affording a clue to the end of the vessel, from which the bleeding arises, and to which the ligature should be applied.

Various instruments for conveying a ligature under a very deep artery, have been invented by Desault, Ramsden, Weiss, M<sup>r</sup>Intyre, and others. (See ANEURISM.)

The most complete invention for the application of ligatures round certain tumours, which admit of being thus extirpated, is that of Baron Graefe, termed the *encircling ligature apparatus*. A pamphlet, containing a correct description of it, has been translated from the German, by Fred. F. Weiss, of the Strand.

**LINIMENTUM ACIDI SULPHURICI.**—℞ Olei olivæ 3 jss. Acid. sulph. 3 ss. M. Recommended by Sir Benjamin Brodie for the removal of some effects of inflammation of the synovial membrane. (See JOINTS.)

**LINIMENTUM AMMONIÆ FORTIUS.** ℞ Liq. ammon. 3 j. Olei olivæ 3 iij. Misce. Properties stimulating.

**LINIMENTUM HYDRARGYRI COMPOSITUM.**—℞ Ung. hydrargyri fortioris, adipis suillæ, sing. 3 j. Camph. 3 ij. Spirit. vinos. rectific. 3 ij. Liq. ammon. 3 j. The camphor being dissolved in the spirit of wine, add the liq. ammon. and the ointment previously blended with the

hog's-lard. (*Pharm. Sancti. Barthol.*) An excellent formula for all surgical cases in which the object is to quicken action of the absorbents, and stimulate the surfaces of the parts. Instead of the liquor ammoniæ, it is better in some cases to add the tincture of iodine, or 3 ij. of the iodide of potassium.

**LINIMENTUM TEREBINTHINÆ SULPHURICUM.**—℞ Olei olivæ 3 x. Ol. terebinth. 3 iv. Acidi sulph. 3 iij. Misce. Efficacious in some chronic affections of the joints, and in the removal of the effects of old sprains and bruises. (*Pharm. Chirurgica.*)

**LIP, CANCER OF.** The lips are subject to ulcers, which put on a very malignant aspect, although some of them are not in reality malignant; and many, situated just on the inside of these parts, will be found to depend on the bad state of the constitution, and the irritation and disturbance which the sores are continually suffering from the incessant motion of the parts, and their rubbing against a projecting or rough tooth.

"The continual irritation arising from the introduction of food, the effort of speaking, and the constant flow of saliva (as Mr. Earle remarks), are sufficient to keep up the morbid disposition, and to prevent any reparative effort of nature from being carried into effect. After a time, the neighbouring glands will often become enlarged, which confirms the surgeon in the opinion he had been induced to form of the nature of the affection." (See *Med. Chir. Trans.* vol. xii. p. 272.) The irritation of tobacco-pipes frequently gives rise to malignant, and even truly cancerous, diseases of the lip. The use of cigars may have the same effect. (See vol. cit. p. 278.)

[Epithelioma is the form of cancer which usually affects the lip. Under the microscope it presents the appearance of numerous nucleated cells resembling the ordinary tessellated epithelium. These cells are found on the surface as well as interstitially deposited, and form the principal bulk of the morbid growth. Epithelial cancer, after removal, does not return at so early a date as the other forms of cancer; Mr. Paget calculates the average period of return to be four years. He admits, however, that the disease, when located in the lip, does not reappear till after a longer interval, and mentions—what must have occurred in the practice of every surgeon of experience—that in many cases the disease has been arrested for several years, and that in some few cases no return of the disease has occurred. See CANCER.]

When cancer takes place, it is usually in the lower and very seldom in the upper lip. Sir A. Cooper has seen but one instance of it in the latter part.

The disease sometimes puts on the appearance of an ulcerated wart-like excrescence, occasionally acquiring a considerable size. Sometimes it is seen in the form of a very destructive ulcer, which consumes the surrounding substance of the lip; and, in other examples, the disease resembles a hard lump, which at length ulcerates. The disease, in its infancy, is often no more than a pimple, which gradually becomes malignant. As the disease advances, the glands under the jaw enlarge. According to Mr. Travers's observations, cancer of the lower lip begins in the cellular tissue between the mucous membrane and the skin. The enlarge-

ment and induration, he says, render it conspicuous before the villous surface of the lip cracks transversely, and a thin fluid oozes; it then ulcerates and scabs by turns, and ultimately penetrates more deeply, and throws out a fungus. The patient is generally a healthy male of advanced years, and accustomed to smoking. Pus sometimes escapes when the fungus is divided; but the base of the tumour is hard and granular. The skin and mucous membrane, and the labial glands, now prominent and warty, form a close compact mass. As the ulceration proceeds, the induration extends, and the salivary glands and the lymphatic glands, at one or both angles of the jaw, become enlarged and tender. (*Travers, in Med. Chir. Trans.* vol. xv. p. 239.) Whenever there is reason to believe that the disease is of an unyielding cancerous nature, and it does not soon give way to arsenic, iodine, hemlock, or mercurials, the sooner it is extirpated the better. For this purpose, some surgeons admit the propriety of using caustic, when the whole disease can be completely destroyed by one application. But as the action of caustic is not capable of being regulated with so much precision as the extent of a wound can be, and as caustic will not allow the parts to be united again, the knife is the most desirable means, especially as it also occasions less pain. Two incisions are to be made, meeting at an angle below (supposing it to be the lower lip), and including the whole of the disease. The sides of the wound are then to be united by the twisted suture. (See HARELIP.) When the affection is extensive, however, the surgeon is frequently necessitated to remove the whole of the lip, or too much of it to admit of the above plan being followed. This circumstance has generally been regarded as particularly unfavourable; and it has been commonly believed that, unless some attempt can be made to succour the patient by the Taliancotian practice, in the manner mentioned by Mr. Earle (*Med. Chir. Trans.* vol. xii. p. 276), the patient's saliva would continually run over his chin, or only admit of being kept from doing so by some artificial contrivance. It was also thought that the deformity would be very great, and that pronunciation and swallowing would be but imperfectly performed. [Mr. Syme has suggested a plan, by which a new border to the lip may be formed after extensive removal by the V incision. It consists in making the incisions cross where they meet below, and in carrying them outwards and upwards above the margin of the chin. Two flaps may thus be formed, which, when freely dissected back, can be so adjusted by sutures that the sides of the original V incision will form the border of the new lip, while the margins of the gap left below may be approximated by harelip pins.] Various other plans have been recommended, suited to particular cases, to obviate the deformities necessarily arising where large portions of the lip or cheek are removed. Baron Dupuytren, many years ago, occasionally adopted the practice of cutting off a considerable portion of the lip by a semilunar incision, and yet the part healed so as to leave but little disfigurement. M. Maligne deems the plan of excising the lip by a semilunar incision proper only when the cancer is superficial and extends along the border of the lip. The incision, in the shape of the letter V, is to be preferred in the opposite circumstances, and espe-

cially when the commissures of the lips are implicated. (See *Man. de Méd. Opér.* p. 477. ed. 2.) Some observations published by Mr. Travers, however, tend to prove that the disadvantages of this plan have been exaggerated; and, convinced of the prudence of a free removal of the disease in its early stage, he prefers "a full crescent-shaped section of the substance of the lip" to an operation resembling that for the cure of a harelip. He recommends the commissure of the mouth to be spared, if possible: "The contraction, during the healing process, under a double-headed bandage passing over the vertex and occiput, so as to keep a little moistened lint, or simple ointment, on the cut surface, shapes and adapts the lip with singular neatness; and, what is more remarkable, the cut surface takes a depth of colour, and a plumpness, and a defined border, which give much the appearance of the natural surface." In one case of malignant ulcer published by Mr. Earle, he removed the angle of the mouth, and a large portion of each lip, together with a considerable part of the cheek, yet succeeded in uniting the wound; which object was facilitated by the extraction of five teeth from the lower jaw previously to the operation, which were useless, in consequence of having no corresponding ones in the upper jaw. (*Med. Chir. Trans.* vol. xii. p. 274.)

[LIPOMA.—This term is applied by some surgeons to the ordinary form of fatty tumours. (See TUMOURS.) It is also used to designate a peculiar unsightly disease of the nose, which consists of an irregular hypertrophy of the skin and subcutaneous areolar tissue of the alæ and tip of the nose. It presents a nodulated appearance of a purple colour. In some instances the growth reaches to an enormous size, being lobulated and pendulous, blocking up the nostrils and producing a hideous appearance. (See NOSE, HYPERTROPHY OF.)]

LIPPITUDO. (From *lippus*, blear-eyed.) *Bleareyedness*. The ciliary glands and lining of the eyelids only secrete, in the sound state, just a sufficiency of a sebaceous fluid to lubricate the parts in their continual motions. But it sometimes happens, from disease, that this sebaceous matter is secreted in too great a quantity, and glues the eyelids together during sleep, so that, on waking, they cannot be easily separated. Hence the margin of the eyelids becomes red all round, and even the sight itself is weakened.

The best remedies are the unguentum hydrargyri nitratis, smeared, at night, on the edges and inside of the eyelid with a hair pencil, after being melted in a spoon; and a collyrium, composed of ℥j. of the sulphate of zinc in ℥ viij. of rosewater. When alterative medicines are requisite, a grain of calomel, or the compound calomel pill, may be given every night.

Persons who have lippitudo and cataract together bear operations for cataract much better than one would expect from the appearance of the eyes; and Mr. Hey never rejected a patient on this account, provided such state were habitual. (*Pract. Obs.* p. 51.) However, the lippitudo, if possible, should be removed before the operation is undertaken. Consult Mackenzie (*On the Diseases of the Eye*. 4th edit. 1854).

C. Bader.

LITHOTOMY. (From *λίθος*, a stone; and *τέμνω*, I cut.) The operation of cutting into the



bladder, in order to extract a stone. No operation in surgery has attracted so much notice, or had so much written upon it, as lithotomy. A full account of the sentiments of every writer who has treated of it, and a detail of the infinite variety of plans of making an opening into the bladder, would occupy as many pages as are allotted to the whole of this Dictionary. It must be my endeavour, therefore, rather to describe what is most interesting and important, than pretend to offer an article which is to comprehend everything.

Throughout the following columns, I suppose the reader to be already well informed of all that relates to the anatomy of the bladder and adjacent parts, especially the perineum. Without correct knowledge of this kind a man must be presumptuous, indeed, to set himself up for a good lithotomist.

The nature of calculi in the bladder, the circumstances under which they form, and the influence of different periods of life, sex, climate, and localities, in promoting or preventing their production, will be considered under the head of URINARY CALCULI. Here I shall principally confine myself to the symptoms of the disease, the mode of discovering the presence of the stone, and the chief methods of performing lithotomy.

#### SYMPTOMS OF STONE.

The symptoms of a stone in the bladder are, pain in the extremity of the urethra and in the glans, frequent propensity to make water, and go to stool, great pain in voiding the urine, and difficulty of retaining it, and often of keeping the fæces from being discharged at the same time. In consequence of the calculus falling against the vesical orifice of the urethra, the stream of urine is liable to stop suddenly while flowing in a full current, although the bladder is not empty, so that the fluid is expelled by fits, as it were. The pain is greatest towards the end of, and just after, the evacuation; there is a dull pain about the neck of the bladder, together with a sense of weight or pressure at the lower part of the pelvis; and even when the calculus is small, a slight cloudiness is seen in the urine, as soon as it begins to cool, and afterwards a large quantity of mucus is mixed with it, and sometimes the urine is tinged with blood, especially after exercise.

It is correctly noticed by Sir Benjamin Brodie, that the symptoms differ:—1st, according to the size of the stone, the smoothness or roughness of its surface, and its general figure; 2ndly, according to the quality of the urine (if the urine be unusually acid, or very alkaline and deposit the triple phosphate, it will be stimulating, and the symptoms of stone will thereby be aggravated); 3rdly, according to the state of the bladder. Nothing aggravates the symptoms so much as inflammation of the mucous membrane; this increases the sensibility of the bladder a hundredfold, and causes a small stone to produce much greater distress and pain than a large one under ordinary circumstances. If the bladder be healthy, a very small stone may produce trifling and equivocal symptoms. The patient has rather more frequent occasion to make water, a sense of irritation scarcely amounting to pain, referred to the neck

of the bladder, urethra, and perhaps the hypogastrium, after the bladder has been emptied. In one instance the patient complained for many months of nothing except an occasional and trifling pain in one of the groins, and of the urine being tinged with blood after riding on horseback. Bloody urine, after any jolting exercise, is a strong indication of a calculus, either in the bladder or kidney. But this symptom is often absent in the early stage, while the stone is small, especially if the patient is leading an inactive life. (See Sir B. Brodie on Dis. of the Urinary Organs, p. 225, ed. 2.)

The pain in the glans penis and fossa navicularis is most severe after making water or after taking exercise, when the stone suddenly falls down on the neck of the bladder. This pain "is one of the most marked symptoms of the disease. A child, who labours under stone, tells you of it, not in words, but in his actions. He is always pulling the end of the penis, and pinching it with his fingers, even so as to cause the prepuce to become elongated. You often find his fingers with the cuticle soft and sodden, as if they had been soaked in water, from the urine which has been imbibed." (Op. cit. p. 229.)

It seldom happens that calculous patients void blood with their urine before other symptoms have taken place. It is not till after the foreign body has descended into the bladder, acquired some size, and presented itself at the orifice of the viscus, that pain is occasioned, particularly when the surface of the stone is unequal. The patient then experiences frequent inclination to make water, and the effort to do so is attended with pain. The jolting of a carriage, riding on horseback, much walking, render the pain more acute. The urine appears bloody, its course is frequently interrupted, and sabulous matter and particles of stone are sometimes discharged with it. The desire to make water becomes more frequent and more insupportable. The bladder is irritated and inflamed; its parietes become thickened and indurated, and its diameter is lessened. A viscid more or less tenacious matter is observed in greater or less quantity in the urine, and is precipitated to the bottom of the vessel. The urine becomes black and putrid, and exhales an intolerable alkaliescent smell, which is perceived at the very moment of the evacuation, but is much stronger a little while afterwards. The patient can no longer take any exercise without all his complaints being redoubled. The urine then becomes bloody. (See *Traité Historique et Dogmatique de l'Opération de la Taille*, par J. P. L. Deschamps, t. i. p. 163. Paris, 1796.)

The symptoms of stone in the bladder are sometimes exceedingly equivocal, and may be produced by several other disorders. "Pain in making water, and not being able to discharge the urine without the fæces, are common consequences of irritation of parts about the neck of the bladder, from a diseased prostate and other causes. The urine stopping in a full stream is frequently caused by a stone altering its situation so as to obstruct the passage; but the same thing may happen from a tumour or fungus in the bladder. I have seen an instance of this, where a tumour, hanging by a small pedicle, would sometimes cause obstruction, and by altering the posture would retire and give a free passage. The dull pain at the neck of the

bladder and the sensation of pressure on the rectum are frequently owing to the weight of the stone, &c., but these may proceed from a diseased enlargement of the prostate gland. Children generally, and grown persons frequently, are subject to a prolapsus ani from the irritation of a stone in the bladder; but it will likewise be produced by any irritation in those parts." (*Sir J. Earle.*) The rest of the symptoms are equally fallacious; a scirrhus enlargement of the os tincæ, and disease of the kidneys may occasion a copious quantity of mucus in the urine, with pain, irritation, &c. "The least fallible sign (says Sir James Earle) which I have remarked, is the patient making the first portion of urine with ease, and complaining of great pain coming on when the last drops are expelled. This may readily be accounted for from the bladder being at first defended from contact with the stone by the urine, and, at last, being pressed naked against it. But to put the matter out of all doubt, and actually to prove the existence of a stone in the bladder, we must have recourse to the operation of sounding."

[The rational symptoms of stone may be thus briefly described. Pain and a sensation of weight about the neck of the bladder are two of the earliest symptoms. At the very early stages, while the bladder may be supposed to be as yet healthy, the pain is dull and heavy; but this symptom is liable to many variations, being sometimes sharp and acute from the commencement.

As the disease advances the pain usually becomes more severe and constant—circumstances which depend rather on the lesions produced by the stone, than on simple increase in size of the foreign body. The pain now begins to extend to the hypogastric region, to the perineum, groin, and thighs.

Disturbance of the functions of the urinary organs now manifests itself. The bladder becomes more or less irritable and cannot retain its contents, the calls to make water are frequent, and the expulsion of the last drops is attended with pain, which shoots along the perineum and penis, and centres in the glans. From this period the sufferings of the patient steadily augment, but, as we have remarked, they are chiefly dependent on or proportioned to the morbid conditions of the genito-urinary organs.

Some of these conditions, however, tend to diminish, rather than to increase, the sufferings of the patient. Thus, should the calculus become fixed, as is the case with encysted calculi, it may remain for years in the bladder without giving any indication of its presence. Again, when the prostate is enlarged, the bladder partially paralysed, and the power of expulsion in a great measure lost, the patient's sufferings are much less intense than in subjects in whom no such changes have taken place. On the other hand, gouty and rheumatic or nervous patients often experience excessive pain, or, at least, describe their feelings in exaggerated terms. We also find that phosphatic calculi are attended by more pain than the lithic acid, or oxalic; but this difference depends not on the physical properties of the stone, but on the circumstance that phosphatic calculi are usually attended by some morbid condition of the bladder or kidneys.

Sudden arrest of the flow of urine and hæmaturia are symptoms which often present them-

selves during the progress of stone; yet not constantly.

The sudden and complete stoppage of the flow, occasioned by an impediment at the neck of the bladder, may be regarded as nearly decisive of the nature of the case, since it seldom arises from any other cause, except, perhaps, the presence of a pedunculated tumour near the neck of the organ. It is particularly worthy of note that the stoppage of urine now alluded to does not last for more than a few moments; it disappears either of its own accord, or from some change of posture which removes the foreign body from the urethral orifice.

Hæmaturia must be regarded as an occasional symptom of stone only. In the advanced stages, however, when the mucous lining of the bladder has become congested or diseased, any violent exercise, the jolting of a carriage, &c., commonly produce bloody urine.]

A stone in the ureter or kidneys, or chronic inflammation in the bladder from any other cause, will sometimes produce the same effects; but if the patient cannot void his urine, except in a certain posture, it is a strong indication that the orifice of the bladder is obstructed by a stone. If he find ease by pressing against the perineum with his fingers, or sitting with that part upon a hard body, there is little doubt the ease is procured by taking off the weight of the stone; or, lastly, if, with the other symptoms, he thinks he can feel it roll in his bladder, it is hardly possible to be mistaken; however, the only sure judgment is to be formed from sounding.

Enlargement of the prostate gland is attended with symptoms resembling those of a stone in the bladder; but with this difference, that the motion of a coach or horse does not increase the grievances when the prostate is affected, while it does so in an intolerable degree in cases of stone. It also generally happens, that the fits of the stone come on at intervals; whereas, the pain from a diseased prostate is neither so unequal nor so acute. (*Sharp, in Critical Inquiry*, p. 165, ed. 4.)

Though, from a consideration of all the circumstances above related, the surgeon may form a probable opinion of there being a stone in the bladder, he must never presume to deliver a *positive* one, nor be so rash as to undertake lithotomy, without having greater reason for being certain that there is a stone to be extracted; and this certainty is only to be obtained by sounding the patient.

The *sound* is an instrument made of highly polished steel, in order that it may convey to the surgeon's fingers the sensation of anything against which its end may strike. It is generally rather less curved than a catheter, so that its extremity may be more easily turned from side to side, or inclined to the lower part of the bladder, where the stone is most frequently situated. Some surgeons prefer a sound which is straight, except a small portion of it, about an inch in length, near the beak, which, after the introduction of the instrument, can be turned down to either side, or even completely round, so as to touch any calculus lodged just behind the prostate gland.

When a patient is to be sounded, he is usually put in a posture very similar to that adopted in the lateral operation for stone, with the exception that he is not bound in this position, as there is sometimes an advantage in making the patient stand up, in order that the stone may come into



contact with the end of the sound. The instrument having been introduced, its extremity is to be turned, and moved in every direction, when, if there be a calculus, its presence will usually be indicated by the collision against the beak of the sound. When the symptoms afford strong evidence of the presence of a stone, which cannot be detected in these ways, the patient should be sounded, while his pelvis is raised, and his chest depressed. He should also be sounded both in the full and empty state of the bladder, and both in the erect and recumbent positions, with sounds and catheters of different shapes.

Stones have sometimes been found in the bladder after death, although they could never be discovered with a sound while the patient was alive, suffering all the symptoms of the complaint. The celebrated French surgeon La Peyronie was thus circumstanced: he was so fully convinced of there being a stone in his bladder, notwithstanding neither he, nor any of his friends, could feel it with a sound, that, on his deathbed, he gave directions for ascertaining the fact. Hence, when the usual symptoms of a stone in the bladder continue, patients should be examined several times, before a positive opinion is delivered respecting the nature of the case. When, during the operation of sounding, all the urine has escaped from the bladder, the inner surface of this viscus comes into contact with the end of the sound, and such a sensation may be communicated to the surgeon's fingers, as leads him to suspect that a fungus, or some other hardish extraneous substance, is contained in the bladder. In such cases, patients have actually been cut for stone, when no foreign body whatever was present.

I know of at least seven cases (and at two of them I was present) where the patients were subjected to all the torture and perils of this operation, without there being any calculi in their bladders. The maxim, therefore, cannot be too strictly enforced, that the operation ought never to be attempted, unless the stone can be distinctly felt with the sound or staff. In one of the examples of which I was a spectator, not only the symptoms, but the feel which the sound itself communicated when in the bladder, made the surgeons imagine that there was a calculus, or some extraneous body in this organ. Most of the above cases, I understand, recovered, which may be considered fortunate; because, when the stone cannot be found, the disappointed operator is apt to persist in roughly introducing his fingers, and a variety of instruments, so long, in the hope of catching what cannot be got hold of, that inflammation of the bladder and peritoneum is more likely to follow than when a stone is actually present; soon taken out, and the patient kept only a short time upon the operating-table.

In a valuable practical work is recorded an instance, in which what is called a horny cartilaginous state of the bladder made the sound communicate a sensation like that arising from the instrument actually touching a stone, and the surgeon attempted lithotomy. The patient unfortunately died in twenty-four hours. (See *Desault's Parisian Chir. Journ.*, vol. ii. p. 125.)

[The *rugous bladder*, not unfrequently met with in children, and more rarely in adults, has been alluded to in this Dictionary. (See *Art. Bladder*, vol. 1, p. 306.) It is an irritable and contracted

condition of bladder, with projecting rugæ on its inner surface, communicating a sensation through the sound which an inexperienced person might mistake for a calculus, and the more so that the symptoms attending it very much resemble those which a stone would produce. It is useful to know that this condition of bladder is not often coexistent with stone.]

However, were the symptoms most unequivocal, there is one circumstance which would always render it satisfactory to touch the stone with an instrument just before the operation; I mean the possibility of a stone being actually in the bladder to-day, and not to-morrow. Stones are occasionally forced, by the violent contractions of the bladder, during fits of the complaint, between the fasciculi of the muscular coat of this viscus, together with a portion of the membranous lining of the part, so as to become what is termed encysted; or, as there is reason to believe, the cyst is sometimes produced first, and the calculus is formed in it, as a kind of effect of the existence of the separate pouch. The opening into the cyst is frequently very narrow, so that the stone is much bigger than such orifice, in consequence of which it is impossible to lay hold of the extraneous body with the forceps, and the operation would necessarily become fruitless. (*Sharp's Critical Inquiry*, p. 228, ed. 4.)

In the article URINARY CALCULI, I have noticed the probability of this having occurred in some of the instances, in which Mrs. Stevens's medicine was supposed to have actually dissolved the stone in the bladder; for, an encysted stone is not likely to be hit with the sound, nor to cause any inconvenience, compared with what a calculus, rolling about in the bladder, usually occasions.

The degree of pain experienced by the patient depends, not only on the state of the urine and bladder, but on the size, shape, chemical qualities, and situation of the calculus. "A patient with a simple lithic acid calculus, suffers less than one with a calculus composed externally of the triple phosphate; and the latter, less than one with a fusible calculus. The oxalate of lime, or mulberry calculus, on the whole, occasions more distress than the lithic acid calculus, probably on account of the irregularities which so frequently exist on the surface of the former; but it occasions less distress than calculi composed of the phosphates." (See *Sir B. Brodie*, *Op. cit.* p. 229.)

According to the same authority, patients with diseased prostate gland do not generally suffer more from stone in the bladder, when it afflicts them, than other individuals; and perhaps less, in consequence of the swelling of the prostate hindering the stone from falling on the neck of the bladder. He has, however, seen three cases, in each of which there was a calculus in the bladder, complicated not only with an enlarged but an ulcerated prostate; and the sufferings were in these instances horribly severe. In two of them lithotomy was performed: one of the patients died in five minutes after the operation; and the other became immediately comatose, and sank in a few hours.

It is remarked by Deschamps, that when the stone is lodged in a particular cyst, or depression of the bladder, when it projects but very little; when it cannot shift its situation in the bladder, so as to fall against the orifice of this viscus;

and when it is also smooth, polished, and light, the patient may have it a long while, without experiencing any afflicting symptoms. He may even live to an advanced age, if not without some degree of suffering, at all events with such pain as is very supportable. Daily experience proves that persons may live a considerable time with one, two, or even three stones in the bladder, and during the whole of their lives have not the least suspicion of the existence of these foreign bodies.

At first, the general health is not disturbed, but in time it begins to suffer, and the urine becoming alkaline, the triple phosphate is deposited on the original stone. The patient's sufferings are now greatly increased, in consequence of the more stimulating quality of the urine, and the morbid sensibility of the nervous system always accompanying the secretion of such urine. As the disease advances, the irritation of the calculus excites inflammation of the mucous coat of the bladder, and hence, still greater pain, almost constant desire to make water; the offensive, putrid, and ammoniacal smell of the urine, and a thick mucous sediment in it, streaked with blood. (See *Sir B. Brodie on Dis. of the Urinary Organs*, p. 228.)

When stone proves fatal, the usual cause of death is disease of the kidney or inflammation of the mucous membrane of the bladder. A moderate degree of chronic inflammation of it may continue for a long time, and, if the stone be extracted, the patient recovers. But if it become aggravated so as to assume an acute form, the patient's situation becomes desperate. The inflammation may extend up the ureters to the kidneys. Even the glandular structure of the kidneys becomes affected, and rendered more vascular and softer than natural. Sometimes abscesses form in the kidneys, or a collection of muco-purulent fluid takes place in the pelvis and in the infundibula. Inflammation sometimes extends to the loose cellular tissue around the bladder, and putrid gangrenous abscesses are produced in it. In one case, where the patient died very soon after lithotomy, a very large pelvic abscess was found to communicate with the bladder. (*Brodie, Op. cit.* pp. 231—234.)

A question may here suggest itself: Ought lithotomy to be practised where calculi are under a certain size? Certainly not: because they frequently admit of being extracted through the urethra, or discharged with the urine, without any operation at all, even from the male subject; and how much more likely this is to happen in females, must be plain to everybody who recollects the direct course, the shortness, ample size, and dilatability of the meatus urinarius. On this subject, various facts, and, in particular, the dilator used by Sir A. Cooper, will be adverted to in considering lithotomy in women. Sometimes, also, when a calculus is too large to pass completely through the male urethra, it lodges in this passage, where it may be more safely cut upon and removed, than from the bladder; and in a very few rare examples it has been discharged by an ulcerative process. Thus Dr. R. A. Langenbeck has published a case, in which a stone made its way out by ulceration, and was discharged immediately behind the testes (see *J. C. Langenbeck's Bibl. für die Chir. Gött.*, 1809); and G. Coopmans has recorded an almost incredible case, in which a calculus,

weighing five ounces one drachm and a half, was discharged on the left side of the urethra of an elderly man, a little below the glans penis. In fact, without some further explanation, this case would be pronounced impossible; but, it should be recollected, that after a small calculus has made its way out of the urethra by ulceration, if the urine have still access to it, it will continue to increase in size in its new situation; and this is what happened in the present example; for the extraneous body, when first felt externally, was not larger than a pea. The calculus is now preserved in Camper's Museum. (*Neurologia*, 8vo. Franequeræ, 1795.)

Sir Benjamin Brodie refers to a preparation at St. George's Hospital, of a bladder ulcerated at its fundus. There were several calculi, and one of them was fixed in the ulcerated opening, half in and half out of the bladder. He also records a case, in which the mucous membrane of the bladder was found extensively ulcerated in a man, who had died after lithotomy, and the ulcer communicated with the ulcerated cavity in the perineum, in which the stone was lying at the time of the operation. (*On Dis. of the Urinary Organs*, p. 232, ed. 2.)

In many cases small calculi may be voided by dilating the male urethra with elastic gum catheters of very large diameter, and then desiring the patient to expel his urine with considerable force, a plan which Baron Larrey has repeatedly found to answer. The idea of withdrawing calculi from the bladder through the urethra, by suction and dilatation of the passage, seems to have been entertained by several practitioners of former days, especially Alpinus, Muys, Verduc, Mayerne, and Le Dran. (See *Dr. Kerrison's Paper in Med. Chir. Trans.* vol. xii. p. 315.) Desault even tried experiments with a kind of forceps, which admitted of being protruded, and of opening and shutting at the extremity of a canula, which was introduced into the bladder; but no instance of success with it on the human subject is recorded. (See *Journ. de Chir.* t. ii. p. 375. Paris, 1791.) The honour of bringing the plan to perfection was reserved for Sir Astley Cooper. "The instrument," says he, "which I first had made for the purposes of removing these stones from Mr. Buller, were merely common forceps, made of the size of a sound, and similarly curved; but Mr. Weiss, surgeons' instrument maker, in the Strand, showed me a pair of bullet forceps, which he thought would, with a little alteration, better answer the purpose I had in view. He removed two of the blades of these forceps (for there were four), and gave them the form of the forceps which I had constructed: the blades of this instrument could be opened whilst in the bladder, by means of a stilet, so as to grasp and confine the stone; and they appeared so well constructed for the purpose as to induce me to make trial of them, on November 23, 1820, and the manner in which they were used was as follows:—Mr. Buller was placed across the bed with his feet resting on the floor; a silver catheter was then introduced, and the bladder emptied of urine. I then passed the forceps into the bladder, and was so fortunate in my first operation as to extract eight calculi. The instrument gave but little pain on its introduction, but when opened to its greatest extent, and the stones admitted be-



tween its blades, their removal was painful, more especially at the glans penis, which appears to be the portion of the urethra which makes the greatest resistance to the removal of the stones. A dose of opium was given after each operation." (*Med. Chir. Trans.* vol. xi. p. 358.) Sir A. Cooper thus removed from the above patient eighty-four calculi at different times. From one patient, Sir B. Brodie also extracted in the same manner about sixty calculi of various sizes; but the largest measured half an inch in one diameter, and five-eighths in the other. (*Op. cit.* vol. xii. p. 383.) In one case, Sir Astley Cooper took out with the urethral forceps a calculus that weighed fifty-four grains, after having gradually dilated the urethra with bougies. (*Vol. cit.* p. 387.) Other convincing examples of the practicability and success of the practice are also related by the same distinguished surgeon. According to his valuable observations, when a great number of calculi are found in the bladder, they are generally attended with an enlargement of the prostate gland, and are lodged in a sacculus formed directly behind it. (*Med. Chir. Trans.* vol. xi. p. 357.)

To me, the establishment of the preceding practice by Sir Astley Cooper, and of lithotrity for cases properly admitting of it, seem two of the greatest triumphs of modern surgery; and I have no doubt, that the names of all concerned in bringing them about, will receive from the latest posterity the honour which cannot fail to attach itself to improvements, by which the necessity for a severe and highly dangerous operation is rendered considerably less frequent. Even when the stone cannot be drawn completely out of the urethra by the forceps, but only into it, the advantage is great, because it may then be easily cut down to and extracted, without any wound or injury of the bladder. (See *Med. Chir. Trans.* vol. xi.) See LITHOTRITY.

I shall next describe the various methods of cutting for the stone.

#### OF THE APPARATUS MINOR, CUTTING ON THE GRIPE, OR CELSUS'S METHOD.

The most ancient kind of lithotomy was that practised upwards of two thousand years ago, by Ammonius, at Alexandria, in the time of Herophilus and Erasistratus, and by Meges, at Rome, during the reign of Augustus; and being described by Celsus, is named *Lithotomia Celsiana*. As the stone, fixed by the pressure of the fingers in the anus, was cut directly upon, it has been called cutting on the gripe, a knife and a hook being the only instruments used. The appellation of the lesser apparatus was given to it by Marianus, in order to distinguish it from a method which he described, called the apparatus major, from the many instruments employed.

The operation was performed in the following way. The rectum was emptied by a glyster a few hours previously; and immediately before cutting, the patient was desired to walk about his chamber to bring the stone down to the neck of the bladder; he was then placed in the lap of an assistant, or secured in the manner now practised in the lateral operation. The surgeon then introduced the fore and middle fingers of his left hand, well oiled, into the anus, while he pressed with the palm of his right hand on the lower part of the abdomen above

the pubes, in order to promote the descent of the stone. With the fingers the calculus was next gripped, pushed forward toward the neck of the bladder, and made to protrude and form a tumour on the left side of the perineum. The operator then took a scalpel and made a lunated incision through the skin and cellular substance, directly on the stone near the anus, down to the neck of the bladder, the extremities of the incision being directed somewhat towards the thigh. Then, in the deeper and narrower part of the wound, a second transverse incision was made on the stone into the neck of the bladder itself, till the flowing out of the urine showed that the incision exceeded in some degree the size of the stone. The calculus being strongly pressed upon with the fingers next started out of itself, or was extracted with a hook for the purpose. (*Celsus*, lib. vii. cap. 26; *J. Bell's Principles*, vol. ii. p. 42; *Allan on Lithotomy*, p. 10.)

The objections to cutting on the gripe are the impossibility of always dividing the same parts; for those which are cut will vary, according to the degree of force employed in making the stone project in the perineum. When little exertion is made, if the incision be begun just behind the scrotum, the urethra may be altogether detached from the prostate; if the stone be much pushed out, the bladder may be entered beyond the prostate, and both the vesiculæ seminales and vasa deferentia inevitably suffer. Lastly, if the parts are just sufficiently protruded, the neck of the bladder will be cut, through the substance of the prostate gland. (*Allan on Lithotomy*. *Burns in Edinb. Surg. Journal*, No. xiii. *J. Bell*, vol. ii. p. 59.)

The preceding dangers were known to Fabricius Hildanus, who attempted to obviate them by cutting on a staff, introduced through the urethra into the bladder. He began his incision in the perineum about half an inch on the side of the raphe; and he continued the cut, inclining the knife, as he proceeded, towards the hip. He continued to divide the parts till he reached the staff; after which, he enlarged the wound to such an extent as permitted him easily, with a hook, to extract the stone, which he had previously brought into the neck of the bladder, by pressure with the fingers in the rectum. (*Burns*.) In this way, Sir C. Bell has operated with success.

The apparatus minor, as practised by Fabricius, with the aid of a staff, is certainly a very simple operation on children, and some judicious surgeons doubt the propriety of its present neglected state. "You cut (says an eminent writer) upon the stone, and make, of course, with perfect security, an incision exactly proportioned to its size. There is no difficult or dangerous dissection; no gorget, or other dangerous instrument, thrust into the bladder, with the risk of its passing betwixt that and the rectum; you are performing, expressly, the lateral incision of Raw and Cheselden, in the most simple and favourable way. The *prisca simplicitas instrumentorum* seems here to have been deserted, for the sake of inventing more ingenious and complicated operations." (*J. Bell*.)

[Foubert employed a modification of the Celsian method. Having filled the bladder with fluid, and introduced the left forefinger into the rectum, he plunged a trocar, five inches long, into the skin at about an inch from the anus, and two or three

lines from the tuberosity of the ischium. The trocar was then passed into the bladder, through the triangular space formed by the muscles of the perineum. The canula of the trocar was grooved, and the groove served to conduct the point of the knife into the bladder. About an inch and a quarter of the bladder, near the neck, were thus divided, and the external incision formed while the knife was being withdrawn. A gorget, which acted as a dilator, was next passed into the bladder, and it served to conduct the finger and forceps into the viscus.]

Celsus has delivered one memorable precept in his description of lithotomy: "ut plaga paulo major quam calculus sit;" and he seems to have known very well, that there was more danger in lacerating than cutting the parts.

The simplicity of the apparatus minor, however, formerly emboldened every quack to undertake it; and, as this was followed by the evils and blunders unavoidably originating from ignorance, at the same time that it diminished the emolument of regular practitioners, the operation fell into disrepute. (See *Heister*.) It was longer practised, however, than all the other ancient methods, having been continued to the commencement of the 16th century; and it was performed at Bordeaux, Paris, and other places in France, on patients of all ages, by Raoux, even as late as 150 years ago. Frère Jacques occasionally had recourse to it; and it was successfully executed by Heister. (Part ii. chap. 140.) A modern author recommends it always to be preferred on boys under fourteen. (*Allan*, p. 12.)

#### OF THE APPARATUS MAJOR, AND OF THE MODERN MEDIAN OPERATION.

The apparatus major was so named from the multiplicity of instruments employed; or as the Marian method, from having been first published by Marianus Sanctus, in 1524, as the invention of his master, Johannes de Romanis.

This operation, adopted from avaricious motives, was rude and painful in its performance, and very fatal in its consequences. The apology for its introduction was the declaration of Hippocrates, that wounds of membranous parts are mortal. It was contended, however, that such parts might be dilated with impunity; and, on this principle of dilatation, Romanis invented a complex and dangerous plan of operating; one very incompetent to fulfil the end proposed; one which, though supposed only to dilate, really lacerated the parts. (*Burns*.)

A grooved staff was first introduced through the urethra. The operator, kneeling on one knee, then made an incision with his razor, along the perineum, on one side of the raphe; and, feeling with his little finger for the curve of the staff, he opened the membranous part of the urethra; and, fixing the point of the knife in the groove of the staff, gave it to an assistant to hold, while he passed a probe along the knife into the groove of the staff, and thus into the bladder. The urine now flowed out, and the staff was withdrawn. The operator next took two conductors, a sort of strong iron probes; one, named the female conductor, having in it a groove, like one of our common directors; the other, the male conductor, having a probe-point corresponding with that groove. The grooved, or female conductor, being introduced

along the staff into the bladder, the staff was withdrawn, and the male conductor passed along the groove of the female one, into the bladder. Then commenced the operation of dilating. The lithotomist took a conductor in each hand, and, by making their shafts diverge, dilated, or, in plain language, tore open the prostate gland. (*J. Bell*.)

It would be absurd in me to trace the various dilating instruments, contrived for the improvement of this barbarous operation, by the Colots, Maréchal, Le Dran, Paré, &c. Among the numerous glaring objections to the apparatus major, I need only notice the cutting of the bulb of the urethra, not sufficiently dividing the membranous part of the urethra, nor the transversalis perinei muscle, which forms a kind of bar across the place where the stone should be extracted; violent distention of the membranous part of the urethra and neck of the bladder; laceration of these latter parts; large abscesses; extravasation of urine, and gangrene; frequent impotency afterwards; and extensive fatality. Bertrandi even saw the urethra and neck of the bladder torn from the prostate by the violence employed in this vile method of operating. (*Operations de Chir.* p. 169.) However, Paré, Le Dran, Le Cat, Mery, Morand, Maréchal, Raw, and all the best surgeons in Europe, most strangely adhered to this rash method for two hundred years, till Frère Jacques, in 1697, taught at Paris the original mode of lithotomy, as commonly adopted at the present day.

[The Marian method had been abandoned for nearly two hundred years, when Dr. Willis endeavoured to revive it, with some modifications.]

The first steps of the modified operation are the same as those for the lateral operation; but when the membranous part of the urethra has been opened, Dr. Willis advises that dilatation of the prostate and neck of the bladder should be substituted for incision.

The dilatation may be effected with Dr. Arnott's instrument, and continued from twenty-four to forty-eight hours, according to circumstances. If the calculus be very large, Dr. Willis advises us to break it up, and extract it through the dilated passages.

A few trials of this method have been made, but the results have not been very encouraging.

But long previous to the appearance of Dr. Willis's work, the method of gradual dilatation had been employed by Manzoni, of Verona, and after him by Dr. de Borsia, of the same city. These operators declare that of one hundred patients operated on by them, one only died, and that from a cause unconnected with the operation. De Borsia commenced his operation by making an external incision along the middle line, extending to within half an inch of the anus. He then, with a double-edged scalpel, divided the whole of the membranous portion of the urethra, on the groove of the staff, to the extent of about ten lines, sometimes nicking the apex of the prostate. The left forefinger was next passed, in contact with the staff, into the bladder, and generally came at once into contact with the stone. The staff having been withdrawn, the prostatic portion of the urethra and the neck of the bladder were dilated by gently rotating the finger; the forceps was introduced, and the stone extracted.

Whatever advantages may have attended this



mode of operating, they cannot, assuredly, be attributed to slow dilatation; because Dr. de Borsia informs us that he usually extracted the stone in about a minute after having made the opening into the urethra.

*Modern Median or Allarton's Operation.*—In 1840, Mr. Allarton, who was unacquainted with the operations of Manzoni and De Borsia, extracted a calculus by a method of which slow dilatation is the principal feature; and, since then, the operation has been often repeated. The following is Mr. Allarton's description of this operation:—

"I introduce a grooved staff in the usual manner, and of the usual size, and confide it to an assistant, with directions to keep it perpendicular, and hooked up against the pubes; I then introduce the index finger of my left hand into the rectum, placing its extremity in contact with the staff, as it occupies the prostate, and press it firmly against the staff, so as to steady it; then, with a sharp-pointed straight knife, with tolerably long and rough handle, I pierce the perineum in the middle line, about half an inch above the anus, or at such distance as may appear necessary to avoid dividing the fibres of the external sphincter; I carry the knife steadily and firmly on, till it strikes the groove of the staff, the deep sphincter lying between the knife and the directing finger, which enables me to judge of the distance as the knife passes along. If the incision be not made exactly in the median line, the contracting fibres of the injured muscles draw the point of the knife from its direct line, and interfere with the accuracy of striking the staff; hence the advantage of the long rough-handled knife, which affords a firmer hold and better purchase. Having struck the groove of the staff, I move the point of the knife along the groove towards the bladder a few lines, and then withdraw it, cutting upwards, so as to leave an external incision of from three-quarters of an inch to one and a half inches, according to the presumed size of the stone; the escape of urine indicates the entrance to the urethra. I then introduce a long ball-pointed probe or wire through the external opening into the groove of the staff, and slide it into the bladder, to sufficient depth to insure its safe lodgment in that viscus, and withdraw the staff. I then well grease the index finger of the left hand, and pass it along the probe, with a semi-rotatory motion, through the prostate into the bladder; which procedure is achieved without difficulty, and when the stone is free it comes at once into contact with the finger, and, if of moderate size, passes at once into the wound on withdrawing the finger, the patient having power to strain upon, and thereby facilitate, the extraction of the stone." (*Lithotomy Simplified*, &c., by George Allarton, London, 1854, p. 22.)

It would appear from the history of the cases published by Mr. Allarton, that when the stone is small, little or no dilatation of the internal wound is required; one case, indeed, is described as having been terminated in a few seconds; and in the two other cases no artificial dilatation of any kind was had recourse to.

Mr. Teale, of Leeds, has published some useful observations on this method, in the *Medical Times* (Dec. 10th, 1859). According to Mr. Teale, the operation had been performed in Leeds, at the time of his publication (December 1st, 1859) in 23 cases; of which 20 recovered, and 3 died.

Fifteen operations were performed on adults, resulting in 13 recoveries and 2 deaths.

Mr. Teale considers that, in children, the left forefinger is the best dilator. As the aperture is necessarily the size of the finger which produces it, if the stone be large some other dilating power must be employed in addition to the dilating effect of the forceps and stone combined; for this purpose Weiss's three-bladed female dilator, Arnott's hydraulic dilator, or, what is at once ready and effective, the addition of the vulcanized india-rubber finger stalls, one over another, until the finger is sufficiently enlarged for the purpose, the outer covering being well lubricated with lard before being introduced. But Arnott's dilator, where it can be procured, is by far the most efficacious, though not the most expeditious means. Should the stone be of unusual size, it may be broken by a short, strong, and straight lithotrite, or by a strong and suitable pair of forceps closed by a screw, if the stone be soft and yielding.

Mr. Teale is disposed, both from his own experience and from the results of the operations which he has witnessed, to judge favourably of Mr. Allarton's method.

The incisions are made readily and without danger. In children, however, some difficulty may be found in sufficiently dividing the membranous part of the urethra, and the fibrous structure which it traverses; unless these parts be sufficiently divided, the surgeon may experience some difficulty in passing the fingers through the prostate; and hence he recommends the use of a beaked guide, as a more certain means of directing the finger than the bulb probe of Mr. Allarton. A dilator intended to effect the same object has been invented by Mr. Bowman. (*Medical Times*, December 17, 1859, p. 614.)

Mr. Teale, as becomes a prudent and scientific practitioner, has not passed any final judgment on this operation, because a more prolonged and varied experience of the median is required to determine its merits. As regards the question between dilatation and laceration of the prostate, Mr. Teale thinks it probable that in the living body, the process which suffices for the extraction of a stone of moderate size, is one of simple dilatation; and that, in the case of a large stone, it is attended with some solution of continuity, both of the mucous membrane and of the proper structure of the prostate.

The median operation also, according to Mr. Teale's opinion, is just as applicable to the extraction of large stones as the lateral operation, provided that the resistance afforded by tense perineal fibres be relieved by gently touching them with the knife.

Some surgeons state that the operation is nearly bloodless, but, according to Mr. Teale's experience, the bleeding in most instances at the time of the operation was about the same as in lateral lithotomy, although the subsequent draining was much less.

Mr. Erichsen states that he has found it advantageous to modify, in one or two points, the operation as described by Mr. Allarton.

Instead of the ordinary staff he employs a rectangular one, grooved from about one inch above the elbow nearly to the point, resembling (in fact) the rectangular staff of Dr. Buchanan. The advantages obtained by the use of this instrument are, that when

in the bladder, the angle rests against the apex of the prostate, and can be felt in the perineum. The surgeon is thus enabled to judge of the exact point where to enter the knife, which he cannot do with the curved staff. The incision upwards is also limited; and there is, besides, less danger of wounding the rectum. The knife should be straight-backed, having the blade not more than two inches long, so that the surgeon can tell to what depth he has entered it. Mr. Erichsen prefers dilating the prostate before withdrawing the staff, by pushing the finger slowly, with a rotatory movement, along its side; if the probe only be used, the surgeon is apt to push the bladder before him. No safe dilatation, according to Mr. Erichsen, can be effected except by the finger; while the greatest possible mischief may be done with screw dilators.

The indications for the median operation are reduced by Mr. Erichsen within a narrow compass. It is suited for cases of stone not exceeding one inch in diameter; whenever lithotripsy is not admissible; for an anæmic case where the slightest additional loss of blood is to be avoided, and, lastly, in certain cases where lithotripsy has been previously performed. With respect to the operation in children, says Mr. Erichsen, lateral lithotomy is so successful that the median can scarcely be superior to it; and unless the latter can be shown to possess decided advantages over the lateral in ease of execution, it does not appear to him to be desirable to abandon an operation of proved safety for one that is still on its trial. (*Science and Art of Surgery*, 3rd edition, London, 1861, p. 1014.)

Mr. Thompson fully agrees with Mr. Erichsen in the opinion that it is very undesirable to use any kind of mechanical apparatus to dilate the neck of the bladder, regarding it much safer to make an additional section, when required.

"Of all the cutting operations for stone (says Mr. Thompson), it is unquestionable that the median still presents that in which the bladder is reached with the smallest amount of section by the knife, and it appears to become dangerous just in proportion as injury by laceration, or over-pressure under the name of dilatation, is superadded to the incisions. These latter involve the bulb to a small degree, which is the only structure of importance divided by the knife besides the prostate, and this latter is only slightly notched at the apex in the ordinary mode of performing the operation. But when the deeper parts of the wound feel more than usually rigid and unyielding, or when the stone proves to be larger than was anticipated, it seems desirable to make additional incision for the purpose of affording more space. Unless this be done, the opening is certainly confined, and does not safely afford room for any but stones of moderate size."

"After all, the anatomical axiom must not be forgotten, viz. that any operation, the incisions of which lie altogether between the anus and the symphysis pubis, even although aided by some lateral section, do not afford an opening sufficiently capacious for the safe removal of really large stones. Contrast the want of space in this part of the pelvic outlet, caused by the converging pubic rami, with the room which exists in one of its lateral divisions, and the truth of this assertion will be manifest." (*Lectures on Surgery*, Lancet, March 1862, p. 219.)

The most reliable comparison between the median

and lateral operations is probably that afforded by the statistics published by Mr. Williams, of the Norfolk and Norwich Hospital, giving the results of 44 cases of median lithotomy with the last 44 current cases of lateral lithotomy performed in that institution up to November 1863:—

## MEDIAN LITHOTOMY.

Ages of the Patients.	Cases.	Deaths after Median Lithotomy.
Under 5 years . . .	9	Under 5 years . . . 1
From 5 to 10 . . .	5	From 30 to 40 . . . 1
„ 10 to 20 . . .	5	„ 50 to 60 . . . 2
„ 20 to 30 . . .	0	„ 60 to 70 . . . 7
„ 30 to 40 . . .	3	—
„ 40 to 50 . . .	0	11
„ 50 to 60 . . .	5	
„ 60 to 70 . . .	15	
„ 70 to 80 . . .	2	
	44	

## LATERAL LITHOTOMY.

Ages of the Patients.	Cases.	Deaths after Lateral Lithotomy.
Under 5 years . . .	5	From 50 to 60 . . . 1
From 5 to 10 . . .	4	70 to 80 . . . 1
„ 10 to 20 . . .	4	—
„ 20 to 30 . . .	3	2
„ 30 to 40 . . .	3	
„ 40 to 50 . . .	1	
„ 50 to 60 . . .	8	
„ 60 to 70 . . .	10	
„ 70 to 80 . . .	6	
	44	

Average period that each of the 33 cases of cure, after median lithotomy, was under care was thirty days.

Average period that each of the last 33 cases of cure, after lateral lithotomy, was under care was thirty-seven days.

A table of the weight of the calculi in each case is also given, but space will not admit of its insertion here.

With respect to the deaths after median lithotomy, Mr. Williams remarks, that in no case did recovery result when the calculus exceeded 3 drachms 2 scruples; except in one case in which it weighed upwards of 4½ ounces, but a portion of the rectum and perineum sloughed and a perineo-recto-vesical fistula was established. In no case did a cure result when the long diameter of the calculus exceeded 1½ inch, and the short 1¼ inch, except in the case in which the stone weighed 4½ ounces. (See *Holmes's System of Surgery*, vol. iv. 1864, p. 471.)

It does not appear, therefore, that the median operation possesses the greater degree of safety which its advocates have claimed for it; indeed, the reverse seems to be manifestly the case at the Norfolk and Norwich Hospital, especially in adults, and in the case of large stones. In children the results will probably always be nearly the same after both operations; in them lateral lithotomy is well known to be so successful that improvement is hardly to be expected. In adults, however, the case is different, and any operation which would diminish the mortality after lithotomy would be an incalculable advantage. The experience of the last few years has not shown that median lithotomy



can accomplish this; and we believe the opinion of surgeons is becoming general, that there is nothing to be gained by making the incision in the limited space afforded in the median line, rather than through the much more convenient region of the ischa-rectal fossa; or by substituting forcible dilatation and laceration of the prostate gland for the limited incision now almost universally recommended.]

#### THE HIGH OPERATION

Was first described in 1556, by Pierre Franco, in his *Treatise on Hernia*, ed. 1. He performed it on a child, two years old, after finding the calculus too large to admit of being extracted from the perineum, where he had first made an opening; his remarks, however, tended to discourage the practice. Rousset recommended it, with great zeal, in his book entitled *Parvus Cæsarius*, printed in 1591; but he never performed the operation himself. Folet mentions the trial of it in the Hotel-Dieu, but, without entering into particular causes of its discontinuance, merely says that it was found inconvenient. About the year 1719 it was first performed in England, by Dr. Douglass, and, after him, practised by others. (*Sharp's Operations*.)

The patient being laid on a square table, with his legs hanging off, and fastened to the sides of it by a ligature, passed above the knee, his head and body lifted up a little by pillows, so as to relax the abdominal muscles, and his hands held steady by some assistants; as much barley-water as he could bear, which was often about eight ounces, and sometimes twelve, was injected through the catheter into the bladder.

In order to prevent the reflux of the water, an assistant grasped the penis the moment the catheter was withdrawn, holding it on one side, in such a manner as not to stretch the skin of the abdomen; then, with a round-edged knife, an incision, about four inches long, was made between the recti and pyramidal muscles, through the membrana adiposa, as deep as the bladder, bringing its extremity almost down to the penis; after this, with a crooked knife, the incision was continued into the bladder, and carried a little under the os pubis; and, immediately upon the water flowing out, the forefinger of the left hand was introduced, which directed the forceps to the stone. (*Sharp's Operations*.) Sabatier disapproves of making the cut in the bladder from below, upwards, lest the knife injure the peritoneum. (*Med. Oper.* t. iii. p. 160.)

Although this method of operating appears at first view feasible enough, several objections soon brought it into disuse. 1. The irritation of a stone often causes such a thickened and contracted state of the bladder, that this viscus will not admit of being distended, so as to rise above the pubes. 2. If the operator should break the stone, the fragments cannot be easily washed away, but, remaining behind, forming a nucleus for a future stone. 3. Experience has proved, that the high operation is very commonly followed by extravasation of urine, attended with suppuration and gangrenous mischief in the cellular tissue of the pelvis. This happens because the urine more readily escapes out of the wound in the bladder than through the urethra; and also because, when the bladder contracts, and sinks behind the os pubis, the wound in it ceases to be parallel to that in the linea alba

and integuments, and becomes deeper and deeper. For the prevention of these ill consequences, says Sabatier, it will be in vain to make the patient lie in a horizontal posture, and keep a catheter introduced, as Rousset and Morand recommended—the bad effects being still neither less frequent, nor less fatal. (See *Méd. Opératoire*, t. iii. p. 161, ed. 2.) And Sir Everard Home confesses, that while the high operation for the stone had no other channel but the wound for carrying off the urine, it seemed to him a method which ought never to be adopted. “The urine almost always insinuating itself into the cellular membrane behind the pubes, producing sloughs, and consequently abscesses.” (*On Strictures*, vol. iii. p. 359, 8vo. London, 1821.) 4. The danger of exciting inflammation of the peritoneum. 5. The injection itself is exceedingly painful, and, however slow the fluid be injected, the bladder can seldom be dilated enough to make the operation absolutely secure; and, when hastily dilated, its tone may be destroyed. (See *Sharp, Allan, Sabatier, &c.*)

Some surgeons are of opinion that, when a stone in the bladder is known to be very large, no attempt ought to be made to extract it from the perineum. Scarpa declares that the lateral operation should not be practised when the calculus exceeds twenty lines in its small diameter. (See *Memoir on the Cutting Gorget of Hawkins*, p. 8, transl. by Briggs.) In such cases, it is true, the surgeon may perform the lateral operation, and try to break the stone. But ought this proceeding to be preferred to the high operation? I allude particularly to cases in which the stone is known to be of very large dimensions before any operation is begun. Were the lateral operation commenced, the stone, if too large for extraction, must, of course, be broken; for it is then too late to adopt the high operation with advantage. That such things have been done, however, and yet the patients escaped, is a truth which cannot be denied. Deschamps mentions an instance, in which M. Lassus, after using Hawkins's gorget, could not draw out the calculus, and he therefore immediately performed the high operation, and the patient recovered. Indeed, the second example of the high operation on record was executed by Franco under similar circumstances, and the patient was saved. I have also heard of a modern French surgeon, who began with the lateral operation, but, finding a large calculus, ended with performing the high operation, without the least delay or hesitation: the patient died.

Mr. S. Sharp, an excellent practical surgeon in his time, after noticing with great impartiality the objections which were then urged against the high operation, says that he should not be surprised if, hereafter, it were revived and practised with success; an observation which implied that he foresaw that the method was capable of being so improved as to free it from its most serious inconveniences. In fact, since his time, various attempts have been made to introduce the high operation anew, and upon improved principles. Frère Côme, in particular, knew very well that there were circumstances (as, for instance, a calculus above a certain size, disease of the urethra or prostate gland, &c.) where the lateral operation was liable to great difficulties and disadvantages, and where the high operation, if it could be perfected, would be a fitter and safer mode of proceeding. However, it was

only in such cases, and not in all, that Frère Côme thought the latter method better than the lateral operation. He had also discernment enough to perceive that it was extremely desirable to invent some means whereby the painful and hurtful distension of the bladder, for the purpose of making this organ rise behind the pubes, would be rendered unnecessary, at the same time that some measure was adopted for letting the urine have a more depending outlet than the wound in the hypogastric region. Côme operated after the following way: he first introduced, through the urethra, into the bladder, a staff, which was then held by an assistant; an incision, an inch in length, was now made in the perineum, in the same direction as in the lateral operation. Another incision was made in the membranous part of the urethra, along the groove of the staff, as far as the prostate gland. A very deeply-grooved director was then passed along the staff into the bladder, and the latter instrument was withdrawn. By means of the director, a sonde à dard, or kind of catheter furnished with a stilet, was now introduced into the bladder, and the director taken out. An incision was then made, about three or four inches in length, just above the symphysis of the pubes, down to, and in the direction of, the linea alba. A trocar, in which there was a concealed bistoury, was next passed into the linea alba, close to the pubes, and the blade of the knife then started from its sheath towards the handle of the instrument, while its other end remained stationary. In this manner, the lower part of the linea alba was cut from below, upwards, and an aperture was made which was now enlarged with a probe-pointed curved knife, behind which a finger was kept, so as to push the peritoneum out of the way. Côme then took hold of the sonde à dard with his right hand, and, elevating its extremity, lifted up the fundus of the bladder, while, with the fingers of his left hand, he endeavoured to feel its extremity in the wound. As soon as the end of the instrument was perceived, it was taken hold of between the thumb and middle finger, the peritoneum was carefully kept up out of the way, and the stilet was pushed by an assistant from within, outwards, through the fundus of the bladder. The bladder being thus pierced, the operator introduced into a groove in the stilet a curved bistoury, with which he divided the front of the bladder, from above, downwards, nearly to its neck. He then passed his fingers into the opening, and keeping up the bladder with them, withdrew the sonde à dard altogether. But, as it was desirable that both his hands should be free, the bladder was prevented from slipping away by means of a suspensory hook, held by an assistant, as soon as the opening was found to be already ample enough, or had been enlarged to the necessary extent. Côme next introduced the forceps, took out the stone, and passed a canula, or elastic gum catheter, through the wound in the perineum into the bladder, so as to maintain a ready outlet for the urine, and divert this fluid from the wound in the bladder. [Although these modifications seem to contribute to the safety of the operation, they have been rejected as superfluous by Scarpa and Dupuytren.] In women, of course, the catheter was passed through the meatus urinarius. And I ought here to observe, that Côme, like Scarpa, thought the high operation especially advisable for females, because his experience had

taught him that the division or dilatation of the meatus urinarius was generally followed by an incontinence of urine. (See *Nouvelle Méthode d'extraire la Pierre de la Vessie par dessus le Pubis*, &c. 8vo. Bruxelles, 1779.)

Another modification of the high operation was suggested by Deschamps, who, instead of opening the membranous part of the urethra, as Côme did, perforated the bladder from the rectum, and through the canula of the trocar effected the same objects which the latter lithotomist accomplished by means of the incision in the membranous part of the urethra. Of the two plans, that devised by Côme is unquestionably the best, because not attended with a double wound of the bladder; a thing which, I conceive, must always be highly objectionable.

Dr. Souberbielle, who practises Côme's method, introduces a silver wire through the canula of the sonde à dard, and passes it through the wound made in the linea alba. The wire is then held while the sonde à dard is withdrawn, and a flexible gum catheter is passed by means of the wire into the bladder, through the wound in the membranous part of the urethra. The wire is now withdrawn, and the catheter is fixed with tapes, passed round the thighs and pelvis, and a bladder is tied to it for the reception of the urine. "A piece of soft linen, half an inch wide and six or eight inches long, is to be introduced, by means of a pair of forceps, into the bottom of the bladder;" the object of which slip of linen is to carry off such urine as may not escape through the catheter. Lint and light dressings are applied, and a bandage round the abdomen. Great care is to be taken to keep the catheter pervious, and, usually on the third day, the slip of linen may be taken out, and the wound closed with adhesive plaster. (See *Carpue's History of the High Operation*, pp. 171—172.)

Sir Everard Home made trial of Dr. Souberbielle's method, in St. George's Hospital; and, though some difficulty and delay occurred in the operation, on account of the stone being encysted, the result was successful. Subsequently to this case, however, Sir Everard invented and practised another method, which, so far as I can judge, is better than that of Côme or the plan formerly adopted by Souberbielle, though its principles are the same.

Sir Everard Home performed his new operation for the first time, in St. George's Hospital, on the 26th of May, 1820. "An incision was made in the direction of the linea alba, between the pyramidales muscles, beginning at the pubes, and extending four inches in length; it was continued down to the tendon. The linea alba was then pierced close to the pubes, and divided by a probe-pointed bistoury to the extent of three inches. The pyramidales muscles had a portion of their origin at the symphysis pubis detached to make room. When the finger was passed down under the linea alba, the fundus of the bladder was felt covered with loose fatty cellular membrane. A silver catheter, open at the end, was now passed along the urethra into the bladder, and, when the point was felt by the finger in the wound, pressing up the fundus, a stilet, that had been concealed, was forced through the coats of the bladder, and followed by the end of the catheter. The stilet was then withdrawn, and the opening through the



fundus of the bladder enlarged towards the pubes by a probe-pointed bistoury, sufficiently to admit two fingers, and then the catheter was withdrawn. The fundus of the bladder was held up by one finger, and the stone examined by the forefinger of the right hand. A pair of forceps with a net attached, was passed down into the bladder, and the stone directed into it by the finger: the surface being very rough, the stone struck upon the opening of the forceps, and, being retained there by the finger, was extracted. A slip of linen had one end introduced into the bladder, and the other was left hanging out of the wound, the edges of which were brought together by adhesive plaster. A flexible gum catheter, without the stilet, was passed into the bladder through the urethra, and kept there by an elastic retainer surrounding the penis. The patient was put to bed, and laid upon his side, in which position the urine escaped freely through the catheter." As no blood had been lost in the operation, twelve ounces were taken from the arm. The next day the slip of linen was withdrawn, as useless and irritating; the catheter, while pervious, preventing any urine from escaping by the wound. Sir Everard thought that, in future, the linen need only be left in the external wound, so as to prevent collections of matter, and carry off any urine which may issue from the opening in the bladder when the catheter happens to be stopped up. For this operation, Sir Everard particularly recommended catheters, with their insides polished like their outsides, in order that they may better resist the effects of the urine. Suffice it to add, with respect to the above case, that the boy soon recovered, the bladder having resumed its healthy functions in ten days, although the calculus was of the roughest possible kind.

Sir Everard Home repeated his new method on a gentleman who went out in his carriage, with the external wound completely healed, on the fourteenth day after the operation. The only particulars which need here be noticed, in regard to the latter case, are, that some difficulty was experienced in bringing the point of the catheter forwards toward the pubes, and the slit in the front of the instrument made it so incapable of bearing lateral motion, that the two sides were twisted over one another. (*On Strictures*, vol. iii. p. 359. 8vo. Lond. 1820.) Some other cases, however, which have occurred in St. George's Hospital, have had the effect of satisfying numerous very good judges, that, as a general practice, the high operation ought to be abandoned. I was present when it was attempted there by the late Mr. Ewbank, and the patient sent back to bed without the stone being extracted. This case had a fatal termination.

Whoever follows this method of operating should always be provided with several tubes and stilets, of different lengths and curvatures; for, in the only case in which I have seen the operation attempted, the extremity of the catheter could not be made to project the fundus of the bladder towards the pubes, and, after long-protracted endeavours had been made to bring the end of the instrument upwards and forwards, the tube broke, and the operation was left unfinished. The impression upon my mind was, that no resistance of the bladder could account for what happened, and that the fault lay in the instrument itself, which should have been exchanged for another of more suitable form, as soon as it was found to be inapplicable.

And I believe that if attention be paid to the suggestion of always having at hand a sufficient number of tubes and stilets, of different lengths and curvatures, Sir Everard Home's new method will be the best modification of the high operation yet proposed. The slip of linen, however, I think, is more likely to do harm by its irritation, than any good as a conductor of the urine or matter out of the wound. At all events, as Sir Everard has observed, it should never be passed into the bladder itself. Whenever I am asked my opinion of the high operation, I always restrict my approval of further trials of it to cases in which the calculus is known beforehand to be of very large size, or the urethra and prostate gland are diseased. The reasons urged by Mr. Carpie in favour of the high operation in most cases, are: 1. Because it is generally performed in less time; a point which may be disputed, though it is perhaps not worth contesting, since the danger of an operation cannot always be truly estimated by the length of time which the patient remains in the operating room, slow and gentle proceedings sometimes contributing to his safety. 2. There is less pain; a remark, the justness of which may depend, perhaps, upon the manner in which each operation is performed. 3. There is no fear of a fatal hæmorrhage; a consideration which, I admit, is one good reason in favour of the high operation, though the lateral operation is only subject to risk of hæmorrhage when the incisions are directed in a manner not sanctioned in this Dictionary. 4. There is no division of the prostate and inferior part of the bladder; no, but there is one of the fundus; so, perhaps, on this point the two operations stand upon an equality. As for there being no danger in the high operation of wounding the rectum, it is undoubtedly an advantage, though the accident, as far as I have seen, is not followed by any serious consequences, and can only happen from inattention to rules easily followed. 5. The stone, if of a certain size, cannot be extracted by the lateral operation, but admits of being so by the high operation. Of all the reasons for the latter practice, this appears to me the strongest, with the exception, perhaps, of disease in the urethra and prostate. 6. A small stone is more readily discovered in this method than in the lateral operation, a point which I consider questionable, and, at all events, not sufficiently important to form a ground for the high operation. Indeed, the long time during which several patients in St. George's Hospital were subjected to the agony caused by repeatedly groping and fishing for the stone in vain, has filled a great many judicious surgeons with strong aversion to a continuance of the attempts to revive the practice of the high operation. 7. If a stone breaks, the particles can be extracted with more certainty than in the lateral operation; on this question authors differ, and the remarks in the foregoing passage are rather against the correctness of the statement. 8. The high operation enables the surgeon to remove encysted calculi with greater ease; a reason which may perhaps be generally true, but which is somewhat weakened by the consideration that encysted calculi are not very frequent. Mr. Carpie allows that the high operation should not be selected when the patient is corpulent, and the bladder thickened and diseased, so that its fundus cannot be raised above the pubes. (*See Hist. of the High Operation*, p. 173, 8vo. Lond. 1819.)

Although Scarpa thinks the lateral operation unlikely to answer when the calculus exceeds twenty lines in its lesser diameter, he considers the high operation also useless in such a case, and even fatal; because, according to his observations, when the stone is very large the bladder and kidneys are almost always too much diseased for the patient to recover. (*Osservazioni sul Taglio Retto Vesicale*, p. 3 and 48, 4to. Pavia, 1823.) He has only met with two cases to the contrary. However, in another place, in considering the advantages and disadvantages of the high operation as compared with that performed through the rectum, in cases where the stone is too large to be extracted by the perineum, he gives his decided preference to the former (p. 47). The high operation he also considers the only method by which women can be cured without leaving them afflicted with an incontinence of urine (p. 49). However, after the facts related by Sir Astley Cooper, Mr. Thomas, and others (*Lond. Med. Chir. Trans.*), and Dr. Hamilton (*Edin. Med. Chir. Trans.* vol. ii. p. 117), few surgeons would think of having recourse to so dangerous an operation, in preference to the simple and safe plan of dilating the meatus urinarius.

In December 1818, Mr. Kirby, of Dublin, performed the high operation for the extraction of an elastic gum catheter, which had slipped into the bladder through the canula of a trocar, with which paracentesis had been performed. No contrivance was found necessary for lifting up the fundus of the bladder. The puncture already made was enlarged, and, after the operation was finished, a catheter was placed in the wound, but was withdrawn on the fourth day, as the urine passed out by the side of it. The case terminated well. (See *Kirby's Cases*, p. 92, &c. 8vo. Dublin, 1819.) In an example in which the calculus was lodged in the fundus of a little boy's bladder, aged six years, Dr. Ballingall undertook the high operation, in the expectation that the stone might have been more easily extracted above the pubis, than from the perineum. Great difficulties were experienced, however, in getting it out, and the peritoneal inflammation which ensued had a fatal termination. The stone measured more than two inches in one diameter, and one inch and a half in the other, while the space between the tuberosities of the ischium was only two and a half inches. (See *Edin. Med. Chir. Trans.* vol. ii.) Lithotomy, in whatever way performed, when the stone is encysted (a circumstance that unavoidably lengthens the operation and leads to great disturbance of the parts) is generally unsuccessful; and I do not, therefore, consider this example as more against the high than the lateral operation, which might have been attended, as Dr. Ballingall observes, with even greater difficulties.

The high operation has been twice performed by my friend Mr. Copland Hutchinson. It was first performed in the United States by Dr. Gibson, Professor of Surgery in the University of Pennsylvania, and subsequently by Dr. McLellan and others. It was preferred on account of the great size of the calculi (see *Reese, in American edition of this Dictionary*). Whoever is desirous of examining further the merits of the high operation should refer to the accounts of it recently published by Dr. Souberbielle, whose experience in it has been more considerable, and success greater, than those of any other surgeon who has ever given the general preference to this form of lithotomy.

[The high operation is not now often performed in this country, and is rarely, we believe, performed in France, or other parts of Europe, at the present day. It should not, however, be completely neglected, for circumstances may occur to render its employment necessary. The great advantage of this method is that it enables the surgeon to extract very large calculi without the dangerous incisions, and still more dangerous laceration of parts, which are inevitable when an attempt is made to remove very large calculi from the bladder by the lateral operation.]

It is also said to be a valuable resource in cases where the stone is impacted in the neck of the bladder, or is partially encysted in the floor of that organ. On the other hand, although it may be admitted that the largest calculi can be readily extracted by the high operation, many reasons may be adduced to show, what indeed is confirmed by statistics, that the extraction cannot be effected without danger.

To perform the high operation with the best chance of success, the bladder should be raised above the pubis, so as to present a portion of its anterior wall uncovered by the peritoneum; but, as nearly all cases of large calculi are attended by a thickening of the bladder, and a degree of irritability, which render it most difficult to make the organ rise above the level of the pubis, one of the important conditions of the operation cannot in all cases be attained. Hence the frequent occurrence of peritonitis, by which so many patients are carried off.

The lateral operation, however, may be impracticable from some peculiarity of the case under treatment. Thus, the outlet of the pelvis may be obstructed by a tumour, or it may be impossible to place the patient in the proper position, or to pass a staff into the bladder. In cases of this kind, the surgeon must remove the calculus either through the rectum or above the pubis, and will, we believe, act wisely in selecting the supra-pubic method. The mortality from the operation is high; but it should be remembered that a great number of the cases to which this method has been applied were of a very serious nature, and regarded as beyond the domain of the lateral operation.

One of the most recent cases of success in this country has been revealed by Dr. Humphry, surgeon to the Addenbrooke Hospital, Cambridge, who has published it, and collected an account of 104 operations performed by various other surgeons. Of these 104 cases, 31 were fatal, giving a mortality of 1 in 3.35, or 29.8 per cent.

The subject of Dr. Humphry's case was a boy, 14 years of age, who had suffered from the usual symptoms of stone for seven years. On examination, it was thought that the calculus was too large to admit of its being extracted by the lateral or bi-lateral methods, and Dr. Humphry therefore decided on employing the high operation.

This was performed without any great difficulty, although neither the sonde-à-dard nor injection of the bladder was had recourse to. On the contrary, the bladder was emptied by a catheter previous to the commencement of the operation, with the view of diminishing the chance of infiltration of urine into the cellular tissue. The bladder was found to be deeply seated behind the pubis: its distance from the surface being considerable. When exposed, the stone could be felt through its parietes



and was easily poised between two fingers, one placed in the rectum and the other in the wound. On opening the bladder, a considerable quantity of urine escaped, which the operator conceives must have been derived from the ureters, as the bladder had been emptied previous to the operation by the catheter.

The thickened coats of the bladder embraced the stone so closely, that a considerable time elapsed before the foreign body could be removed with the forceps. It was nearly egg-shaped, weighed rather more than an ounce and a half, and appears to have measured two inches by one inch and a half. Precautions were taken to favour the flow of urine through the wound, but they failed, and the syphon was removed on the second day. No serious accident occurred, and in about two months the patient was able to leave his bed, the wound having granulated and healed up.

Dr. Humphry refers to the well-known fact, that the success of the lateral operation varies greatly with the size of the stone, so much so that of twenty cases operated on in the Norwich Hospital, in which the stones weighed more than three ounces, only eight recovered; whereas the dangers of the high operation do not appear to increase in so great a ratio with the size of the stone, for of twenty-one cases, where the stone weighed more than three ounces, fourteen recovered. It was from this comparison of the two operations, and from the consideration of the evils resulting from the laceration and bruising of the soft parts in the lateral operation, in extracting a large stone entire or in breaking it up, that Dr. Humphry was induced to practise the high operation in this instance, and thinks it worthy of adoption in cases where there are good grounds for believing that the stone is of very large size. (See *Trans. of Prov. Med. and Surg. Assoc.* vol. xvii., 1850, p. 103.)

#### LATERAL OPERATION.

This mode of operation is so named from the prostate gland and neck of the bladder being laterally cut.

[To Pierre Franco, a celebrated surgeon of Provence, is undoubtedly due the merit of having first described, if he did not invent, an operation which contained the principal elements of the lateral operation as practised at the present day. (*A Treatise on Hernia and Stone*, 1561). From his description it appears that Franco employed a scalpel, gorget, and grooved director; that he made an oblique incision, then divided the membranous part of the urethra and the prostate, introduced the gorget, and then passed the forceps along the hollow of the gorget and withdrew the stone.]

But though Franco appears to have practised the lateral operation, he never established the method as a permanent improvement in surgery, which measure was left to be completed 50 years afterwards by an itinerant lithotomist, who called himself Frère Jacques. He came to Paris in 1697, bringing with him abundance of certificates of his dexterity in operating; and having made his history known to the court and magistrates, he got an order to cut at the Hôtel-Dieu and the Charité, where he operated on about fifty persons. His success, however, did not equal his promises, and, according to Dionis, some loss of reputation was the consequence.

Frère Jacques used a large round staff without a groove; and when it was introduced into the bladder, he depressed its handle, with an intention of making the portion of this viscus which he wished to cut approach the perineum. He then plunged a long dagger-shaped knife into the left hip, near the tuber ischii, two fingers' breadths from the perineum, and pushing it towards the bladder, opened it in its body, or as near the neck as he could, directing his incision upward from the anus. He never withdrew his knife till a sufficient opening had been made for the extraction of the stone. Sometimes he used a conductor to guide the forceps, but more commonly directed the last with his finger, which he passed into the wound after withdrawing the knife. When he had hold of the stone, he used to draw it out in a quick rough manner, heedless of the bad consequences. His only object was to get the stone extracted, and he disregarded everything else, all preparatory means, dressings, and after-treatment. (*Allan*, p. 23.)

But although Frère Jacques, totally ignorant of anatomy, and rude and indiscriminate in practice, sunk into disrepute, some eminent surgeons conceived, from a consideration of the parts which he cut, that his method might be converted into a most useful operation.

The principal defect in his first manner of cutting was the want of a groove in his staff, and the consequent difficulty of carrying the knife into the bladder. At length, Frère Jacques was prevailed upon to study anatomy, by which his judgment was corrected, and he readily embraced several improvements which were suggested to him. Indeed, we are informed that he now succeeded better, and knew more than is generally imagined. Mr. Sharp says that when he himself was in France, in 1702, he saw a pamphlet published by this celebrated character, in which his method of operating appeared so much improved that it scarcely differed from later practice. Frère Jacques had learnt the necessity of attending to the wound after the operation, and had profited so much from the criticisms of Méry, Fagon, Félix, and Hunauld, that he then used a staff with a groove, and had cut 31 patients successively without losing one. (*Sharp's Operations*.) In short, as a modern writer has observed, "he lost fewer patients than we do at the present day in operating with a gorget." He is said to have cut nearly 5,000 patients in the course of his life, and though persecuted by the regular lithotomists, he was imitated by Maréchal at Paris, Raw in Holland, and by Bamber and Cheselden in England, where his operation was perfected. (*Allan*.)

[Frère Jacques' second method, adopted after a course of two years' study of anatomy and operative surgery, at Versailles, may be thus briefly described:—He passed a grooved staff into the bladder, made an oblique incision from the raphe towards the tuberosity of the ischium, then cut down between the erector penis and accelerator urinæ, until he arrived at the groove of the staff, divided the neck of the bladder in its whole length, and introduced the forceps along his finger.]

For a particular history of Frère Jacques and his operations, see Bussière's Letter to Sir Hans Sloane, *Philos. Trans.* 1699; J. Méry, *Obs. sur la Manière de Tailler dans les deux Seves, pratiquée par F. Jacques*; Lister's *Journey to Paris*, 1698;

*Cours d'Opérations de Chirurgie, par Dionis ; Garengot, Traité des Opérations, t. 3 ; Morand, Opuscles de Chirurgie, part 2.*

Among the many who saw Frère Jacques operate was the famous Raw, who carried his method into Holland and practised it with amazing success. He never published any account of it himself, though he admitted several to his operations; but after his death his successor, Albinus, gave the world a very circumstantial detail of all the processes, and mentions, as one of Raw's improvements, that he used to open the bladder between its neck and the ureter. But either Albinus, in his relation, or Raw himself in his supposition, was mistaken, since it is almost impossible to cut the bladder in that part upon the common staff without also wounding the neck (*Sharp, in Operations and Critical Inquiry*). Raw's method was objectionable, even when accomplished, as the urine could not readily escape, and it became extravasated around the rectum, so as to produce terrible mischief. There is little doubt that Raw's really successful plan was only an imitation of Frère Jacques' second and improved method.

The following observation by Dr. Yelloly respecting Raw I consider to be important. "The success which attended Raw's practice is stated to have been unexampled in the history of surgery; for he is represented as having cut 1547 patients without ever losing one. The account is altogether incredible, but I am surprised that the refutation of it, which is afforded to a certain extent by the celebrated Camper, the successor of Raw and Albinus in the Chair of Anatomy and Surgery at Leyden, has been entirely overlooked by those authors who have had occasion to notice the circumstance, for that distinguished physician informs us that on examining the register kept at the College of Surgeons of Amsterdam by order of the magistracy, he found that Raw lost 4 cases out of 22 whom he cut for the stone in that city, or one in five and a half (*Demonstrationum Anatomico Pathologicarum, liber secundus, p. 14*). Camper tells us that he had no other opportunity of ascertaining by unquestionable documents the result of Raw's operations, but this fact is sufficient to show how little dependence was to be placed on Raw's asseverations of his success." (See J. Yelloly, M.D., in *Med. Chir. Trans.*, vol. xv.)

Dr. Bamber was the first man in England who made a trial of Raw's method on the living subject, which he did in St. Bartholomew's Hospital. Cheselden, who had been in the habit of practising the high operation, gladly abandoned it on receiving the account of Raw's plan and success; and a few days after Bamber, he began to cut in this way in St. Thomas's Hospital. Cheselden, finding that he lost many patients in imitating Raw according to the directions given by Albinus, began a new manner of operating, which he thus describes: "I first make as long an incision as I can, beginning near the place where the old operation ends, and cutting down between the musculus accelerator urinae and erector penis, and by the side of the intestinum rectum. I then feel for the staff, holding down the gut all the while with one or two fingers of my left hand, and cut upon it in that part of the urethra which lies beyond the corpora cavernosa, and in the prostate gland, cutting from below upwards, to avoid wounding the gut." A gorget was then passed along the groove of the

staff into the bladder, and the forceps over it in the usual way.

Although the method of operating now adverted to was always preferred by Cheselden, after the trial of others, yet, by an extraordinary mistake in Dr. Douglas's *History of the Lateral Operation*, so clearly exposed by my friend Dr. Yelloly (see *Med. Chirurg. Trans.*, vol. xv.), it is represented that Cheselden's last and most improved plan consisted, after the external incision had been made, in first passing the knife into the groove of the rostrated or straight part of the staff, *through the side of the bladder immediately above the prostate*, and bringing its point afterwards along the same groove in the direction downwards and forwards, or towards himself. Cheselden is thought to have divided that part of the sphincter of the bladder which lay upon the prostate gland, of which he next cut the outside of one half obliquely, according to the direction and whole length of the urethra within it, and finished the internal incision by dividing the membranous portion of the urethra on the convex part of his staff. (See *Appendix to the History of the Lateral Operation*, by J. Douglas, 1731.)

"When he first began to practise this method," continues Douglas, "Cheselden cut the very same parts the contrary way; that is, his knife entered first the muscular part of the urethra, which he divided laterally from the pendulous part of the bulb to the apex, or first point of the prostate gland, and from thence directed his knife upward and backward all the way into the bladder; as we may read in the Appendix he lately published to the fourth edition of his *Book of Anatomy*. But some time after, he observed that in that manner of cutting, the bulb of the urethra lay too much in the way, the groove of the staff was not so easily found, and the intestinum rectum was in more danger of being wounded." (See *Appendix to Hist. of Lateral Operation*, p. 12. Dr. T. Thomson's ed. p. 30.)

"The least consideration will show," says Dr. Yelloly, "that this account of Cheselden's improved operation is perfectly irreconcilable with that which is given by Cheselden himself in the Appendix to his fourth edition of his *Anatomy*; or by M. Morand with his sanction and authority."

[The error committed by Douglas is now universally admitted; it does not, therefore, seem necessary to retain in the present edition the copious extracts which Mr. Cooper has given from Dr. Yelloly's *Memoir*.]

According to Dr. Yelloly, "Heister seems to have been one of the first authors who took Dr. Douglas's representation as demonstrative of what Cheselden's improved operation of lithotomy was, and he gives by deduction from Dr. Douglas's account a progression of three different modes of operation employed by Cheselden, which he designates as the *modus primus, alter, and tertius*. The first was that in which injection was employed; the second, that mentioned in the Appendix to the fourth edition of Cheselden's *Anatomy*, and quoted by Morand, and from which I venture to think that Cheselden never deviated; the third, that described by Douglas as Cheselden's latest improvement, but which I presume to conclude was one that never entered into his contemplation."

But (as Dr. Yelloly adds) Heister very fairly admits what it may be thought should have excited



a little further enquiry on his part into the subject, that Morand, whom Cheselden instructed in his operation, and who was therefore the person of all others the best entitled to be acquainted with it, says nothing of the change mentioned by Douglas: "Morandus nihil adhuc de hac methodo proponit sed præcedentem No. 19 descriptam (alluding to the mode in which he was instructed by Cheselden) pro optimâ declarat." (Heister's *Institutiones Chirurgicæ*, p. 977.)

Sabatier, also, in his *Médecine Opératoire*, t. 4, p. 251, published in 1796, has given a correct exposé of Cheselden's practice, in which he has been since followed by Baron Boyer, in nearly the same words.) *Traité des Maladies Chir.*, t. 9, p. 356.)

For several other interesting facts I must refer to Dr. Yelloly's valuable paper.

*Lateral operation as performed with cutting gorgets.*—[The operation with the cutting gorget is almost entirely discarded in the present day; the discussion of its merits, therefore, is daily becoming more a matter of historical than of practical interest. The following remarks, however, though relating more especially to the operation with the gorget, include many points of great interest and importance with reference to lithotomy generally.]

The gorget has the same kind of form as one of the instruments used by F. Colot and others in the performance of the apparatus major, and the common opinion that the conductor of Hildanus was the first model of it is not exactly true; but it differs from the instruments employed by these ancient surgeons in having a cutting edge. Sir Cæsar Hawkins thought that if its right side were sharpened into a cutting edge, it might be safely pushed into the bladder, guided by the staff, so as to make the true lateral incision in the left side of the prostate gland more easily, and with less risk of injuring the adjacent parts than Cheselden could do with the knife; and surgeons were pleased with a contrivance which saved them from the responsibility of dissecting parts with the anatomy of which all were not equally well acquainted. (*J. Bell; Allan.*)

As Scarpa observes: To render the execution of the lateral operation easier to surgeons of less experience than Cheselden, was the motive which induced Hawkins to propose his gorget. He thought that two great advantages would be gained by the use of this instrument: one, of executing invariably the lateral incision of Cheselden; the other, of constantly guarding the patient, through the whole course of the operation, from injury of the rectum and of the arteria pudica profunda. The utility of the latter object (says Scarpa) cannot be disputed, as it is evident that the convexity of the director of the instrument defends the rectum from injury, and that its cutting edge, not being inclined horizontally, towards the tuberosity and ramus of the ischium, but turned upwards in the direction of the longitudinal axis of the neck of the urethra, cannot wound the pudic artery. But with respect to the first advantage, or that of executing precisely the lateral incision of Cheselden, it must be admitted that it does not completely fulfil the intention which he proposed, not only on account of the cutting edge of his instrument not being raised enough above the level of the staff to penetrate sufficiently the substance of the prostate gland,

and consequently to divide it to a proper depth; but, because being too much turned upwards at that part of it which is to lay open the base of the prostate gland, it does not divide it laterally, but rather at its upper part, towards the summit of the ramus of the ischium and the arch of the pubis; an opening, of all others in the perineum, the most confined, and presenting the greatest impediment to the passage of the stone from the bladder. (See also *Key on Lithotomy*, p. 10.)

Scarpa considers all the modifications of Hawkins's gorget proposed by B. Bell, Desault, Cline, and Cruikshank, as deteriorations of the original instrument. B. Bell (he observes) has diminished the breadth of the director, but giving the cutting edge a horizontal direction. The horizontal direction of the cutting edge is also preferred by Desault, Cline, and Cruikshank; but they have enlarged the director and flattened the part which was previously concave. Aware of the danger of wounding the pudic artery by the horizontal direction of the gorget, they direct the handle of the staff to be inclined towards the patient's right groin, and the gorget to be pushed along it, inclined in such a manner that its obtuse edge may be directed towards the rectum, and its cutting edge placed at a sufficient distance from the tuberosity and ramus of the ischium, to avoid wounding the artery. Scarpa contends, however, that it is difficult to give a proper degree of obliquity to the staff; and that such inclination of the instrument must be incommensurable, arbitrary, and unsettled, in comparison with that position of it in which the handle of the staff is held in a line perpendicular to the body of the patient, and its concavity placed against the arch of the pubis; on which stability of the instrument (says Scarpa) the safety and precision of the lateral operation depend. According to this eminent professor, the defects of Hawkins's original gorget arise from the excessive breadth of the director, particularly at the point, the want of sufficient elevation of the cutting edge above the level of the groove of the staff, and the uncertain inclination of the edge to the axis of the urethra and prostate gland. The cervix of the urethra in a man between 30 and 40 years of age is only three lines in diameter at the apex of the prostate gland, four lines in its centre, and five near the orifice of the bladder. The apex of the prostate gland is rather more than two lines in thickness, the body or centre four, and the base six and sometimes eight, which surrounds the orifice of the bladder. In an adult of middle stature, from 18 to 20 years of age, the thickness of the base of the prostate gland is about two lines less compared with that of a man of 40 and of a large size. The precise line in which the lateral incision of the prostate gland should be made in an adult (says Scarpa) is found to be inclined to the longitudinal axis of the cervix of the urethra, and of the gland itself, at an angle of 69°. Now, from these data, drawn from the structure of the parts, Scarpa makes the director of his gorget only four lines broad, and two deep; the breadth decreasing at the beak. The cutting edge of the instrument is straight near its point, but gradually rises and becomes convex above the level of the staff, so that its greatest convexity is seven lines broad. Lastly, the inclination of the cutting edge to the longitudinal axis of the director is exactly at an angle of 69°, that is to say, the same as the left side of the

prostate gland to the longitudinal axis of the neck of the urethra. (See *Scarpa's Memoir on Hawkins's Gorget*, trans. by Briggs, p. 12, 17.)

For nearly thirty years the instrument makers in London have been in the habit of selling a gorget which Mr. Abernethy invented, and which, in the particularity of its cutting edge turning up at an angle of  $45^\circ$ , bears much analogy to the instrument recommended by Scarpa. The cutting edge is straight, and that useless and dangerous part of a gorget sometimes called the shoulder, is removed. Admitting that the principles of the lateral operation, as inculcated by Scarpa, are correct, it appears to me that Abernethy's gorget is preferable to that proposed by Scarpa. Its edge is not so immoderately turned up, and it will enter with more ease and less risk of slipping from the staff because it has not any projecting shoulder, which, while the staff is firmly held with the beak of the gorget in it, can have no other effect but that of obstructing the passage of the last instrument.

Gorgetes which cut on both sides have also been sometimes employed in England; and as a larger opening can be obtained by them, even without trespassing the limits of the incision fixed by Scarpa, that is to say, without cutting any part of the body of the bladder, they appear to promise utility, especially when the stone is suspected to be large. However, they are less used now than they were some years ago, when Sir Astley Cooper employed them in Guy's hospital. The preference more commonly given to the knife will account for the fact.

Before the operation, the following instruments should all be arranged ready on a table. A staff of as large a diameter as will easily admit of introduction, and the groove of which is very deep and closed at the extremity; a sharp gorget, with a beak nicely and accurately adapted to the deep groove of the preceding instrument, so as to glide easily and securely; a large scalpel for making the first incisions; forceps of various sizes and forms for extracting the stone; a blunt-pointed curved bistoury for enlarging the wound in the prostate if the incision of the gorget be not sufficiently large, as I believe the parts should never be lacerated; a pair of Le Cat's forceps, with teeth for breaking the stone, if too large to come through any wound reasonably dilated; a syringe for washing out clots of blood or particles of the stone, a practice, however, not considered necessary by Sir Astley Cooper; a scoop, for the removal of small calculi or fragments; two strong garters or bands with which the patient's hands and feet are tied together.

The curvature of the staff is a matter of considerable importance, because the direction of the incision through the prostate gland and neck of the bladder is partly determined by it. The French surgeons, convinced of the advantage of introducing the gorget in the direction of the axis of the bladder, always use a staff which is more curved than what English surgeons employ. (See *M. Roux, Voyage fait à Londres en 1814, ou Parallèle de la Chir. Angloise*, &c., p. 319.) But I am inclined to believe, with Scarpa, that upon the whole it is best to let the curvature of the staff correspond exactly to that of the axis of the neck of the urethra and prostate gland. (*Opusculi di Chirurgia*, vol. i. p. 39.)

The staff is "of the figure of a sound," from which, however, it differs, first, in the handle, which, instead of being smooth and polished, is made rough, in order that it may be more firmly and steadily held; secondly, in having a groove like that of a director on its convex side. It is, in fact, a director, and intended to answer precisely the same purpose." A staff should be as large as the urethra will admit without being painfully stretched. A large staff is more easily felt in the perineum than a small one, and it allows a wider and deeper groove to be constructed in it. Sir C. Bell, Mr. Liston, and some others, prefer a deep groove placed between the lateral and convex aspects. The end of the staff ought to be neatly rounded off, as well as the edges of the groove. (*Sir B. Brodie on Dis. of the Urinary Organs*, p. 269.) After the staff has been introduced and the stone felt with it to be in the bladder, the next thing is to secure the patient in the most desirable position. He should be placed on the operating table lying on his back, supported by pillows, with his shoulders somewhat elevated. He should be directed to grasp the outside of each foot with the hand of the same side, and then the hand and foot are to be bound together by several turns of the lithotomy garters, a noose being first made for the reception of the wrist. The patient is then drawn towards the end of the table, with the buttocks projecting rather beyond it. An assistant is required to stand on each side of the patient in order to hold his feet, hands, and knees, and to keep the limbs well apart. A third assistant is necessary to hand the instruments to the surgeon as soon as wanted, and a fourth to hold the handle of the staff. It is also convenient to have a fifth assistant to support the patient's shoulders. The assistant who holds the staff usually stands on the patient's left side, in order that he may take the handle of the instrument in his right hand. (*Sir B. Brodie, Op. cit.* p. 271.)

The assistant, holding up the scrotum with his left hand, is with his right to hold the staff, inclining its handle towards the right groin, so as to make the grooved convexity of the instrument turn towards the left side of the perineum. Some operators also like the assistant to depress the handle of the staff towards the patient's abdomen, in order to make its convexity project in the perineum, while others condemn this plan, fearing that it may withdraw the instrument from the bladder. (*Al-lan, &c.*)

Scarpa disapproves of inclining the handle of the staff towards the patient's right groin, and he expressly recommends this instrument to be held firmly against the arch of the pubes (also *Liston, Practical Surgery*, p. 410) in a line perpendicular to the body of the patient, so that the convex part of the director may be placed towards the rectum, and take the exact course of the axis of the urethra and prostate gland. (*Opusculi, &c.*, p. 40.) This position of the staff appears to Scarpa the firmest and most commodious, and he maintains that on such stability of the instrument the safety and precision of the lateral operation depend. It is observed, however, by Mr. Stanley, that the pressure of the curved part of the staff upwards is objectionable, as it may lead to the incisions being made in the narrower part of the space beneath the arch of the pubes. "To the pressure of the staff downwards (says he) the



objections are that it may have the effect of withdrawing the point of the instrument from the bladder, and of approximating the bladder and the urethra to the rectum. In an instance where the assistant pressed the staff downwards, the rectum was wounded by the scalpel in the first stage of the operation; and in the young subject the risk of such an occurrence will be greater on account of the small size and soft texture of the prostate gland." (On the *Lateral Operation*, p. 3.)

On this point, Mr. Liston, who employs a knife, agrees with Scarpa. "The staff," he says, "is hooked against the symphysis, and entrusted to an assistant with directions to maintain the position steadily from first to last, neither to turn it so as to make it bulge in the perineum, nor to depress the handle as the knife enters the bladder. The surgeon's left hand is thus left at liberty to guide the knife, and guard important parts from danger." (On *Practical Surgery*, p. 410.) The best surgeons differ, however, with regard to the most advantageous way of holding the staff. Thus, Sir Benjamin Brodie, after mentioning that the surgeon should be seated on a stool before the patient, adds that "he is first to attend to the position of the staff, taking care that it is held nearly perpendicularly, the handle of it, however, being inclined towards the patient's right groin. This causes the convexity of the instrument to project slightly on the left side of the perineum. (On *Dis. of the Urinary Organs*, p. 271, ed. 2.)

Sir A. Cooper directs the operator to hold the staff perpendicularly and to let it rest on the stone, as he has seen many instances in which the gorget has not entered the bladder, owing to the staff not having itself passed into it, but rested against the prostate gland. It seems then that there is no agreement among surgeons respecting the best position of the staff, and that the main points are to hold the instrument firmly, taking care that its beak is in the bladder.

The operation is accomplished by a free incision of the skin and subjacent fat, by dividing the transversalis muscle and a part of the triangular ligament, and continuing the incision through the left side of the prostate. (See *E. Stanley, Op. cit.*)

The first incision should commence below the bulb of the urethra, about an inch and a quarter in front of the anus, over the membranous part of this canal, at the place where the operator means to make his first cut into the groove of the staff, and the cut should extend at least three inches obliquely downward to the left of the raphe of the perineum, at an equal distance from the tuberosity of the ischium and the anus, or, as some operators prefer, the line of it may be to a point distant two thirds from the anus, and one from the tuberosity of the ischium. (*Stanley*.) The first cut should descend rather beyond the level of the centre of the anus, for it is a general rule in surgery to make free external incisions, by which the surgeon is enabled to conduct the remaining steps of his operation with greater facility, and nowhere is it so necessary as where a stone is to be extracted. (*Allen*.) Callisen lays it down as a rule that the incision ought not to extend to such parts as can make no impediment to the extraction of the stone, and therefore (says he) the bulb and that part of the urethra which is surrounded by the corpus

spongiosum should never be cut. Only those parts ought to be divided which firmly resist the safe introduction of instruments into the bladder and the extraction of the stone. Hence, the integuments must be opened by an ample incision, and the membranous part of the urethra, transversus perinei muscle, levator ani, and prostate gland be properly divided. (*Systema Chirurgiæ Hodiernæ*, pars ii., p. 655.) Like Scarpa, however, he is fearful of making a free cut through the neck of the bladder, and in lieu of doing so prefers a slow and cautious dilatation of the parts. Mr. Martineau used also to introduce the point of the knife into the groove of the staff as low down as he could, and cut the membranous part of the urethra. (*Med. Chir. Trans.* vol. ii.) The nearer to the prostate gland the urethra is opened, the better, as it lessens the risk of wounding the bulb or its artery. (*E. Stanley, Op. cit.* p. 7.) When the external cut through the integuments, fat, and superficial fascia has been executed, the next object is to divide the lower fibres of the accelerator urinæ and transversus perinei muscle, which stands like a bar across the triangular hollow out of which alone the stone can be extracted. This second cut should also divide the triangular ligament.

Having placed the beak of the gorget in the groove of the staff, the operator takes hold of the latter instrument with his left hand, raises its handle from the abdomen so that it may form nearly a right angle with the body, and stands up. Before attempting to push the gorget into the bladder, however, he should slide it backwards and forwards with a wriggling motion, that he may first be sure of its beak being in the groove of the staff. The bringing forward of the handle of the latter instrument, so as to elevate its point before introducing the gorget into the bladder, is also considered of great importance; for it is by this means that the gorget is introduced along the groove of the staff in the only direction unattended with risk of wounding the rectum.

Attention to this rule is especially necessary when a staff with a groove not closed at the end is employed. The neglect of it in this case might make the operator cut the bladder with the gorget in several places, as, according to Mr. B. Bell, has actually happened. But since the gorget, when introduced as nearly as possible in the axis of the bladder, may transfix and otherwise injure this organ if introduced either too far or at all beyond the extremity of the staff, I am decidedly of opinion that every surgeon who chooses to perform the lateral operation with a gorget should employ a staff, the groove of which is closed at the extremity, as is invariably done in France, and is expressly enjoined by Scarpa. See *Sabatier, Méd. Opératoire*, t. iii., p. 233, ed. 2, and *Scarpa, Opusculi di Chirurgia*, vol. i. p. 39.) There can also be no doubt of the prudence of endeavouring to have only a limited depth of the staff in the bladder. Scarpa specifies an inch and a half as the proper distance to which the end of the staff should enter the bladder. However, this distinguished professor was an advocate for a very limited incision, and other operators who prefer making a freer opening must use a staff that reaches into this viscus rather further. Much, however, will depend upon the kind of gorget employed, particularly its breadth; and if the staff is to rest against

the stone, as advised by Sir A. Cooper, of course the extent to which it passes will be determined by the situation of the calculus. As soon as the gorget has been introduced, some operators withdraw the staff, pass the left fore-finger along its cavity into the bladder, and then take out the gorget. The gorget should be withdrawn in the same line in which it entered, pressing it towards the right side in order to prevent its making a second wound. If, however, the operator should prefer passing the forceps into the bladder along the gorget, the latter instrument must be quite motionless, lest its sharp edge do mischief: and at all events, as soon as the forceps or finger is in the bladder, the cutting gorget is to be withdrawn.

Others, calculating on the division of the prostate by the gorget being sufficient, withdraw it, preparatory to the introduction of the forceps. The gorget having been withdrawn, the staff is to be taken in the right hand, and the left fore-finger passed along it into the bladder. The staff is then to be withdrawn, and it is to be ascertained by the finger to what part of the bladder the forceps should be directed that they may immediately touch the stone. On withdrawing the finger, the forceps with their blades closed are to be passed slowly through the wound, and inclined upwards as they approach the bladder. Upon the foregoing plan, the staff will be the conductor of the finger into the bladder, and the finger the conductor of the forceps. The introduction of the finger is useful to ascertain the situation of the stone, and by separating the sides of the incision in the prostate, to facilitate the passage of the forceps. By allowing the staff to remain in the bladder until the finger has entered its cavity, the beaked or probe-pointed knife can be readily conducted to the bladder for the purpose of enlarging the incision of the prostate, should this have been inadequately made; and if, from an unusual firmness of the prostate, the sides of the incision through it do not readily yield, much difficulty may be experienced in discovering the passage to the bladder when the staff has been withdrawn, and its aid as a conductor to the finger is thereby lost. (See *Stanley on the Lateral Operation*, p. 11.) In the prudence of these directions I entirely concur.

The operator has next to grasp the stone with the blades of the forceps, for which purpose he is not to expand the instrument as soon as it has arrived in the bladder, but he should first make use of the instrument as a kind of probe for ascertaining the exact situation of the stone. If this body should be lodged at the lower part of the bladder, just behind its neck, the operator is to open the forceps immediately over the stone, and after depressing the blades a little, is gently to shut them so as to grasp it. Certainly, it is much more scientific to use the forceps at first, merely for ascertaining the position of the stone; for when this is known, the surgeon will more certainly grasp the extraneous body in a skilful manner than if he were to open the blades of the instrument immediately, without knowing where they ought next to be placed or when shut. No man of experience can doubt that the injury which the bladder frequently suffers from rough, reiterated, awkward movements of the forceps is not an uncommon cause of such inflammation of this viscus, as extends to the peritoneum and occasions death.

If the surgeon cannot readily take hold of the stone with the forceps, he should, with his fore-finger passed into the rectum, raise it up, when in general it may be easily grasped. The stone should be held with sufficient firmness to keep it from slipping away from the blades, but not so forcibly as to incur the risk of its breaking.

The skilful management of the forceps consists in pressing the blades gently against the sides of the wound first in one direction, then in another, but especially downwards (towards the wider part of the space between the rami of the ischia), and in drawing them out slowly that time may be allowed for the yielding of the surrounding parts. (See *Stanley on the Lateral Operation*, p. 13.)

For the most part, as Sir B. Brodie has correctly stated, it is better that the convexity of one blade of the forceps should be turned upwards, and that of the other blade downwards. Attention to this point is especially of consequence in cases where there is an enlarged prostate gland forming a tumour projecting into the bladder. The smooth convex surface of the blade of the forceps is not interfered with by the projection, whereas if the forceps are turned in the other direction, the stone coming in contact with the tumour becomes, as it were, entangled by it, and the extraction is rendered difficult. (*On Diseases of the Urinary Organs*, p. 282, *Ed. 2.*)

The stone should always be attentively examined immediately it is extracted, because its appearance conveys some information, though not positive, concerning the existence of others. If the stone is smooth on one surface, the smoothness is generally found to arise from the friction of other stones still in the bladder, but when it is uniformly rough, it is a presumptive sign that there is no other one remaining behind. In every instance, however, the surgeon should gently examine the cavity of the bladder with his fore-finger, for it would be an inexcusable neglect to put the patient to bed with another stone in his bladder.

After the operation, the patient is to be laid in bed on his back, a piece of oil-silk and some folded napkins being placed under him for the reception of the urine. His shoulders and loins are to be as much elevated as they can be without inconvenience, so as to make the wound in the perineum as depending as possible (*Brodie*). With respect to the application of a pledget and bandage and keeping the thighs closed, I confess that my own ideas lead me to regard them as Sir A. Cooper, Sir B. Brodie, and many other surgeons do, as disadvantageous; indeed, I believe the best plan is to leave the wound open, so that the urine may have a free outlet; strict attention being paid to keeping the parts clean. Sir B. Brodie recommends the thighs to be somewhat elevated by a bolster placed under the hams, and the knees to be a little asunder. (*On Diseases of the Urinary Organs*, p. 287.)

In many cases where there has been a deep perineum, and especially where the stone has proved to be of large size, Sir B. Brodie has introduced an elastic gum canula through the wound into the bladder, and allowed it to remain for the first two or three days—that is, until the surrounding parts have had time to become consolidated by inflammation. Such a canula makes an excellent conductor for the urine. It keeps



the bladder always empty, and prevents the pain which otherwise is experienced on the first passage of the urine. It prevents also that obstruction to the flow of the urine which sometimes occurs after the operation, in consequence of the wound having become plugged by a coagulum of blood. In cases in which the stone has been of so large a size as to make it probable that, in the extraction of it, the soft parts have been lacerated beyond the boundaries of the prostate, the canula will answer another purpose by lessening the danger of the urine becoming effused in the cellular membrane. (*Sir B. Brodie*, op. cit. p. 287.) In Edinburgh I understand this practice has been common; and Mr. Liston is an advocate for it in all cases, and recommends the tube to be secured by tapes to a band round the waist. One reason which he gives for the plan is, that if the oozing from some vessels persists, it can readily be arrested by pushing some pieces of lint with a probe between the tube and sides of the wound. (See *Practical Surgery*, p. 416.) I believe that in order to avoid the presence of an extraneous body in the wound, it is better to restrict the use of the elastic gum canula to examples attended with disposition to hæmorrhage or the circumstances specified by Sir B. Brodie.

Professor Jameson, of Baltimore, who aims at uniting the wound as far as practicable by adhesion, introduces a moderately large flexible catheter through the wound into the bladder, and secures it by a soft strip of rag to the penis. The patient is laid on his side, his knees brought together and tied by means of a soft silk handkerchief. No sutures are employed, but the patient must lie quietly on his side for two or three days, so as to obtain the effect of a syphon from the tube. He may, however, after some hours, if particularly desirous, turn upon his left side, yet never forgetting that the outer end of the tube must be lower than the inner. The patient may be kept comfortably dry by using a cup or large sponge to contain the water as it drops from the tube. (See *Amer. Ed. of this Dict.*) A surgeon at Dundee has lately advocated the same practice.

[The after treatment in cases of lithotomy is extremely simple when no unfavourable symptoms present themselves.

It is unnecessary to tie the patient's knees together, as some surgeons recommend, or to elevate the shoulders in order to give a depending position to the wound.

The surface of the wound itself requires no application whatever, but the parts must be kept clean and dry.

It is of great importance that the urine should escape freely through the wound soon after the operation; and the surgeon should pay particular attention to this point; but the propriety of using a tube, as recommended by Collet, and in recent times by Mr. Liston, seems doubtful. Whatever is calculated to annoy the patient in any shape or excite the wound should be carefully avoided.

If the patient experiences any considerable pain about the neck of the bladder soon after the operation, an opiate may be administered; and this will have the further benefit of keeping the bowels quiet.

During the first three or four days the diet should be very light; but it must be remembered that children and very old persons will require support much earlier than adults.

The time at which the urine begins to flow through the urethra varies in almost every case; but, generally speaking, the wound begins to contract about the fourth or fifth day, and then some urine escapes through the urethra as well as through the wound. More and more urine now passes through the urethra in proportion as the wound in the prostate continues to heal, until at last the whole of the urine takes the natural route. This usually happens in about sixteen to twenty days. From this time the external wound begins to close, and the cure is completed in from thirty to forty days.

In less favourable cases various accidents, which will be presently described, may require corresponding treatment.]

*Lithotomy with a Knife. The Modern Lateral Operation.*—[The modern lateral operation, or, as Mr. Cooper terms it, lithotomy with a knife, is essentially the same as the operation invented by Franco, practised by Frère Jacques, and improved by Cheselden. Before being submitted to this—or, indeed, to any other operation for the extraction of vesical calculus—the patient should undergo careful preliminary treatment. This is an important point to which the most successful lithotomists have always been attentive.]

Sir A. Cooper, I think with considerable reason, recommends putting the patient on vegetable diet for a little while previously to the operation. He disapproves of operating when the kidneys are diseased, the bladder is ulcerated, and disease in the chest, asthma, or any irregularity prevails. He has found the operation generally more successful in the poor and labouring classes, than in the rich and luxurious. Old age is not considered by him as an objection to the operation, which he differs from the generality of surgeons in believing most successful in persons from 61 to 63 years of age. If the patient is loaded with fat, he says the chance of peritoneal inflammation is always great—according to his experience, convulsions having a fatal result, are frequent after operations on children, particularly when much blood has been lost. When a stone of considerable magnitude is accompanied with an enlarged prostate gland, the patient (he says) rarely recovers from the operation.

An opening medicine should be given the day before the patient is cut, and a clyster injected a couple of hours before the time fixed upon for the operation, in order to empty the rectum and thus diminish the chance of its being wounded.

It is generally considered advantageous to let the bladder be somewhat distended, and the patient is therefore directed to retain his urine a certain time before he is cut. Formerly a jugum penis was sometimes used for confining the urine in the bladder, but since my entrance into the profession I have never heard of this contrivance being employed. The presence of urine in the bladder, it is conceived, may lessen the chance of the fundus of that organ being injured by the gorget, but I am not sure that the reason for the practice is good. The plan is disapproved of by Sir A. Cooper, who says, that when the urine collected gushes out, the bladder contracts and embraces the stone so closely, that it is difficult to get hold of the foreign body with the forceps.

[The existence of serious organic disease is

rather a contra-indication to the operation, than a complication to be combated; but, as Mr. Erichsen observes, "if the patient's health be in a pretty good state, it will only be necessary to subject him to preparatory treatment for a short time, so as to allay or remove irritability of the urinary organs before proceeding with the operation."

With this view, he should be kept as quiet as possible for about a week or ten days preceding the operation; his diet should be properly regulated, but not of too low a kind. The pain should be lessened by the administration of opium or henbane, and the bowels properly relieved.

On the night preceding the operation, the bowels should also be cleared out by a dose of castor oil, &c.; and on the morning of the operation an enema is administered, and repeated an hour or two before we proceed to cut.

The instruments now employed for the lateral operation are few and simple. A straight knife for the external, and a probe-pointed bistoury for the internal incision; a grooved staff, and the forceps for extracting the stone; finally, scoops of various sizes; a searcher, and a pair of lithotomy tapes. It will be prudent to have in readiness, likewise, some needles and tenacula for taking up vessels, and canulæ for plugging.

The position of the patient should be one which affords a full view of the perineum, previously shaved, and which, at the same time, ensures complete fixity. The patient should be placed evenly on his back and be supported by pillows on a table of convenient height, about two feet and a half from the ground.

The use of chloroform, to which the patient should be submitted either before his removal from bed or when he has been placed on the operating table, would seem to render the employment of bands or tapes unnecessary; but it is nevertheless more prudent to bind the hands and feet firmly together. The bands should be of coarse flannel, about three yards long and three inches wide.

The forceps should be of good length, but not too heavy. As the depth of the perineum varies in different patients, and the calculus may occupy different parts of the bladder, it is necessary that the surgeon should be provided with forceps of different lengths and shapes. Mr. Liston recommends forceps without teeth, but lined on the inner surface of the blades with coarse linen. This prevents the stone from slipping, and there is less risk of chipping it. In order to reduce the weight and lessen the diameter of the instrument when a stone is grasped, Mr. Coxeter has lately made forceps with open blades.

As the use of the staff is to conduct the cutting instrument along its groove into the bladder, attention should be paid to its shape and length.

The staff should be full-sized, sufficiently long and curved to enable the point to enter fairly one inch at least beyond the neck of the bladder.

The groove of the staff should be as deep as is consistent with the solidity of the instrument. The curve should be sufficiently great to cause the convex portion of the instrument to be readily felt in the perineum without the necessity of depressing the handle, but the portion of the staff beyond the curve may be straight, or nearly so, in order to facilitate the passage of the cutting in-

strument into the bladder. The assistant entrusted with the care of the staff should hold it firmly with the handle in the vertical direction, and the plane of the instrument in the middle line. The direction of the instrument should correspond as closely as possible to the natural curve of the urethra; and there is no necessity either for pressing the convexity of the staff down on the middle line of the perineum or of directing it towards the left ischium.

Having introduced the staff, the surgeon employs it as a sound, to assure himself, once more, of the presence of stone in the bladder. The patient is then secured on the table in the manner already noticed, and the surgeon, seating himself between the patient's legs, introduces the forefinger of the left hand into the anus to ascertain that the gut is empty. The operation is now proceeded with; it consists of several acts which succeed each other in a given order, and may be described separately. These are, the external incision, the division of the membranous part of the urethra, the division of the prostate, or internal incision, and, finally, the extraction of the stone.

The first incisions are made with the object of enabling the surgeon to fix his cutting instrument (whether it be a knife or gorget) in the groove of the staff, and also of affording not only free access to the bladder but a ready exit for the stone.

It is of great importance that these incisions should be made in a proper manner.

Having fixed the staff and entrusted it to an assistant, the surgeon places the thumb and forefinger of the left hand so as to render the skin of the perineum on the left side of the *raphé tense*. In doing this he should avoid drawing the skin up too much, for if this be done, the superior angle of the wound will fall too low after the completion of the operation.

The first, or external incision comprises the skin and subjacent fatty tissues. Some operators are in the habit of cutting down on the groove of the staff with a single incision; but a more cautious method is preferable, unless in cases where the perineum is very shallow.

The direction and extent of this external incision have been varied, yet the principles according to which we should be guided are sufficiently simple. The surgeon should not commence it too high under the arch of the pubes, nor too low near the rectum; nor should he carry it too obliquely towards the ramus of the ischium. With a common scalpel an incision is made through the integuments, commencing three or four lines from the left side of the *raphé*, about an inch above the level of the anus, and continued obliquely downwards and outwards until it ceases a little below the level of the tuber ischii, midway between it and the anus.

As a general rule, the length of the first incision will depend on the size of the perineum and the presumed size of the stone; and in the adult subject it extends from three to three and a half inches.

The integuments having been divided, a few rapid touches with the scalpel now likewise divide the fat and the transverse muscles of the perineum. The index finger of the left hand is now passed into the wound at its upper angle, between the left accelerator urine and erector muscles. Any resisting tissues and the fibres of the levator ani



are cut through, so that the operator can feel the groove of the staff through the membranous portion of the urethra.

Having distinctly felt with his nail the groove of the staff, the surgeon passes the knife along this finger and the nail until the point has penetrated the membranous portion of the urethra and come into contact with the groove of the staff.

When the knife has entered the groove, the operator ascertains by a slight motion of the point, that it remains in contact with the staff. Having assured himself of this important matter, he makes a small incision of three or four lines in length into the membranous part of the urethra. Many distinguished operators complete the operation with the same knife which serves to make the first incisions; but the writer thinks it more safe to employ a button-headed bistoury, and hence the necessity of making the small incision, just mentioned, into the membranous part of the urethra.

Having made this incision, and taking care to keep the nail of the left index finger well in the groove of the staff, the surgeon abandons the knife and substitutes for it a button-headed bistoury, or straight-bladed knife armed at the extremity with a button, which prevents it from slipping out of the groove of the staff. This instrument he directs along his finger to the groove of the staff, and then fixes the button in the groove.

This done, the knife is passed steadily onwards until it reaches the end of the groove in the staff, dividing the deep fascia, the muscular fibres between its layers, a small portion of the membranous part of the urethra, the prostatic portion, and notching obliquely the left side of the prostate gland itself. In making this internal incision the handle of the bistoury must be depressed towards the lower angle of the wound, while its cutting edge is inclined outwards and downwards in the line of the external incision, the edge of the bistoury being kept in such a manner that it never deviates from the angle it would form with the ramus of the ischium. As soon as the bistoury enters the bladder a little urine commonly escapes. The instrument is now withdrawn, exactly in the direction of the external wound, after which the incisions may be considered as being completed.

During the withdrawal of the bistoury or knife no tissues are divided beyond those already cut for the purpose of entering the bladder. However, Mr. Fergusson advises, if the stone is supposed to be of considerable magnitude, that the blade should, in withdrawing it, be carried a little out of the groove so as to increase the incision of the prostate.

As a sufficient opening has now been made into the bladder, the surgeon's next business is to introduce the forceps and extract the stone.

The left index finger which has been passed into the bladder, following the knife, serves to guide the forceps and at the same time to ascertain in most cases the position or the size of the calculus. Along this finger the closed forceps, which have been warmed by immersion in tepid water, is conducted directly on the stone. The foreign body usually lies on the posterior fundus of the bladder, and hence the handle of the forceps is to be somewhat elevated, while the instrument is being opened, and one of the blades is slid underneath the calculus. The blades are

then closed gently, and the operator proceeds to extract the stone. It may for the present be assumed, that no obstacle exists to the ready extraction of the calculus. In such case the forceps are withdrawn slowly in the direction of the external wound, the instrument being moved backwards and forwards so as to dilate the parts gently, and being brought towards the lower angle of the external wound in a sweeping direction, so as to follow the axis of the pelvis. When the stone has been extracted, the bladder must be carefully examined, lest any fragment or other urinary concretion remain behind, for which purpose the searcher may be employed with advantage.

The operation of lithotomy may be considered as completed at this stage. The late Mr. Liston, whose example the surgeons of University College Hospital still follow, was in the habit of introducing a gum elastic tube through the wound into the bladder, with a view of favouring the flow of urine and preventing its infiltration; but the use of this tube has not been generally adopted, and Mr. Fergusson states that it may be dispensed with altogether.

Many modern operators, as it has been already observed, following the example of Cheselden, employ the same knife during every stage of the incisions; hence, when the external incisions have been completed by the division of the membranous portion of the urethra, the knife is not withdrawn, but its handle is slightly depressed and the blade is carried onwards until the point is stopped by the closed end of the staff in the cavity of the bladder.]

Mr. Allan, who is a strenuous advocate for using the knife instead of the gorget, directs us, after laying bare the urethra and bringing the staff so as to form a right angle with the patient's body, to feel that the instrument is fairly lodged in the bladder. The operator is to use the forefinger of his left hand as a director in feeling for the groove in the staff and in distinguishing the prostate gland, and with this finger he is to depress the rectum and direct the deeper part of his dissection. Feeling the gland with the point of the forefinger of the left hand and the groove of the staff in the upper part of the wound, the assistant is desired to steady his hand, and the operator, holding his knife as he does a writing pen, his fingers an inch and a half from the point, turns up its edge towards the staff, and strikes its point through the membranous part of the urethra into its groove, half an inch before the prostate gland. He now turns the back of the knife to the staff, slides it a little backwards and forwards in the groove, that he may be sure it has fairly entered; then shifts the forefinger with which he guides the incision, places it under the knife, and always keeps it before its point, so as to prevent the rectum from being wounded; he then lateralizes the knife, enters the substance of the prostate, is conscious of running the scalpel through its solid and fleshy substance, and judges by the finger of the extent of the incision which he now makes. The urine flows out; he slips his finger into the opening, withdraws the scalpel, and gives it to an assistant, who hands him the forceps which he passes into the bladder, using the forefinger of his left hand which is still within the wound, as a conductor. The forceps instantly encounter the staff, which serves to conduct them safely into the

bladder, while the finger guides them through the wound, &c." (*Atlas on Lithotomy*, p. 48, Edinb., 1808.)

The staff used by Mr. Liston is of large size, and deeply grooved betwixt the lateral and convex aspects. "This instrument," (he observes) "is easily felt after the first incision, and the urethra opened upon it. It is hooked against the symphysis and entrusted to an assistant, with directions to maintain the position steadily from first to last; neither to turn it so as to bulge in the perineum, nor to depress the handle as the knife enters the bladder; the surgeon's left hand is thus at liberty to guide the knife and guard important parts from danger." The knife "is then entered pretty deeply into the perineum, about an inch, more or less, behind the scrotum, and it is made to cut downwards and outwards through the skin and superficial fascia, in a line about midway between the tuberosity of the ischium and the anus, and beyond that orifice, towards the sacro ischiatic ligament.

"The forefinger of the left hand is then placed in the bottom of the wound, about its middle, and directed upwards and forwards. Any fibres of the transverse muscle, or of the levator of the anus, that offer resistance, are divided by the knife, its edge being turned downwards. The finger passes readily through the loose cellular tissue, but is resisted by the deep fascia, immediately anterior to which the groove of the staff can be felt not thickly covered." [The anatomy of this oft-quoted passage is somewhat faulty, inasmuch as the fibres of the levator ani are said to be divided before the deep fascia is reached, whereas that muscle is situated altogether beneath the deep perineal fascia.] "The point of the instrument is slipped along the nail of the finger, and, guided by it, is entered, the back still directed upwards, into the groove at this point. The finger all along is so placed as to depress and protect as much as possible the coats of the rectum; and the same knife pushed forwards is made to divide the deep fascia, the muscular fibres within its layers, a very small portion, not more than two lines, of the urethra, anterior to the apex of the prostate, together with a part of the prostatic portion of the canal, and the gland to a very limited extent." According to Mr. Liston's views, the external incision should be free, but the internal one very limited indeed, not extending beyond seven lines from the urethra downwards and outwards. The object of this is not to interfere with the reflection of the ileo vesical or pelvic fascia, from the sides of the pelvis over the base of the gland and side of the bladder. "If this natural boundary betwixt the external and internal cellular tissue is broken up, there is scarcely a possibility of preventing infiltration of urine, which must almost certainly prove fatal. The prostate and tissues around the neck of the bladder are very elastic and yielding, so that without much solution of their continuity, by a very slight incision and without the least laceration, the opening can be so dilated as to admit the forefinger readily; still further, the forceps can be introduced upon it as a guide, and removed, along with a stone of considerable dimensions, say from 3 inches to nearly 5 inches in circumference in one direction and from 4 to 6 in the largest. The finger follows the knife, which is then withdrawn, and the position and volume of the stone can be at once distinctly ascertained in

the greater number of cases." If the prostate be rigid or very large, or the patient very corpulent, Mr. Liston conceives that it may sometimes be expedient, after dividing the membranous and prostatic portions of the urethra, to dilate gently with a blunt gorget, as practised by the late Mr. Martineau, Sir B. Brodie, and Mr. Dalrymple, of Norwich. (See *Practical Surgery*, 2nd Edit. p. 441.)

Mr. Liston's use of the elastic gum tube after the operation has been already noticed. This is not now commonly employed in London, and is strongly reprobated by M. Velpeau. (*Nouv. Elém. de Méd. Opératoire*, t. iii., p. 775.)

In operating with a scalpel, one with a longish blade or handle will be found more convenient than a common one on account of the depth of the parts requiring division, especially in adults and fat subjects.

[The manner of holding the knife during the deep incision has been much discussed, especially since the death of Mr. Liston. Upon this point Mr. Erichsen remarks that, "he believes it signifies little how the handle of the instrument is held between the surgeon's fingers, provided the edge is never turned upwards, but is always kept well lateralised and the point steadily pressed into the groove of the staff. Provided a surgeon knows what he is about, he may safely hold his knife as best suits his own convenience."

Hence the knife may be held in the first position (as a pen) or with the handle of the instrument under the hand, while the index finger rests on the back or side of the blade. The latter is the position recommended by Mr. Fergusson, and the one probably adopted by Mr. Liston when his experience became matured.]

*Lithotomy with a straight Staff.*—I would next beg the attention of surgeons to the modification in the manner of performing Cheselden's operation, proposed by Mr. Key, and executed with a staff of nearly a straight form and a scalpel that has a slightly convex back near its point, in order that it may run with more facility in the groove of the staff.

[The staff used by Mr. Key was straight to within about an inch of its extremity, where it was slightly turned upwards, in order that the point might not be liable to be caught in the prostate gland, or in some accidental fold of the bladder; but the knife was never intended to be introduced so far as to reach the curved part of the instrument. The form of the ordinary staff, says Mr. Key, has always appeared to me to present the greatest difficulty in executing the operation on the true principles of lateral lithotomy. At the part where it serves the purpose of a director it is curved—a form certainly least adapted to convey a cutting instrument in safety where the eye of the operator cannot follow it—while the straight instrument, besides being, in this respect, greatly superior to the curved one, has the further great advantage of allowing the surgeon to turn the groove in any direction he may wish. Thus, before carrying the knife into the prostate, the groove which has been held downwards for the first incision may be turned in any oblique line towards the patient's left side that the operator may think preferable for the division of the prostate. Mr. Key's mode of conducting the operation was as follows: An assistant holding the staff, with the



handle somewhat inclined towards the operator, the external incision of the usual extent is made with the knife until the groove is opened, and the point of the knife rests fairly in the director; the point being then kept steadily against the groove, the operator with his left hand takes the handle of the staff, and draws it downwards, keeping his right hand fixed; then, with an easy and simultaneous movement of both hands, the groove of the director and the edge of the knife are to be turned obliquely towards the patient's left side; the knife having the proper bearing is now ready for the section of the prostate; at this time the operator should look to the exact line the director takes, in order to carry the knife safely and slowly along the groove, which may now be done without any risk of the point slipping out. The knife may then either be withdrawn along the director, or if it is thought necessary, the parts may be further dilated with it as it is being withdrawn. Having delivered the knife to an assistant, the operator takes the staff in his right hand, and, passing the forefinger of his left along the staff through the opening in the prostate, withdraws the staff, and, exchanging it for the forceps, passes the latter upon his finger into the cavity of the bladder. (*On the Section of the Prostate Gland in Lithotomy*, p. 28. London, 1824.)

Mr. James Lane is an advocate for the use of Mr. Key's straight staff, and has repeatedly operated with it in St. Mary's Hospital with success. He thinks, however, that the pattern of Mr. Key's staff is faulty in the circumstance of the groove being continued on into the curved part near the point, and in its ceasing gradually, instead of abruptly, or by a stop. It is important that the groove should terminate before the curve commences, and that it should cease abruptly, in order that there may be no danger of the knife passing beyond the groove. Without this it is quite possible, especially in an empty bladder, that the point of the knife might pass out at the end of the groove and penetrate the opposite wall of the bladder. The staff may with advantage be curved at its extremity for an inch or rather more into a form approaching that of the ordinary lithotrite; it is then well adapted for being used as a sound, and the operator has no difficulty in satisfying himself that it has been properly passed into the bladder. The difficulty in employing it as a sound, and the fear that the point may not have fairly entered the bladder, or may slip out of it during the progress of the operation, are the principal objections which have been urged against the straight staff, and by this modification of its form both these objections are removed.

During the first part of the operation the staff must be held by the assistant, not perpendicularly, as when the curved instrument is used, but inclined towards the operator at an angle of about  $45^\circ$  with the patient's body. When he has opened the urethra, the operator himself takes the handle of the staff in his left hand and depresses it still further before he commences his deep incision. By thus firmly depressing the handle, the point of the staff, and with it the prostate and neck of the bladder are raised in a corresponding degree and are lifted away from the rectum, the danger of wounding which is consequently much diminished. Still

further safety to the surrounding parts may be obtained by the operator pressing his knife firmly against the staff while he is making his incision, so as to carry both staff and prostate upwards and towards the right pubic ramus.

By having the staff in his own hand while he is using the knife, the surgeon obtains a feeling of consent and security in the movement of the two instruments which can never be obtained while one of them is in the hands of another individual. The straight staff is admirably adapted for children; but Mr. J. Lane states that he has used it with perfect facility in an adult of advanced age with a greatly enlarged prostate.

The sole objection which can be urged against the straight staff, he thinks, is that it does not afford the same support to the first incision, and the groove is not so easily exposed. The urethra is further from the surface, and the operator must therefore take care not to open it too far forwards, and in doing so to wound the bulb. A very little care and practice will enable him, by directing his knife deeply towards the apex of the prostate, at the moment of opening the urethra, to avoid this error. (*See Lancet*, Feb. 11, 1865.)

*Rectangular Staff.*—Dr. Buchanan, of Glasgow, called attention, in 1847, to the advantages of employing a staff of rectangular form, the angle being placed about three inches from the extremity of the instrument, and the part beyond the angle being deeply grooved at the side, not on the under surface. This is introduced into the urethra, and by means of the left forefinger in the rectum, the angle is made to correspond in situation with the apex of the prostate, so that the gland can be felt just beyond, between the finger and the staff; the latter being well depressed, the angle is brought near to the surface, and is readily felt in the perineum. The staff is then carefully maintained in this position by an assistant; the operator, keeping his finger still in the rectum, enters a bistoury opposite this angle of the staff, and therefore immediately in front of the anus; he holds it in his right hand with the palm upwards, the blade horizontal, and its edge directed to his right; and he pushes it straight into and along the groove as far as the stop at its extremity. He thus enters the bladder at once, taking care to keep the blade parallel with the horizontal or grooved portion of the staff throughout the whole of the thrust. Next he withdraws the bistoury slowly, and as he does so cuts outwards and downwards a distance rather more than equal to another breadth of his blade, and then directly downwards to the same extent, describing in this manner a curved line equal to about one-fourth of a circle round the upper and left side of the rectum, in which his finger still remains. The above description is quoted from Mr. H. Thompson's "Lectures on Lithotomy." It is from a French account, forwarded to Mr. Thompson by Dr. Buchanan, no English version of it having been previously published. (*See Lancet*, vol. i. 1862, p. 219.)

Mr. Hutchinson has proposed the use of a rectangular staff differing from Mr. Buchanan's in being tubular, and thus combining the catheter with the staff.

The advantages claimed for the rectangular staff are that the urethra may be opened with more precision at the point required, i.e. just in front of the prostate, and that the grooved part of the in-

strument being straight, instead of curved, the knife can be passed on into the bladder with greater facility, and with less danger of accident from its slipping out of the groove. It has, however, the disadvantage of being more difficult of introduction, and when introduced it is not readily available for the purposes of a sound in consequence of its very restrained mobility. The advantages believed by Mr. Hutchinson to be possessed by his instrument in respect of its being a catheter as well as a staff are, that as urine may be allowed to flow through it, there can never be the slightest doubt as to whether or not it is in the bladder; and that it saves the trouble of using two instruments—one to inject the bladder, and the other to cut upon.

On the subject of lithotomy accidents, Mr. Hutchinson states that he was acquainted with no less than eleven instances connected with the first step of the operation. In six cases the knife slipped out of the groove of the staff; in one case the point of the staff had not quite entered the bladder; in one case the point had passed between the urethra and the rectum; in another case the point of the staff became engaged in an old false passage; and, finally, in two cases the knife escaped from the staff, although the latter had fairly entered the bladder. (*Proceedings of Med. Chir. Soc.* 1857, vol. i. p. 41.)]

That the performance of lithotomy with a knife, when the operator has the assistance of a proper staff, cannot be very difficult, may be inferred from the fact that, under peculiar circumstances, lithotomy has been performed even without the aid of a staff at all.

In the spring of 1814, when at Oudenbosch, in Holland, I was requested by Sergeant Ryan, of the 1st Foreign Veteran Battalion, to see his little boy, about four years old, who was troubled with symptoms which made me immediately suspect that there was a stone in the bladder. As I had no sound, I introduced a small silver catheter, which distinctly struck against a calculus. Without taking the instrument out again, I determined to perform lithotomy with a common scalpel. Indeed, no other mode could be adopted, as we had neither staff, gorget, nor lithotomy instruments of any kind. After making the external part of the incision in the common way, I found that the catheter afforded me no guidance. I therefore withdrew it, and dissected deeply by the side of the prostate gland till the forefinger of my left hand passed rather beyond it. The scalpel was then plunged into the bladder behind this gland, under the guidance of my left forefinger, and with the edge turned towards the urethra. The necessary division of the prostate and neck of the bladder was then made by cutting inwards and upwards in the direction of the rest of the wound. With a small pair of ordinary dressing forceps, a calculus, rather larger than the end of the thumb, was easily extracted. This operation was performed at the Military Hospital, in the presence of Dr. Shanks, of the 56th Regiment, and several other medical officers. Not a single bad symptom ensued, although the army unexpectedly moved into the field three days afterwards, and the child travelled about for some time in a baggage cart, in an exposed and neglected state. The little boy completely recovered.

[The modern French operation with the Lithotome

caché may be now described. It is a modification of that invented by Frère Côme.

The patient being placed in the usual manner, the first incision is made with a convex bistoury, commencing at the raphé, a little above the level of the anus, and terminating at the middle point of a line drawn from the anus to the tuber ischii. The parts subjacent to the skin are now divided successively, and the index finger of the left hand is passed to the bottom of the wound until the groove of the staff is felt. The point of a straight bistoury is now directed along the nail of the finger to the groove of the staff, and when the surgeon has assured himself that it is well fixed in the groove, he applies the extremity of the left index finger lightly to the back of the bistoury, while with the right hand he raises the handle of the cutting instrument, and then depresses it so as to make it describe an arc of a circle on the point which remains immoveable.

The object of this motion is to divide a few lines of the membranous part of the urethra. The groove of the staff being now laid bare, the left index finger returns to its former position on the edge of the staff, and acts as a guide to the lithotome caché, which is introduced exactly in the same way as the bistoury. Having ascertained that the button of the lithotome is engaged in the groove of the staff, the operator now seizes this latter in his left hand and raises the handle until the concave portion is applied under the pubic arch; he then pushes the lithotome from below upwards so as to create a certain space or distance between the staff and the lower wall of the urethra; and while the instrument is being advanced, the handle of the staff is gradually lowered. In this way the lithotome is advanced until the button is arrested by the groove of the staff, which is closed near its extremity in the bladder. The lithotome is now removed from the staff, and used as a sound to determine the position of the stone while the staff is withdrawn. The operation is completed during the withdrawal of the lithotome. The surgeon presses its handle against the right pubis, taking care that the end of the lithotome projects by a couple of lines at least beyond the neck of the bladder; he then turns his instrument in such a way that the incision about to be made shall correspond exactly to the direction of the external incision; at the same time he presses the lithotome with his left hand against the pubis, to prevent any change of direction. Having, in the next place, pressed the spring and brought out the blade to the extent which he has deemed sufficient, he withdraws the lithotome in a horizontal direction. As soon as the cessation of resistance tells him that the prostate has been divided, he lowers the handle and continues to withdraw the instrument, thus completing the division of the soft parts.

The most difficult step in this operation is unquestionably the withdrawal of the lithotome. The instrument should be withdrawn in a perfectly horizontal direction: if the handle be raised, there is the risk of wounding the fundus of the bladder; if it be depressed too much, the internal incision is too small; while deviations outwards or backwards expose us to the danger of wounding the perineal arteries or the rectum.

To avoid these accidents, which, according to M. Néaton, are not very rare, Boyer recommends



that the internal incision should take a transverse direction. To effect this, instead of pressing the lithotome against the pubis, he pressed it on the lower side of the neck of the bladder, so that the blade was turned nearly outwards, and in this direction he withdrew it. (*Nélaton, Elémens de Pathol. Chir.* t. v. p. 226, 227. Paris, 1859.)]

Sabatier observes, that Frère Côme's method possesses all the advantages of the lateral operation, besides being more easy than Cheselden's plan, and most of the other modes subsequently proposed, for cutting the prostate gland and orifice of the bladder with perfect smoothness and to a sufficient extent to allow the calculus to be removed without laceration of the parts. (*Méd. Opératoire*, t. iii. p. 199.)

Several objections have been urged against the use of the lithotome caché.

1. Frère Côme made his incision too high, so that an extravasation of urine in the scrotum followed some of his operations; but the above method of operating is free from any objection of this kind.

2. Some surgical writers insist on the danger of cutting the bladder too extensively with the lithotome.

3. The arteria pudica profunda and the rectum, which some authors conceive to be endangered, must always be in absolute safety, if the edge of the knife of the lithotome be turned in the direction above recommended.

When I was in Paris in 1815, I saw Dr. Souberbielle operate very skilfully with the lithotome caché. A stone of considerable size was extracted from a gentleman, who was, I should think, not less than 70. No apprehensions were entertained of ill-success, as I understood that this operator hardly ever lost a patient.

M. Roux, when he visited England, seems not to have been informed that at the Westminster Hospital the lithotome caché had been commonly employed for many years past. It was sometimes used at Guy's Hospital by Sir A. Cooper, and it is a favourite instrument with my friend Mr. Keate.

[The lateral operation with the beaked knife, such as it has been described, is the one which the writer would recommend as the standard method. But many writers of authority recommend other methods and certain modifications, which must be described likewise.

Indeed, it will be found in practice that hardly any two operators follow the same method precisely from the beginning to the termination of the operation. Each has his own improvement or modification, the most important of which I now proceed to notice.

The length of the external incision will be modified according to the size of the perineum, and, generally speaking, extends, in the adult, from three to three and a half inches. "The line (as Mr. Thompson observes) is somewhat differently taken by different operators. Nearly all agree to commence a little to the left of the raphé, but not so in regard to the distance in front of the anus. Thus, Mr. Fergusson directs that it should commence an inch and three-quarters in front; Mr. Erichsen, an inch and a half; Sir B. Brodie, Mr. Stanley, and Mr. Skey advise an inch and a quarter; while Mr. Coulson and Dr. Keith (of Aberdeen) direct that it should com-

mence at one inch only in advance. The latter attaches considerable importance to this point, and argues in its favour at some length. Mr. Crichton made his incisions always low—I infer from his notes, at about the last-named point. It is quite clear also that Cheselden himself commenced not more than one inch in advance of the anus. The directions given by other well-known operators are not expressed in precise terms, and on this account they are not quoted." (*Lancet*, Feb. 22, 1862, p. 194.)

Now, as it appears that nearly all advise an external incision of about the same length—that is, of three inches, or thereabouts, for an adult patient—it follows that the situation of the opening relatively to the pubic arch and to the bladder must differ, and somewhat materially. This discrepancy has sometimes been the source of perplexity to the student; although it is true that, where the incisions are commenced high up the skin only is cut at first, and where they are low the knife is made to penetrate deeply at once, so that in any case the deepest part of the incision is made into the hollow between the accelerator and the erector penis muscles, just beneath and outside the bulb of the urethra. Nevertheless, I believe it is the safer practice to err (if it be an error) by placing the incision too low rather than too high.

The low incision avoids the bulb and the artery leading thereto; it enters the urethra in the membranous portion, or just at the apex of the prostate; and it places the axis of the wound in its best relation to the pubic arch—that is, as far as possible from that unyielding boundary of the perineal space. It thus affords room for removing a large stone, and lessens the chance of bruising the neck of the bladder, with its external cellular relations, in the act of extraction.

Mr. Samuel Smith, of Leeds, whose clinical observations on the subject of lithotomy will well repay perusal, introduces the left forefinger into the anus, and places the extremity of it on the apex of the prostate. He enters the knife a few lines to the left of the raphé, about three-quarters of an inch below the termination of the scrotum, aiming towards the apex of the prostate, but remembering that, although the finger is placed in the rectum touching the apex to give an indication where that is to be found, it is still placed as a sentinel on guard over the rectum. (*See Brit. Med. Journ.*, Jan. 1859.)

Mr. Skey and some other surgeons advise "the knife to be pushed straight backwards at once into the groove of the staff" (*Op. Surg.*, London, 1850, p. 550); that is to say, cutting on the groove from the skin to the urethra with a single incision; but even the most practised operator might find such a proceeding difficult; and it will be more prudent to make way by a few rapid touches of the scalpel.

Mr. Skey recommends the use of a staff with an increased convexity at the part corresponding to the perineum, to facilitate the exposure of the groove, but straight beyond the curve to the point, to facilitate the transmission of the knife onwards into the bladder. Mr. Skey holds the staff in his left hand while he is making the deep incision.

The point at which the membranous part of the urethra should be opened next requires notice. Lithotonists were formerly in the habit of making this incision much too far forwards; but since

Cheselden's time all operators, with, perhaps, the exception of Mr. Skey, are agreed that the bulbous portion of the urethra should not be divided. Mr. Skey thinks (l. c., p. 547) "that the bulb is always more or less divided;" that it is an unimportant structure, and may be cut with impunity. Yet the experience obtained in the Parisian hospitals shows that division of the bulb is one of the most frequent causes of phlebitis and the purulent infection consequent thereon.]

The best point of the urethra to open is, perhaps, as close to the anterior part of the prostate as possible. This was Mr. Liston's opinion, who says, that the knife should divide "a very small portion, not more than two lines, of the urethra anterior to the apex of the prostate." Mr. Allan directs us to enter the membranous portion about half an inch in front of the prostate; while Deschamps made his opening in such a manner as to divide eight or ten lines of the membranous canal.

[Some writers on this subject seem to over-estimate the length of the membranous part of the urethra, being probably misled by the appearance which the parts present when dissected and separated from their surrounding connexions. In fact, the available length of this portion of the canal for surgical purposes is exceedingly limited, from the way in which the bulb overlaps and conceals its under surface; consequently, unless the knife be made to enter the urethra close in front of the prostate, the bulb must almost of necessity be wounded.]

Mr. Smith, of Leeds, uses a beaked scalpel for the incision of the prostate gland. Having opened the urethra and introduced the beaked knife into the groove of the staff, he stands up, takes the handle of the staff in his left hand, and depresses it while he passes the knife onwards into the bladder. By depressing the instrument, he observes, with the beak of the scalpel pressing into the groove at an obtuse angle, it is then a *straight* staff, the curve is all in the bladder, and you have to go on in a straight line. Great part of the instrument being within the bladder, it lifts it up from the rectum, and there will be no risk of wounding it. (*Med. Journ.*, Jan. 1859.) Mr. Smith's operation, therefore, resembles that of Mr. Aston Key, in respect of his taking the staff in his left hand and using only the *straight* portion on which to make his incision. Mr. Smith, however, strongly condemns Mr. Key's operation, which it appears to us he is scarcely justified in doing, seeing that his own resembles it in two such very essential particulars. He states that four of the surgeons of the Leeds Infirmary have been in the habit of using Mr. Key's knife and staff.

It will be seen from the authorities which have been referred to in this article, that some, probably the majority, following Mr. Liston, prefer that the staff should be held steadily and firmly by the assistant throughout the operation; while others, as Mr. Skey and Mr. Smith, of Leeds, prefer to take the staff in their left hand, while they make the deep incision into the bladder. The point is one which every surgeon should settle for himself by experiments upon the dead body. Without doubt, a greater feeling of security and confidence is obtained when the operator has both instruments in his own hands; in our opinion, however, when the usual curved staff is employed, and especially

if the same knife is used throughout, it is safer that the assistant should retain the charge of the staff, in order that the surgeon may have his left forefinger free to accompany the knife in the deep incision, the better to protect the rectum from injury, and to avoid the risk of the knife slipping out of the groove of the staff. On the other hand, with the straight staff, both these risks are diminished, and he may safely avail himself of the advantage of having both instruments in his own hands.]

Many of the points now briefly noticed are likewise discussed by Mr. Cooper in the following passages:—

*A few General Remarks on the best mode of making the Incision in the Lateral Operation.*—Perhaps of all the great operations in surgery, lithotomy is that in which great awkwardness, mortifying failures, and dangerous blunders, are most frequently observed. Many a surgeon who contrives to cut off limbs, extirpate large tumors, and even tie aneurismal arteries, with élat, cannot get through the business of taking a stone out of the bladder in a safe, much less a masterly, style. This fact is so familiarly known in the profession, and its truth so often exemplified, that I may well be excused the unpleasant task of relating, in proof of it, all the disasters which have fallen under my own notice. But, I must take the liberty of remarking that, in this branch of surgery, a great number of individuals do not profit by these instructive lessons of experience. The more they see of lithotomy, the more they are convinced of its dangers; yet, too often, instead of studying the causes of ill success, they merely derive, from the examples before them, a suspicion of the unskilfulness of the operator, or some discouraging conjectures about the difficulties of the operation.

The establishment of certain principles to be observed in lithotomy, appears the most probable way of diminishing the frequency of the accidents and failures of this common operation.

After the very opposite principles, and different methods of cutting for the stone, which are explained in the preceding columns as preferred by different surgeons, I think it may be useful to offer a few general observations on the proper direction and size of the incision. These points, which are of the highest practical consequence in regulating the principles to be observed in lithotomy, are far from being settled, as must be plain to everybody who recollects that Cheselden, Desault, John Bell, Klein, Martineau, Langenbeck, &c., recommend a free opening; Scarpa, Callisen, and others, a small one; or, as Scarpa objects strongly to my calling his incision small, I will say one extending from the apex of the prostate gland to the orifice of the bladder, no part of which is divided; that Mr. Abernethy and Scarpa employ gorgets, which cut upwards and outwards, at angles of 45° and 69° from the axis of the urethra; and that the gorgets of Cruikshank, B. Bell, Desault, Mr. Cline, and most other surgeons, are intended to cut either directly outwards, or outwards and downwards.

The incision through the whole of the parts cut in lithotomy should always be made in a straight, regular, direct manner, from the surface of the skin in the perineum to the termination of the wound in the urethra and bladder. In an



adult subject, the external wound should commence about an inch above the anus. The propriety of beginning it higher up has been duly insisted upon by Sharp, Brandi, Callisen, and every good writer on the operation. "Il ne faut couper l'urèthre que le moins qu'on peut, parcequ'on obtient par ce moyen une meilleure voie pour pénétrer dans la vessie sous l'angle du pubis. C'est avec raison que Sharp dit que l'incision de l'urèthre faite au-dessus de cet angle est si peu utile pour l'extraction de la pierre, qu'on n'en retireroit pas plus d'avantage en le coupant presque dans toute sa longueur." (*Brandi, Traité des Opérations*, p. 127.) And Callisen lays it down as a maxim: "Ut eæ partes hand sectione attingantur, quæ pro calculi egressu nihil faciunt; adeoque bulbis urethrae, et hujus pars corpore spongioso circumdata intacta relinquantur." (*Systema Chirurgiae Hodiernæ, pars posterior*, p. 565.)

Extraordinary as it may seem, it is not the less true that cutting too much of the urethra is one of the most common faults still committed by modern surgeons. The incision in the integuments is to be large, that is to say, at least three inches in length in an adult subject; because a free opening in the skin is not only exempt from danger, but attended with many advantages, especially those of facilitating the other steps of the operation, and preventing any future lodgment and effusion of urine. The external wound ought to be directed towards a point situated a little way towards the anus from the innermost part of the tuberosity of the ischium, or, as Mr. Stanley recommends, about one-third from it and two-thirds from the anus. From the line thus made, the incision should be carried inward and upward, through all the parts between it and the side of the prostate gland. Another line, extending from the inferior angle of the wound to the termination of the cut in the neck of the bladder, forms the precise limits to which the depth of the incisions should reach, and no further.

The great principle of making the axis of the wound as straight and direct as possible should always be kept in view, whether the surgeon employ a common scalpel, which cuts into the bladder from without inwards, or other instruments, which divide the prostate gland and the neck of the bladder from within outwards, like the bistouri caché, beaked knives, &c.

The following may be enumerated as important advantages of attending to the foregoing principle:—

1. The wound is made in that direction which affords the greatest room for the extraction of large stones; and the axis of the incision being also as nearly straight as possible, the introduction of forceps, and the passage of the calculus outward, are materially facilitated.

That these are important advantages, I think every surgeon will allow, who knows how much the pain and danger of lithotomy depend upon the injury which the parts suffer from the force sometimes used in the extraction of the stone and the repeated introduction of the forceps. Cheselden, one of the most successful lithotomists England ever produced, made the incision nearly as here recommended. The following remarks merit particular attention:—"J'ai vu plusieurs fois, dans les hôpitaux de Paris, que les chirurgiens, coupant trop en haut vers l'angle du pubis, sentoient une

grande résistance au périnée, quand ils vouloient retirer le calcul avec les tenettes; on voyoit le périnée se tuméfier par la pression qu'y faisoit la pierre; en ce cas, quelques opérateurs plus sages abandonnoient la pierre, introduisoient de nouveau le gorgeret, et en tournant en dessous la cannelure de celui-ci, prolongeoient l'incision obliquement vers la tubérosité de l'os ischion; et enfin, à la faveur de cette plus grande ouverture, retiroient la pierre sans causer de déchiremens." (*Brandi, Traité des Opérations*, p. 133.) Larger stones may likewise be thus extracted, without being broken, than in any other mode of making the lateral incision, as must be obvious to every practitioner who recollects the very limited room afforded at the upper part of the triangular space, between the arch of the pubis, the ramus of the ischium, and the neck of the bladder. This consideration cannot fail to have great weight with all surgeons who feel duly convinced how unsatisfactory a method it is to break a calculus in order to get it out of the bladder. The measures necessary for the removal of all the fragments protract the completion of the operation, and seriously increase its danger, while the continuance of a single part of the stone behind may cause a renewal of all the grievances for the cure of which the patient submitted to the operation. By these remarks, however, I am far from meaning to say that large calculi should not be broken; on the contrary, my only wish is that the necessity for the practice may be avoided as much as possible by making a free incision into the bladder, and even enlarging the opening, if necessary, as far as can be done with safety. In short, instead of breaking the stone, I prefer the practice of the late Mr. Martineau, of Norwich, perhaps the most successful lithotomist that ever lived, as out of 84 patients whom he cut, two only died; a statement highly favourable to operating with a knife, and to making an adequate opening. "Should the stone be large, or there be any difficulty in the extraction, rather than use much force, while the forceps have a firm hold upon the stone," says Mr. Martineau, "I give the handles to the assistant, who is to draw them outwards and upwards, while the part forming the stricture is cut; which is easily done, as the broad part of the blade becomes a director to the knife; and rather than lacerate, I have often repeated this enlargement of the inner wound two or three times." (*See Med. Chir. Trans.* vol. xi. p. 411.) The great advantage of the knife over the gorget, and even the necessity of employing it to adapt the size of the opening in the bladder to the magnitude of the stone, or its fragments, are most convincingly exemplified in several cases recently put upon record. Thus Klein, with the aid of a common scalpel, extracted a calculus which weighed twelve ounces thirty grains, and the patient recovered (*Pract. Ansichten Bedeutendsten Operationen*, h. 1.) In 1818, Mr. Mayo, of Winchester, operated with a knife, and extracted a calculus, which broke in the forceps, weighing fourteen ounces two drachms avoirdupois, and the patient recovered. (*See Med. Chir. Trans.* vol. xi. p. 54, &c.) Mr. W. B. Dickenson, of Macclesfield, also succeeded, with Mr. Gibson's knife, in taking out of the bladder a calculus, the fragments of which weighed eight and a half ounces, and the patient was saved. (*Vol. cit.* p. 61.) And in the same volume may be seen other instances in which immense calculi

were removed from the bladder with various results, but particularly one which weighed sixteen ounces, and which Sir A. Cooper could not succeed in breaking; he was therefore obliged to enlarge the wound first made with the gorget, "to the sacro-sciatic ligament," when, with the aid of a hook applied to the fore part of the stone behind the pubes, and the simultaneous assistance of the forceps, he succeeded, with considerable difficulty, in removing the immense mass. The patient lived, however, only four hours after the operation. (See *Med. Chir. Trans.* vol. xi. p. 73.)

2. The arteria pudica profunda can never be injured, because the surgeon does not let the knife or gorget approach nearer to the ischium than a point which is situated some way from the tuberosity of that bone towards the anus; and consequently the edge of the instrument cannot come into contact with the inside of the tuberosity and ramus of the ischium, where the great pudic artery is situated.

3. The rectum will not be wounded, because the direction of the axis of the incision, downwards and outwards to the above-mentioned point, sufficiently removes the edge of the knife or gorget from the intestine. But the rectum will be in still greater safety if it be pressed downwards with the forefinger of the left hand in the wound, and the prudent plan of emptying it, by means of a clyster, a short time before the operation, be not omitted; for no lithotomist should ever forget that when this bowel is considerably distended with fæces it rises up a little way on each side of the prostate gland.

4. As the seminal duct penetrates the lower part of the substance of the prostate gland, in order to reach the verumontanum, and the knife or other instrument employed divides the side of that gland obliquely, outwards and downwards, the duct will not be in danger of being cut.

The judicious Callisen is well aware of the advantages of making a smooth, even, direct incision into the bladder;\* but, like Scarpa, Dupuytren, Brodie, Stanley, Liston, and others, he is averse to extending the cut through the neck of that viscus. Indeed, as we shall presently notice, Scarpa does not sanction cutting any portion of the bladder whatever.

Every practitioner who will take the trouble to look over the history of the lateral operation, will find that the greater number of lithotomists who have particularly distinguished themselves by their unparalleled success, as Frère Jacques, Cheselden, Côme, Martineau, Souberbielle, &c., made a free incision in the bladder. This fact alone is enough to raise doubts of the goodness of the advice delivered upon this subject by Callisen and Scarpa; especially as neither they, nor any other modern surgeon (with the exception, perhaps, of Pajola, whose individual skill is said by Langenbeck to make amends for the disadvantages of his method), can boast of having cut patients for the stone with a degree of success at all equal to that of the above-mentioned operators. The extraordinary success which characterised Cheselden's practice, we have

already detailed. The accounts of the successful operations performed by Frères Jacques and Côme, are equally remarkable.

Mr. Martineau, as I have noticed, lost but two patients out of eighty-four on whom he operated, and this without making a selection, as he never rejected any case. His patients were always kept a week in the house before they were operated upon; and this precaution, with a regulated diet, and, perhaps, a dose or two of opening medicine, was the only preparatory treatment. (*Med. Chir. Trans.* vol. xi. p. 409.)

During my stay at Paris, in 1815, I saw Dr. Souberbielle extract a stone of considerable size, on the plan of his well-known ancestor. The incision was ample and direct, so that the calculus was taken out with perfect ease. Now, as the operations of this professed lithotomist are very numerous, and he enjoys the reputation of scarcely ever losing a patient, are we not justified in inferring that the advocates for a small opening are promulgating the worst advice which can be offered to the practitioner? My own observations certainly tend to such a conclusion, as will be presently explained. The tract published by Scarpa (*Memoir on the Cutting Gorget of Hawkins*, &c., trans. by Wislart), has for its main objects the recommendation of a modification of Hawkins's gorget, and the inculcation of the propriety of making a limited incision in the prostate gland, without cutting any part of the bladder. As sufficient room cannot thus be obtained for the extraction of even a stone of moderate size, he is an advocate for the gradual dilatation of the urethra and orifice of the bladder. He observes that the lateral operation, though executed with the greatest precision, does not exempt the surgeon from dilating, in a certain degree, the orifice of the bladder and cervix of the urethra; the dilatation of those parts, however moderate, being always necessary, even where the calculus is of middling size. He states that, in the adult, the orifice of the bladder dilates almost spontaneously to the diameter of five lines; and he adds that the lateral incision, within proper limits, divides the body and base of the prostate gland to the depth of four, or, at most, five lines, forming, with the five to which the orifice of the bladder naturally yields, an aperture of ten lines. But, says Scarpa, in an adult a stone of ordinary size and oval figure is sixteen lines in the small diameter, to which must be added the thickness of the blades of the forceps; consequently, even after the incision has been made with the most scrupulous exactness, the stone, though of moderate size, cannot pass out of the bladder unless the dilatation of the base of the gland and orifice of the bladder be carried to the extent of nearly eight lines, beyond the size of the aperture made with the knife. But, adds Scarpa, if, in order to avoid distending the parts to the extent of eight lines, the base of the prostate gland, together with the orifice of the bladder and a part of its fundus, be divided to a depth equivalent to it, the event would necessarily be an effusion of urine into the cellular membrane, between the rectum and bladder, and consequently suppuration, gangrene, fistulæ, and other serious evils. (pp. 4, 5.)

According to Scarpa, the apex of the prostate gland forms the greatest resistance to the introduction of the forceps and the extraction of the stone,

\* *Vulnus sit æquale, haud angulatum, cornicæ figuræ, apice vesicam respiciente, externa plaga ampla, et quatuor pollicum longitudine, unde effluxus sanguinis, puris, lotii, arenæ, facilitatur.* (See *Systema Chirurgiæ Hodiernæ, pars posterior*, p. 656, Hafnia, 1800.)



and therefore ought to be completely divided, (p. 7); but he contends that two, and sometimes three lines of the substance of the base of the gland should be left undivided; which, he asserts, is a matter of great importance, because the untouched portion around the orifice of the bladder prevents effusion of urine and the formation of gangrene or fistulæ between that part and the rectum. (p. 22.)

After this statement of one of the great principles which Scarpa wishes to be observed in the performance of the lateral operation, a question or two naturally arises. Are we then to conclude that the plan of making a free and direct incision into the bladder ought to be abandoned?

We have seen that an apprehension of effusion of urine, gangrene, fistulæ, &c., is the only reason assigned by Scarpa for his aversion to making a complete division of the side of the prostate gland and orifice of the bladder. But, I would inquire, do we find extravasation of urine between the rectum and the bladder, and gangrene, and fistulæ, so frequent after lithotomy in England, as to render it probable that these ill consequences can ever proceed from our usual mode of dividing completely, not only the side of the prostate gland, but also the adjoining part of the bladder? Are such bad effects so often experienced in this country as to constitute a material source of uneasiness in the mind of a surgeon about to undertake lithotomy? Do they form a substantial reason for abandoning the maxim of always endeavouring, as far as circumstances will allow, to make an incision of sufficient size for the easy removal of the calculus? And would not Scarpa's method of stretching and dilating the wound, in order to get the stone out of the bladder, often dangerously prolong the operation, lead to much mischief from the repeated use of the forceps, cause serious contusion and laceration of the parts, and, for all these reasons, render inflammation of the bladder and peritoneum very likely to follow?

I have seen the lateral operation performed an immense number of times, either with various kinds of gorgets, beaked knives, the lithotome caché, or common scalpels. In most of these examples the avowed intention of the surgeon was to make a free opening into the bladder. I do not mean, however, to say that this was always actually accomplished, since the bad construction of the instruments employed, and other causes, sometimes frustrated the wise design of the operator. But what was the consequence? Generally speaking, those surgeons who made only a small incision into the bladder, and kept their patients a long while upon the operating table ere they succeeded in getting out the stone, by the repeated and forcible use of the forceps, had the mortification to see very few of their patients recover, a large proportion of them being carried off by peritonitis on the third or fourth day after the operation.

On the contrary, when the incision was ample and direct, so that the calculus could be easily and gently removed, the patients were almost always saved.

For the first six or seven years of the long time during which I enjoyed frequent opportunities of seeing lithotomy performed in St. Bartholomew's Hospital, gorgets were invariably used, most of which made an insufficient opening. The consequence was that many of the patients were de-

tained a long while upon the operating table before the stone could be extracted; and some considerable numbers were lost by peritonitis. Afterwards, however, in the same institution, common scalpels and beaked knives were generally used; a freer opening was mostly made; and the proportion of deaths from peritonitis was strikingly lessened.

The following observation, made by Mr. Martineau, is also worthy of particular attention:—"In the first years of my practice," says he, "I was not very successful; and often witnessing many untoward circumstances in myself and others, which appeared to arise from the use of the cutting gorget, I determined to lay that instrument aside, and employ the knife only, and the blunt gorget as a conductor for the forceps." (*Med. Chir. Trans.* p. 405.)

Now, when we remember that this gentleman lost only two out of eighty-four patients on whom he operated, his remarks are of great importance; and his cases, and the other facts, which I have specified, strongly impress my mind with the truth of all that I have urged respecting the advantages of making a free opening, and in the best direction for the easy passage of the stone outward.

In Mr. Martineau's manner of operating, it is true he does not make the external wound parallel to that in the bladder, as I venture to recommend, but directs it nearly in a line with the raphe, a circumstance which may, perhaps, account for his continuing the use of the blunt gorget as a conductor for the forceps. Neither is his internal incision carried downwards and outwards, as Bertrandi, Desault, and many other judicious surgeons, consider most advantageous. But these defects (if I may presume to call them so) are rendered of less consequence by the rule, which Mr. Martineau observes, of making his first incisions long and deep, and avoiding all stretching and laceration of the parts. Like Langenbeck, he uses a staff, the groove of which is much wider and deeper than usual, and therefore more easily felt. This instrument his assistant holds, in the way preferred by Scarpa, and nearly in an upright straight direction." After the first incision (says Mr. Martineau), I look if the staff is not altered in its situation, and then, feeling for the groove, I introduce the point of the knife into it, as low down as I can, and cut the membranous part of the urethra, continuing my knife through the prostate into the bladder, when, instead of enlarging the wound downwards, and endangering the rectum, I turn the edge of the blade towards the ischium, and make a lateral enlargement of the wound in withdrawing the knife." (*See Med. Chir. Trans.* vol. xi. p. 409.) This description is particularly interesting, as coming from a gentleman who had so much experience and success.

With respect to the degree of importance which ought to be attached to the fear of effusion of urine between the bladder and rectum, gangrene, fistulæ, &c., I believe that they are inconveniences which are not commonly observed after lithotomy in this country. In two or three instances only I have known the urine come through the wound longer than usual, and these cases ended well. As for the extravasation of urine and sloughing, I shall merely remark, that although there cannot be a doubt of their occasional occurrence, they have not taken place after any of the numerous opera-

tions with the results of which I have been acquainted.

All these considerations, therefore, incline me to doubt whether the apprehension of effusion of urine, fistulæ, &c., be sufficiently well-founded to make it advisable for surgeons to relinquish the plan of making a complete division of the side of the prostate gland, and a limited one in the neck of the bladder. Nor is it at all clear to my mind that effusion of urine and sloughing are likely to be the effect of practising a free opening. Indeed, whenever they do happen, I believe they proceed from a totally different cause, viz. from the incision in the skin being too small and too high up, and from the axis of the internal part of the incision not corresponding with that of the external wound. Hence the urine does not readily find its way outward, and some of it passes into the neighbouring cellular membrane. (See *Ouvres Chir. de Desault*, t. ii. p. 460, 461.)

I regret that the observations, published by me, relative to Scarpa's method of performing lithotomy, should not have seemed to him a fair account of the subject, and that he should have deemed it necessary to declare my statement of his incision being too small, and inadequate to the passage of any but calculi under the middling size, manifestly false (*Opuscoli di Chirurgia*, vol. i. p. 62). He supposes that Cheselden, Frère Jacques, and Côme, in their successful operations, made the limited kind of incision which he himself recommends, and did not cut the bladder itself—a position that does not appear to me correct. He asserts that after the side of the prostate gland is divided, the orifice of the bladder is capable of yielding so as to allow the stone to pass out without danger, if this part of the operation be done slowly and gradually; and he supports his declaration on this point by a reference to the safety with which the orifice of the female bladder is dilated for the extraction of calculi of considerable size—a case hardly presenting an analogy;—first, because there is no wound made whatever; and, secondly, because lithotomy itself, in women, is a safe measure compared with what it is in men. The frequent evils of dilating the orifice of the female bladder, however, he frankly acknowledges in another part of his writings, and enumerates as the ground of his disapprobation of the practice. (See *Opuscoli*, &c., vol. i. p. 105.) It does not appear to me that Scarpa's gorget can make the division of the prostate in a direction corresponding to that of the external parts. This view, he thinks, is not founded on correct principles; and he maintains that his incision in the prostate does correspond to the outer wound, because, when the bladder is empty, the prostate is naturally placed in a line sloping from the arch of the pubes to the coccyx, and with its posterior surface resting on the rectum, as is represented in *Camper's Demonstr. Anat. Pathol.* lib. ii. tab. 3, fig. 2. This explanation is not satisfactory to myself; but I have great pleasure in mentioning it, as it has appeared to Scarpa to amount to a refutation of my observation that his gorget does not make a division of the prostatic portion of the urethra in a direction corresponding to the axis of the wound of the external parts. (*Opuscoli di Chirurgia*, vol. i. p. 52.)

From conversations which I have had with Sir Astley Cooper, I know that he also regards the chances of effusion of urine from a free incision

as much less than apprehended by several practitioners whose opinions on this point have been already cited. But as, in addition to the names of Le Cat and Scarpa, those of Dupuytren, Sir B. Brodie, Stanley, and Liston, may now be quoted in favour of the plan of not cutting beyond the base of the prostate gland, so as to avoid dividing the fascia interposed between the pelvic cellular tissue and that more superficially situated, I admit that this is a point in surgery needing further careful investigation. It can only be settled by a fair comparison of the results of operations conducted on the two opposite principles—by ascertaining the causes of death in a fair number of instances, and, in particular, by observing in the various dissections the real extent of the wound; because I have some reason to suspect that some persons who advocate a small internal incision, in truth often make a free one. Sir Benjamin Brodie's observations upon this and all other points of surgery, however, I entertain great respect for; and he assures us, that all that he has been able to observe for many years past has confirmed him in the opinion, that an incision in the prostate, extending into the loose cellular texture surrounding the neck of the bladder, is replete with danger. The peritoneal inflammation noticed in fatal cases, he observes, is evidently not the primary disease; it is the inflammation and sloughing of the cellular membrane of the pelvis, which has induced inflammation of the adjoining portion of that membrane. (*On Diseases of the Urinary Organs*, p. 291.)

Thus, while some operators, like Klein, Martineau, &c., refer their extraordinary success as lithotomists to the plan of making a free opening, others ascribe a principal source of danger to this very method of proceeding.

[From the preceding observations, it would appear that the late author recommends the practice of making the internal incision free—that is, “a complete division of the side of the prostate gland, and a limited one in the neck of the bladder.” He also assures us that “he had seen the lateral operation performed an immense number of times,” and that “in most of these examples the avowed intention of the surgeon was to make a free opening into the bladder.”

This may have been true at the time when Mr. Cooper wrote, but it certainly does not represent the opinion of the best operators at the present day. It is now almost invariably admitted that the only safe principles to be adopted are those of moderate incision and gentle dilatation of the parts incised.

The inventor of the lateral method, the great Franco, was the first who understood the advantages of a moderate internal incision. “The smaller the incision (says Franco) the better, provided the stone can pass through it; but, on the other hand, it must not be too small, so as to give rise to much violence in the extraction of the stone. Bref, il est requis de tenir médiocrité.”

Another great surgeon, Scarpa, has been the principal advocate of moderate internal incisions, and he has been followed in this advice by Sir Astley Cooper and Sir B. Brodie, by Dupuytren, Callisen, the late Mr. Crosse of Norwich, Mr. Liston, and by most lithotomists of the present day.

In the standard work of Dr. Gross on the *Urinary Organs*, I find it stated that the prac-



ice of American surgeons is in strict conformity with the same principle. "The wound," says Professor Gross, "should in no instance extend entirely through the lateral lobe of the prostate gland, on account of the danger of urinary infiltration."

The opinion of Mr. Liston has been already given by Mr. Cooper. Mr. Fergusson states his belief "that in a large majority of cases the opening in the deep part of the perineum and neck of the bladder need not at first be larger than what the forefinger will stop," and assures us, "that he has never experienced any remarkable difficulty in extracting stones weighing four ounces without the necessity of cutting beyond the prostate. (*Pract. Surgery*, p. 618.)

Mr. Erichsen, likewise, insists on the propriety of the operator dividing the prostate "to a very limited extent" (l. c. p. 999). If the operator takes care to push the knife in with the point well pressed against the groove of the staff, and the blade forming but a limited angle with the shaft of the staff; and especially in withdrawing it that it be brought back carefully over the finger and still in contact with the instrument, there will be no danger of cutting too widely, or of doing more than merely notching the apex of the prostate.

In addition to the prostate, however, Mr. Erichsen, and particularly Mr. Syme, speak of a peculiar tissue about the neck of the bladder which must likewise be divided.

The tissue was described by Mr. Tyrrell as "an elastic ring" surrounding the neck of the bladder. Its influence as an impediment, when undivided, to the safe extraction of even a small stone, was insisted on by Mr. Syme as far back as the year 1844 (*Edinb. Journal of Med. Science*, August, 1844), and more recently in the *Lancet* (May 19, 1855, p. 504).

"At the base of the prostate, where it joins the neck of the bladder, there is a dense texture forming a sort of ring around the urethra; it is thickest immediately under the mucous membrane, whence it gradually tapers away. There can be no doubt that if this texture be torn the patient will die; if it be extensively lacerated, death will probably occur within two days; and if the injury be of less extent, chronic inflammation will be set up about the neck of the bladder, leading with no less certainty to a fatal termination." Hence Mr. Syme recommends that "the prostate be divided as far into its substance as the ring extends, whereon the rest of the gland tears very readily and without any bad consequence; the muscular fibres of the neck of the bladder separate from each other, and the mucous membrane also yields to the dilating force, so that sufficient space can be obtained without difficulty for the extraction of any stone which the outlet of the pelvis will admit." If the forefinger can be readily passed through the neck of the bladder, the incision has been sufficient; but if (continues Mr. Syme), "on introducing the finger to dilate the deep part of the incision, you feel that you have not cut enough, pass a straight probe-pointed bistoury along your finger, and by a gentle sawing motion carry the incision on to the extent that you find necessary in order to enable you to dilate with facility."

Mr. Liston also directs attention to this texture as a part which it is indispensable to cut.

"If that is effected, the dilatation can be carried to any required extent. The two white triangular spaces at the base of the gland in front and behind show a section of the dense, unyielding, fibrous tissue into which the muscular fibres are inserted; this band effectually prevents dilatation or enlargement of the orifice of the bladder beyond a certain and very limited extent, without laceration, dreadful suffering, and imminent danger." (*Pract. Surg.* Ed. 4.)

That the circular fibres surrounding the vesical orifice of the urethra offer, if undivided, considerable resistance to the passage of the finger, every surgeon of experience in lithotomy must be well aware, and few will question the advantage of a moderate division of the textures at this particular spot. At the same time, it is impossible to pass over without comment the singular statement of Mr. Syme, that if the ring at the neck of the bladder be torn, the patient will certainly die. There is no reliable evidence that such is the case, while there is ample proof to the contrary in the results of Allarton's operation, which has been so frequently performed of late years, and has been so highly extolled by its advocates on the ground, principally, of its alleged greater safety. In that proceeding the neck of the bladder is forcibly dilated by the finger or by some dilating instrument, and more or less laceration must inevitably take place in the great majority, if not in all cases. The experience of this operation affords conclusive evidence that dilatation and laceration of the neck of the bladder is not necessarily followed by any serious or even noticeably untoward results. It is quite another question, however, whether dilatation is preferable to incision, and whether Allarton's method is likely to be generally accepted as superior to the lateral operation.

Mr. Erichsen is of opinion that the division of the ring of tissue now alluded to, is always effected in the act of pushing the scalpel inwards into the bladder.

A moderate internal incision, then, followed by free dilatation, is the principle adopted for the extraction of the stone by the best operators of the present day. But the student in surgery will naturally ask what is to be considered as a moderate incision? while, on the other hand, the great variety of instruments employed during this part of the operation shows the numerous attempts made to supply by mechanical contrivances the want of tact, or to assist the operator in attaining a degree of safety and certainty which long practice alone is supposed to give.

The proper incision, according to the writer, is one by which a small portion of the apex only of the prostate is completely divided, the greater part of the body, and especially the capsule, being untouched. After notching the apex of the prostate, the knife, as it passes on, incises the floor of the prostatic portion of the urethra on the left side of the verumontanum, and penetrates slightly into the substance of the gland in an oblique direction; while at the moment of entering the bladder, it also divides the fibres which have been above alluded to as encircling the neck of the organ. An incision of this kind, followed by dilatation, will give exit to calculi under one inch and a half in diameter. For larger calculi, a modification of the lateral method should be adopted. It must be confessed, however, that the surgeon, while making

the deep incision, is working in the dark; he cannot see what parts he is cutting, and hence the attempts which have been made to compensate this disadvantage by the construction of various instruments. The principles on which these have been constructed are clearly defined by Mr. Thompson in his *Lettsomian Lectures*. With some of them—the bistouri caché, for example—the depth of the incision depends on the breadth of the instrument—that is to say, on the extent to which the blades may have been separated by the surgeon before he begins to cut with it. In the other class of instruments, as the knife or probe-pointed bistoury, the depth of the internal incision depends on the angle which it makes with the staff, when pushed through the prostate and withdrawn; some influence will also be exercised by the breadth of the blade itself.

“Now, with respect to the choice, (says Mr. Thompson) which may be exercised among these methods of making the last incisions, there is a certain ease and simplicity in the use of a single knife, the sharp-pointed scalpel, which has commended it greatly to modern surgeons; and unless there are some exceptional circumstances present, it must be admitted to be both a safe and convenient instrument. But, on the other hand, there are circumstances, and not unfrequent ones, in which the probe-pointed knife is, I believe, superior. When the stone is large, and the deep incision must therefore correspond, the latter is a safer instrument for making it, since the point leaves the staff in that act.”

“When the perineum is deep, as in very stout subjects, and in those with enlarged prostate, so that the finger cannot follow the knife into the bladder, I certainly prefer the probe-pointed knife for the last incision, as well as the blunt gorget to dilate it and conduct the forceps into the bladder. I adopted this method with advantage in the case of a gentleman, aged 69, in November last, whose prostate was unusually large. I incised it with a probe-pointed knife, and, finding myself wholly unable to reach the bladder with the finger, I passed the blunt gorget steadily onwards in the groove of the staff, and then the forceps in its hollow, when I at once encountered and withdrew the stone without difficulty. The patient made a good recovery.” (*Lancet*, vol. 1, 1862, p. 217.)]

*Obstacles to the performance of Lithotomy.*—The most important obstacles to the successful performance of lithotomy are those connected with the extraction of the calculus. They may arise from certain conditions of the organs, or may depend on the nature, position, and size of the calculus.

Sometimes the extraction of the stone is attended with difficulty, owing to the operator having chanced to grasp it in a transverse position, in which circumstance it is better to try to change its direction, or let it go altogether, and take hold of it in another manner. When the stone is so large that it cannot be extracted from the wound without violence and laceration, the surgeon may either break the stone, by means of a strong pair of forceps, with teeth, constructed for the purpose, or with Earle's or Jameson's instrument (see *American Med. Recorder*, vol. 8), or he may enlarge the wound with a probe-pointed crooked bistoury, introduced under the guidance of the forefinger

of the left hand. The latter plan is generally the better of the two.

Sir Benjamin Brodie does not admit the expediency of dilating the wound of the prostate, except where only one side of it has been divided in the first instance, for he sometimes employs a beaked knife, which divides both sides of it; but when the stone is above a certain size, and the division of one side of the prostate is not sufficient, he introduces a straight probe-pointed bistoury, and makes an incision in the right side of the prostate. (*On Dis. of the Urinary Organs*, p. 284.) And Mr. Stanley considers this plan preferable to extending the incision in the left side, at the risk of cutting the coats of the bladder beyond its neck, which he agrees with Scarpa, Sir B. Brodie, Mr. Liston, and some others, in believing would occasion danger of infiltration of urine into the pelvis. (*On the Lateral Operation*, p. 14.) Whatever foundation there may be for this apprehension, however, I see no risk of wounding the pudendal artery or the ureter, if the surgeon cut, as he ought always to do, in the direction obliquely downwards and outwards, parallel to the ramus of the ischium, as Mr. Stanley judiciously recommends.

“In the case of an unusually large stone,” says this gentleman, “it is better to determine upon the incision of both sides of the prostate, whereby an increase of space will be obtained, which is to be measured, not merely by the extent of the incision, but by the greater facility with which the neck of the bladder will then yield to the pressure of the forceps, than when one side of the prostate only has been divided.” (*Op. cit.* p. 17.) This object may be accomplished with a double-edged gorget, a broad double-edged beaked knife, or Dupuytren's double bistoire caché, or by dividing the two sides of the gland in succession, with the knife altogether or with the gorget followed by the latter instrument. Mr. Stanley deems the division of one side of the prostate gland generally sufficient, and he quotes two cases where calculi of large size had been extracted, though, after death, the side of that gland was found not to have been completely divided. He does not mention, however, whether the operations were easy, or whether the patients were kept long on the table, or died of the consequences of the diminutive opening and violence done to the parts. When the calculus is too ample to admit of being safely extracted, he agrees with other surgeons in the prudence of breaking it (p. 17). He does not give an exclusive preference either to the gorget or the knife. For a young subject or a thin adult, the knife seems to him advantageous; but for a very fat or an old subject, in whom, by an enlargement of the prostate or a dilatation of the rectum, the bladder is raised much above its natural situation, he considers the gorget better adapted (p. 19). When the bladder is much contracted he uses a sound, the curve of which is short, being the segment of a small circle. The point of such an instrument can be moved freely, so as to touch every part of the inside of the bladder, and, when directed downwards, it can touch a stone situated below and behind the prostate. The part of the staff along which the beak of the knife or gorget passes, he recommends to be very little curved, whereby the introduction of the knife or gorget will be rendered more easy (p. 20). In imitation of Desault, he prefers a gorget, the handle of which is in the same line



with its blade. His favourite gorget is double-edged, the edges being turned downwards at an angle of  $45^\circ$ , and when used its beak is so placed that two-thirds of the incision of the prostate will be through its left side.

However, as nothing can justify the exertion of great force in pulling out a stone, if the operator should be afraid of making the wound more ample (it being already large and direct), he must break the stone, as above described. As many of the fragments are then to be extracted with the common lithotomy forceps as can be taken away by this method, after which the surgeon should introduce his finger, in order to feel whether any pieces of the stone still remain behind. Perhaps some of these may be most conveniently taken out with the scoop; but if they are very small it is best to inject lukewarm water with moderate force into the wound, for the purpose of washing them out.

[There are many strong objections to this ancient mode of reducing large calculi to fragments. It is an operation of lithotripsy performed under most unfavourable circumstances. When the calculus is very large, and the bladder hypertrophied or strongly contracted on the foreign body, it is nearly, if not quite, as difficult to seize the foreign body with the forceps passed through the prostate, as with the lithotrite introduced through the urethra; and the manipulations are just as likely to excite inflammation of the bladder in the one case as in the other. The necessity of a frequent introduction of the forceps is also a strong objection; as is likewise the possibility of relapse from retained fragments—an accident much more likely to occur than when the lithotrite is employed, because the forceps can never reduce a hard stone into fine fragments.]

The plan which the writer recommends is the following:—After the division of the left portion of the prostate and the withdrawal of the staff, he introduces the left forefinger as far as he can into the wound, carries along it the button-headed bistoury, and divides the right side of the gland in the same manner as the left. He has had recourse to this proceeding in two cases of large calculi with favourable results.]

An occasional embarrassment is the circumstance of stones in the bladder not being always free and detached; some are tightly embraced by its coats, others are partly engaged in the ureters: they are sometimes fixed in the neck of the bladder, and are not unfrequently found lodged in sacculi accidentally formed. These cysts are of different sizes: some are small, and exist in a considerable number; some are deeper, with an orifice smaller than their base. They appear to be formed by a prolongation of the internal coat of the bladder; other sacculi are occasionally found, which seem to be composed of all the tunics of the bladder, and they are sometimes of such magnitude that the bladder appears as if it were divided into two or more cavities of nearly equal size. Stones found in these sacculi sometimes present depressions and irregularities in which fungi of the bladder have been received. When this happens, a portion of such fungous productions is often extracted with the stone; a circumstance that has deceived some practitioners, and led them to suppose that the calculi actually adhered to the coat of the bladder. (See *Desault's Parisian Chir. Journ.* vol. ii. pp. 386, 387.)

The extraction of encysted stones requires different modes of proceeding from those which have been related. Littre conceived that they might be removed in two ways. When they made only an inconsiderable projection into the bladder, he recommended the introduction of a probe, with which the membrane covering the calculus was to be rubbed, a finger being put into the rectum in order to keep it down, and facilitate the action of the probe in opening the cyst. When the calculi were very prominent, Littre recommended taking hold of them with a pair of forceps, and contusing and breaking the membranous pouch with the points and asperities upon the inside of the blades of the instrument. He conceived that suppuration would then destroy the internal parietes of the cyst, and that the stone would fall into the bladder and admit of being easily extracted. As Sabatier observes, it is plain that this theory, which is founded on the idea entertained by Littre of the manner in which stones become encysted, is totally inadmissible in practice.

Garengeot ventured to pass a bistoury into the bladder, for the purpose of disengaging a calculus lodged in a particular cyst at the fundus of this organ, behind the pubes. The knife had some tape twisted round the greatest part of its length, and was introduced under the guidance of the left index finger, which was passed in as far as it could reach. The patient was not more than ten or eleven years old, and consequently of a size which favoured the operation. The stone was loosened and taken out, and the child recovered. However, as Sabatier remarks, there are many instances in which this mode of proceeding cannot be imitated; for, if the calculus should be in a sort of cul-de-sac, as often happens, the entrance of which is narrower than its bottom, and the stone be of considerable size, the incision cannot be made large enough, without risk of cutting through the whole thickness of the bladder, and producing death by effusion of urine in the abdomen.

Other practitioners fancied that the calculus might be taken hold of with the forceps and turned about in different directions, so as to lacerate its connections, or even that it might be forcibly extracted without any serious ill consequences. Houstet mentions (see *Mém. de l'Acad. de Chir.* t. ii. p. 307, &c., ed. 12mo.) that Peyronie adopted this method on a patient thirty-one years of age. The calculus did not resist long, and its surface was found covered with fleshy substances, which formed the adhesions to the bladder. The operation was painful, followed by considerable hæmorrhage, tension of the belly, hiccough, cold extremities, and death.

There are some examples, however, in which this bold practice had better success. In 1730, Le Dran extracted from a woman an enormous stone, adherent to that part of the bladder which lies upon the vagina. The irritation of the inequalities of the stone had produced ulceration of the bladder, and fungous growths, which insinuated themselves into the substance of the extraneous body. The adhesions readily yielded, and the excrescences came away with the calculus. Ten days afterwards, some thick membranous sloughs were voided. This calculus is engraved in Le Dran's Treatise on the Operations.

Le Dran afterwards extracted similar stones which adhered by a less extensive surface; and he relates an operation performed by Maréchal, who, in 1715, extracted with a pair of forceps a stone shaped like a calabash, and having its narrow part surrounded by a fungus. In one case, the position of the calculus led Le Dran to suspect that it was fixed in the extremity of the ureter. He shook it occasionally with a pair of forceps, and, lastly, it fell into the bladder, whence it was extracted without difficulty. It resembled a cucumber in shape, and its large extremity had been lodged in the ureter, from which it could only be gradually removed. Sabatier believes that a case of this description, which must be very uncommon, is the only one in which there is any prospect of removing an encysted stone with success. In other examples, he conceives that it is more prudent to leave the stone, and let the wound heal, than expose the patient to an almost certain death by repeated attempts to extract it. (*Médecine Opératoire*, t. iii. pp. 190, 194, Ed. 2.) Desault employed a sort of concealed knife, called a coupe bride, for opening the cavity or cyst; and he has recorded one example, in which he thus successfully extracted from a woman, aged 62, a stone lodged at the insertion of the ureter into the bladder. The bistoury used by Garengeot, Desault did not consider a safe instrument, as the stones are round, and the knife may slip, and pierce the bladder—an objection to which, he says, the coupe bride is not liable. No injury can be received from its point, as the blade is concealed; nor can any part be divided, except what the surgeon intends. If the incision should not be completed at first, the blade may be withdrawn, the semicircular notch of the instrument pushed more forward, and the incision prosecuted to any extent. This instrument was invented for the express purpose of dividing membranous bands in the rectum, but it was afterwards employed with the greatest success for the excision of diseased tonsils and fungous tumours situated in cavities. The blade is so contrived that, when it passes through the semicircular notch, it firmly fixes the parts which are to be divided—a thing that cannot be done either with the scissors or bistoury, as the movable parts recede, and render the section difficult. (See *Parisian Chir. Journ.* vol. i. p. 33, &c.)

Sir A. Cooper mentions that, when the stone is partly in the cyst and partly in the bladder, it may sometimes be removed without opening the latter organ. In the case of a child, he passed his finger into the rectum and felt the stone, confined in a bag above it. On raising the calculus it struck firmly against the sound. While the finger was in the rectum, the knife was carried through the perineum above the bowel; the cyst opened, and the stone taken out, without any further opening of the bladder itself.

A stone perfectly encysted would not be expected to produce symptoms equal in severity to those which arise from an extraneous body actually in the cavity of the bladder, and generally they do not have this effect; yet in Houstet's interesting dissertation, several cases are recorded which prove that encysted stones do sometimes cause the same distressing symptoms which proceed from the presence of a loose calculus in the bladder. Hence the patients were sounded, and,

in consequence of the sacs, or pouches, in which the stones lay not being entirely closed, the calculi were continually struck by the instrument, and lithotomy attempted. It deserves particular remark, also, that in a large proportion of these cases the pouches or cysts were not single but numerous, occupying different parts of the bladder. In some dissections referred to by Houstet, cysts of this kind were found, not containing any stones whatever—a circumstance that would rather lead one to suspect that, in general, the formation of these sacs precedes that of the calculi commonly found in them. (See *Obs. sur les Pierres Encystées et adhérentes à la Vessie*, par M. Houstet, in *Mém. de l'Acad. de Chir.* t. ii. p. 268, ed. in 12mo.) Many specimens of this kind are contained in University College Museum.

I shall conclude this part of the subject with a few observations on it by Sir Benjamin Brodie:—"It very rarely happens that you meet with an encysted calculus where you perform the operation of lithotomy; in fact, in the great majority of cases of encysted calculi, the bladder is diseased, so that they are quite unfit for operation; however, such an event happens occasionally. A boy, about 16 years of age, was admitted into the hospital in the year 1816. He had suffered a long time from stone in the bladder. There were these remarkable circumstances in his case—namely, that the stone could sometimes be felt distinctly with the sound, appearing to be of a larger size, while at other times it could not be felt at all; and that sometimes, when the bladder was empty of urine, it could be felt distinctly with the finger from the rectum, while at other times, when there was urine in the bladder, it could not be detected at all by this mode of examination. In performing the operation, when I had introduced my finger into the bladder, I could at first discover no stone. At last I felt it on the anterior part of the bladder behind the pubes. It was not lying loose in the cavity of the bladder, but was evidently contained in a cyst, communicating with the bladder by a round opening. By means of a probe-pointed bistoury, I carefully dilated the orifice of the cyst, and then, introducing my finger, separated the membrane of it from the stone, until I was enabled to take hold of the stone with the forceps." It was not only encysted, but adherent, a portion of the lining of the cyst, closely attached to it, having been extracted with it. (See *Sir B. Brodie on Dis. of the Urinary Organs*, p. 287.)

[The chemical nature of the stone will mainly influence its tendency to give way under the pressure of the forceps. Hence it is of importance to ascertain beforehand, as nearly as possible, the composition of the calculus which we are about to extract. Uric acid concretions are the hardest, and the ringing sound which they emit when struck often suffices to indicate their nature. On the other hand, the triple phosphate is easily broken; but the most fragile is the fusible calculus, which sometimes crumbles into fragments on the slightest pressure. It is necessary to bear these points in mind; for, when the operator knows that the calculus is friable, he will, of course, be more careful during its extraction. The forceps employed should be broad-bladed, with the teeth not very long, and the stone must be seized as lightly as possible, care



being taken not to increase the pressure as the forceps is being withdrawn through the neck of the bladder and prostate, where the greatest resistance is usually experienced.

In spite of caution, the calculus, however, may give way, and either throw off several fragments, or even break up into a mass resembling mortar. This is an unfavourable accident, for it compels us to introduce instruments frequently into the bladder; and the irritation thus produced has excited such violent contraction of the organ as to render it impossible to finish the operation. When it does occur, any large fragments must be extracted with the forceps, and the smaller ones with the scoop; some will inevitably remain behind, and to remove these, injections with tepid water are to be employed and repeated before the wound in the perineum closes.

The writer has recorded a case in which more than an hour was employed in removing, with a scoop, the matter of a fusible calculus; still a considerable portion remained; and as he was unwilling to protract the operation any longer, the patient was removed to bed. At the end of a fortnight he introduced a large catheter through the urethra and washed out the bladder thoroughly; this brought away a good deal of the friable matter through the wound in the perineum. The same process was repeated every second day until no more calculous matter came away—that is, for about a fortnight. The patient recovered, and had no relapse.

Although the obstacles connected with the extraction of the calculus are the most frequent and important of those which occur during lithotomy, several other impediments may present themselves, and therefore require notice.

Generally speaking, the practised operator will experience little difficulty in making his way into the bladder; but sometimes the groove of the staff may be missed, or the knife may slip out of the groove, making the incision irregularly or to one side in a dangerous manner. The use of the button-headed bistoury enables us to avoid the latter of these accidents, while the former is avoided by keeping the nail of the left forefinger well in contact with the groove of the staff, which the assistant takes care to hold perfectly steady.

Unusual depth of the perineum, however, may produce some difficulty in reaching the bladder easily. In old and fat persons, the distance from the surface to the neck of the bladder may be so considerable, that it is impossible to reach the cavity of the organ with the finger. A case of this kind is related by Mr. Erichsen, who found that the ordinary lithotomy knife was too short to cut through the prostate. (*Lancet*, August 16, 1856, p. 198.) In children, on the other hand, from the great extensibility of parts and other circumstances, the bladder is apt to yield before the knife; and when the incisions have been made, the bladder is apt to yield before the finger; thus giving an artificial depth to the perineum and impeding the introduction of the forceps.

In aged persons, again, the neck of the bladder may be very thick or unyielding, or spasmodic contraction may exist, as in the case related by Deschamps, where spasmodic contraction rendered it impossible to pass even a catheter into the bladder.

Any considerable enlargement of the prostate gland is always a cause of difficulty and annoy-

ance. The lithotome caché has been more than once broken during attempts to divide an indurated prostate; but the great obstacle which considerable enlargement of the prostate causes is to seizing the stone: it places the calculus beyond the reach of the finger, or even of the ordinary forceps; besides which, the enlarged gland, elevating with it the neck of the bladder, leaves behind it a depression in which the stone becomes lodged. In cases of this kind the surgeon should employ a very long curved forceps, and at the same time seek to raise the stone from the depressed cavity in the bladder by introducing his finger into the rectum; this latter expedient, however, will often fail, as the finger is too short to reach beyond the enlarged gland.

Contraction of the walls of the bladder, whether habitual or as an effect of irritability, often leads to embarrassment, by preventing the operator from passing the blades of the forceps between the stone and the vesical parietes. Previous injection of the bladder with tepid water may assist in obviating this unfavourable condition of the organ.

Under ordinary circumstances the calculus is lodged on the floor of the bladder behind the prostate gland; but, as Mr. Cooper has shown, it may occupy various other positions, being entangled in folds of the mucous membrane, embraced by irregular muscular fibres, or engaged in a cyst. The various attempts made for the removal of encysted calculi are always attended by considerable danger. If the calculus be completely encysted, no attempt should be made to dislodge it by incision of the neck of the sac. But when the stone is only partially contained in the cyst, and when it is not far beyond the reach of the finger, an effort may be made to enlarge the orifice of the sac, and dislodge the foreign body with some blunt-pointed instrument—the scoop, for instance. Cutting instruments should never be employed in such cases.

Without being actually encysted, however, the stone may occupy an anomalous position, appearing to be hooked above the pubes, and perhaps retained there by abnormal adhesions. The nature of these adhesions has been well made out by Mr. Shaw, who has described an interesting case of this kind in the *Transactions of the Pathological Society* (vol. vi. p. 250): “Midway between the orifices of the ureters there was an oval spot of the size of a sixpence, where the mucous and muscular coats were absent, and a quarter of an inch above the orifice of the left ureter there was a rough patch on the surface somewhat smaller. A calculus had been adherent to each of these points. On one side of the larger calculus a circular spot, about half an inch in diameter, was covered with a thick flocculent layer of fibrous tissue; and, on closely inspecting the mode of union between the fibrous tissue and calculus, it was seen to be effected by the fibres dipping into and being incorporated with the calcareous substance.”

The writer has met with cases in which the calculus occupied the irregular position above the pubes. The stone could only be struck by depressing the handle of the sound so as to bring its point against the anterior wall of the bladder; and its extraction with the forceps would be extremely difficult did not the operator take the precaution of raising the pelvis. (*Coulson on the Bladder*, 5th edition, p. 506.)]

[*Lithotomy in children.*—In consequence of the improvements which have been made of late years in the practice of lithotripsy in adults, a very large proportion of the patients now submitted to lithotomy are children under ten years of age. The results of lithotomy in children are very satisfactory, the mortality being probably not more than about 1 in 30. They seem to be but little liable to urinary infiltration, or diffuse suppuration in the pelvic cellular tissue, although from the small size of the parts the incision must often pass beyond the limits of the prostate. The operation has been generally considered to be easier in the child than in the adult; and perhaps under favourable circumstances this may be the case. The fact, however, must not be accepted without reservation; the small size of the parts, especially the prostate gland, must be duly considered, and too free incisions in the deep parts must be specially guarded against.

But in addition to this there are some points deserving of particular notice, an insufficient appreciation of which may at any time give rise to difficulty, and has probably occasioned many of the failures in the accomplishment of the operation which have been known to occur; which failures are without doubt more frequent in the child than in the adult subject. In the first place, the bladder in the child is situated higher in the pelvis than in the adult, consequently it is comparatively deeper from the surface of the perineum; again, its cellular connexions with surrounding parts are much more lax, and therefore it is more easily displaced from its normal position by any undue violence during the operation. It results from this, that the deep incision may not be carried far enough, or that the knife may push the prostate before it, and the bladder may not be opened at all. Under such circumstances, the surgeon will find that, although the groove of the staff is freely exposed, his finger will not pass along it into the bladder, but the latter recedes before his finger, and a space is created between the rectum and bladder which may very easily be, and without doubt very often has been, mistaken for the bladder itself. If force is used with the finger, the urethra may even be torn completely across, and the bladder pushed upwards, till the finger penetrates into the cellular space between the bladder and the pubic symphysis. The knowledge of these sources of difficulty is no new thing to those experienced in lithotomy; nevertheless, it has not always been sufficiently insisted on by surgical writers, and beginners are seldom aware of the depth to which it may be necessary to carry the incision in children, or of the facility with which they may become involved in the misadventure above alluded to. Mr. Fergusson has recently brought these points very prominently and forcibly before the profession, and has stated his conviction that most of the cases heretofore related as instances where the incisions for lithotomy have been made and a stone has not been present, have been examples where the surgeon has failed to reach the bladder from the cause just narrated. He states that he has known of cases where, death having followed the incisions, the stone has been found in the bladder at a post mortem inspection, and has heard of others where the stone has been successfully extracted at a second operation, after

the first wound has been allowed to heal. (See *Lancet*, July 2, 1864. *Report of Lecture delivered at the College of Surgeons.*) If therefore the finger does not readily enter the bladder, no force should on any account be employed, but the knife should be again applied to the groove of the staff, and pushed steadily onwards until the bladder has been fairly opened.]

#### ACCIDENTS OF LITHOTOMY.

[That the accidents of lithotomy are both numerous and severe, may be gathered from the general fact that about one-fifth or one-sixth of all patients, who are cut for the stone, die. They differ, of course, according to the mode of operation which may be adopted. The high operation has its peculiar dangers; so has the vesical, rectal, &c.; it will, however, be sufficient if we confine ourselves to the accidents of the lateral operation.

The nature of the accidents which are likely to occur will be best understood if we bear in mind the obstacles which have been described, because many of the former arise from attempts made to overcome the latter, or from our inability to do so.

The accidents should be distinguished according as they occur during the operation or after it.

In the one case, they constitute accidents, properly so called; in the other they are, for the most part, secondary occurrences, and may more properly be considered with the causes of death after lithotomy.

The primary accidents of lithotomy are few, if we consider those which happen at the present day, and not the unfortunate occurrences described in many systematic works, the greater portion of which should be attributed to carelessness or want of skill. The bulbous portion of the urethra and the artery of the bulb may be divided by the first incisions. This accident may be avoided by not commencing our incisions too high, or too close to the raphe. Mr. Skey, however, is of opinion that, in reality, the bulb is always more or less divided, and the artery of the bulb frequently, and that the perineal artery rarely escapes when the external incision is more than usually long. (*Operative Surgery*, London, 1850, p. 547.) Mr. Skey does not regard this accident as of any consequence whatever; but it would be better to avoid it, if possible.

The next accident which is likely to occur is the slipping of the point of the knife or cutting instrument from the groove of the staff. What has been already said in another part shows that such an occurrence is by no means unfrequent. It has happened in the hands of the best surgeons; and hence the writer, although fully appreciating Mr. Liston's method, prefers the use of the button-headed bistoury. Wounding the rectum is another accident not unfrequent; and, as this also has happened to skilful operators, we are compelled to conclude that it does not always arise from the fault of the surgeon. The anterior wall of the rectum lies close on the posterior surface of the prostate, to which it is connected by cellular membrane; and, in spite of the precaution to empty the gut (which should never be neglected), any abnormal development of the intestine or unnatural change in the position of the parts may bring the intestine immediately under the knife of the operator. It may be di-



vided during the first incision; and this was not unlikely to happen when they were made in nearly a straight direction. We avoid now the accident during this stage by lateralising the incisions. It was long ago remarked by Deschamps, that the rectum is sometimes so enlarged and dilated in old people that it overlaps the prostate to a considerable degree. Here the gut may be injured while the surgeon is opening the membranous portion of the urethra; but in this as well as in other cases, the accident is best avoided by not raising the handle of the knife too much, and by keeping the blade above the index finger of the left hand, while the same finger is used to depress the rectum and put it out of the way.

I have seen the rectum wounded in three or four instances, but no serious consequences were the result. A wound of the bowel, occurring, as it does, close to the sphincter, does not appear to Mr. Key to be a matter of serious moment.

From the manner in which the bladder of very young children ascends into the pelvis, it is necessary to employ some caution in making the internal incision so as to avoid the gut. Dupuytren recommends it to be directed in an imaginary line, drawn from the umbilicus to the tuberosity of the ischium.

Primary hæmorrhage arising from the division of some considerable vessel during the incisions, whether external or internal, is unquestionably a rare accident in the hands of British operators. Mr. Liston says upon this subject: "Out of above one hundred patients on whom I have performed the lateral operation of lithotomy, only one, an aged man, suffered in consequence of hæmorrhage, and in him the artery of the bulb was untouched; but the branches of the hæmorrhoidals were loaded with earthy matter, and incapable of contracting or retracting." (*Prac. Surg.* 2nd ed. p. 448. London, 1838.) Boyer, on the other hand, considers hæmorrhage as one of the most frequent accidents of lithotomy; and M. Begin calculates that one out of every four deaths after the lateral operation is occasioned by hæmorrhage.

It is difficult to determine questions of this kind by statistics, because very few surgeons have recorded, in an accurate manner, the causes of death after the operations performed or observed by them, while our hospital records are nearly equally deficient. The writer has, however, collected ninety cases of death observed in series, and of these no less than eleven were occasioned by hæmorrhage—a circumstance which shows that the accident may occur, not only in a considerable number of cases, but with such severity as to cause death in a considerable proportion to the whole number of cases. From the data now alluded to, it would appear that one in every eight deaths after lithotomy is occasioned by hæmorrhage, but this includes secondary as well as primary bleeding. The latter, however, has been observed with more or less severity during the first as well as the second incisions, and may be considered as an accident, whenever it arises immediately from the division of an important vessel. Varieties in the origin or course of the arteries are the most frequent cause of the accident; yet it cannot always be attributed to them. The arteries of the perineum are derived from the internal pudic, the principal branches of which are the hæmorrhoidal arteries, the superficial artery of the perineum, the transverse artery, and the artery of the bulb. Any of these branches,

or the trunk of the pudic artery itself, may be divided during the operation. The accident sometimes arises from the irregular direction or extent of the incisions, but much more frequently, as has been said, from irregularities of the perineal arteries.

Division of the artery of the bulb may occur when the first incision is made too high. The late Mr. Key and Mr. Skey are of opinion that this artery is nearly always divided during the lateral operation. On the other hand, if the incision be prolonged too much downwards, the superficial hæmorrhoidals may be wounded. Finally, the superficial artery of the perineum may be implicated, because in some subjects it runs too near the median line. The trunk of the pudic artery itself may be divided when the incision is lateralised too much, and its lower angle made to terminate very close to the ramus of the ischium.

This accident has happened in the hands of the very best surgeons; yet we think, with M. Blandin and many other anatomists, that it is impossible for such an accident to occur unless some irregularity disturbs the normal relation of parts at the floor of the pelvis.

The trunk of the internal pudic artery is closely bound down to the ramus of the ischium by a layer of dense fascia, and is nearly an inch and a half from the margin of the anus; nor does it begin to detach itself from the bone until near its terminal division. Under ordinary circumstances, then, I am of opinion that the trunk of the internal pudic cannot be wounded during the lateral operation. The accident, however, has occurred, and to the masters of our art. Deschamps relates how Desault cut the internal pudic with Hawkins's gorget. The same misadventure has happened to M. Roux, to Dr. Physick, to Sir C. Bell, Sir E. Home, and twice to Klein in Germany. (*Coulson, Lithotritry and Lithotomy*, p. 232.)

Happening in the hands of such men, it is not unreasonable to refer this accident to arterial anomalies rather than to neglect or want of skill. But the anomalies now alluded to are themselves subject to fixed laws and occur within certain limits only, and hence it may be useful to notice them somewhat in detail. The trunk of the internal pudic artery bound down by fascia against the ramus of the ischium lies more than half an inch out of the way of the knife in the lateral operation. But in some cases the trunk of the vessel is not closely applied on the bone; it begins to ascend towards the median line almost as soon as it leaves the level of the tuber ischii. Mr. Coote, of St. Bartholomew's Hospital, has recorded a very remarkable example of this kind of deviation. As soon as the internal pudic re-entered the pelvis it passed over to the rectum, and ascended along the gut towards the triangular ligament, lying exactly in the track of the knife during lithotomy.

In several cases, especially in the male subject, the internal pudic, instead of passing out of the pelvis, descends along the inferior surface of the bladder and crosses over the prostate to be distributed to the penis. (*Green, Varieties of the Arterial System*. Dublin, 1830, p. 29.)

The transverse artery of the perineum is occasionally double, and hence increased hæmorrhage may arise.

Again, one of the hæmorrhoidal arteries, especially the inferior, may arise from the pudic close to the edge of the transverse muscle, and thence cross the perineum obliquely downwards and inwards. In such a case its division must be inevitable.

The artery of the bulb is subject to numerous varieties both of origin and of course; it sometimes arises much lower down than usual, and crosses the perineum obliquely upwards in the way of the lateral incision. In some cases it arises from the obturator artery, while it sometimes happens that the artery of the bulb at one side is very large, and furnishes the corresponding branch to the opposite side.

The dorsal artery of the penis is much more liable to varieties than is commonly supposed. This artery very often arises from the obturator or some other branch of the hypogastric; but such deviation does not affect lithotomy. In many other cases, however, the dorsal artery, instead of coming out beneath the symphysis pubis, gains the side of the prostate, round which it winds to the dorsum of the penis. The late Mr. Shaw lost a patient from hæmorrhage occasioned by a variety of this kind; and Professor Harrison justly remarks that the anomaly may account for many other cases of fatal bleeding during the early stages of the operation.

As the surgeon has no means of ascertaining beforehand the existence of arterial anomalies, he does not permit their possible occurrence to influence his proceedings. Should any serious hæmorrhage from the division of an artery take place, the vessel must be sought for and taken up in the usual manner; and, in case of failure, the other means ordinarily employed for the arrest of bleeding must be had recourse to.

Cheselden was in the habit of taking up the vessels as they were divided; and whenever any considerable arterial bleeding occurs his example should be followed. But it is by no means an easy matter to tie either the artery of the bulb or the trunk of the internal pudic artery. The one is hidden so deeply under the arch of the pubes, and the other so closely bound down by aponeurosis to the ischium, that it is almost impossible to discover their divided orifices or reach them with the needle. A few cases, it is true, are recorded where the surgeon was fortunate enough to take up the trunk of the pudic artery; but these are exceptional; and I believe that pressure with the finger against the ascending ramus of the ischium is the only safe practice to which we can have recourse. It may be tedious for the assistant and a source of annoyance to the patient, yet twelve hours may suffice to place the life of a man beyond danger, and no sacrifice is too great for such an object. It is unnecessary to mention that this pressure will also serve to arrest hæmorrhage from the artery of the bulb.]

If the internal pudic artery should be wounded, and bleed profusely, the best plan is, if possible, first to take out the stone and then introduce into the wound a piece of firm sponge with a large canula passed through its centre. The expanding property of the sponge on its becoming wet will make the necessary degree of compression of the vessel, which mostly lies too deeply to be tied. Sometimes lint wrapped round the canula has answered. Linen wet with cold water should

at the same time be applied to the perineum and hypogastric region.

I cannot say that it has fallen to my lot to see any cases (out of the great number which I have seen) in which death could be imputed to hæmorrhage, notwithstanding the bleeding has often been so profuse and from so deep a source, just after the operation, as to create suspicion that it proceeded from the internal pudic artery. Such hæmorrhage generally stopped before the patient had been put to bed.

Sir Benjamin Brodie had the misfortune to lose a patient from hæmorrhage. The case was that of an old man who had an enlarged prostate and an unusually deep perineum. The blood was venous. If the incisions are made low down, and not too extensive, the chance of hæmorrhage seems to Sir B. Brodie to be but trivial. (*On Dis. of the Urin. Organs*, p. 293.) In one example, under this gentleman, where the size of the calculus made it necessary to cut the right side of the prostate, the hæmorrhage would have proved fatal if an assistant had not pressed the internal pudic artery against the bone with his finger for several hours. In another case operated upon by Sir E. Home the bleeding was first suspended by pressure with the finger; and then, as the patient was a thin person, Sir B. Brodie succeeded with the aid of a small flexible silver needle in passing a ligature round the trunk of that artery. Dr. Physick, of the United States, once succeeded in tying the internal pudic artery after lithotomy. (See *Reese in American Ed. of this Dict.*)

Mr. Key believes that the pudic artery itself is rarely wounded, but that in adults the artery of the bulb and the superficial perineal branch often bleed profusely. If the incision be made low down in the perineum he admits that the artery of the bulb may escape; but from experiments which he has made on the dead subject he infers that it is almost always divided. He does not approve of plugging the wound with lint or sponge introduced on a catheter. The cellular membrane is irritated by it, and an unhealthy form of inflammation ensues, while the catheter being soon blocked with coagulum does not carry off the urine from the bladder. I have, however (he adds), found advantage in checking the bleeding by means of pressure made upon the upper part of the left side of the perineum by a forked piece of lint fixed to a piece of cork; pressure in this mode also reaches the deeper branches of the prostate from which the blood sometimes oozes for a long time after the patient is placed in bed, and distends the bladder with masses of coagula. (See *Guy's Hospital Reports*, vol. ii. p. 19.)

[Primary venous hæmorrhage is another accident which occasionally occurs, although its possibility is denied by several authors. It is sometimes supposed to arise from division of a portion of the bulb, an accident not easily avoided when we have to operate on old patients. The bleeding from this source, however, is easily commanded and seldom profuse. A more serious form occurs from division of the venous plexus about the neck of the bladder and prostate. In aged patients, and after long-continued irritation of the urinary organs, these veins are apt to become abnormally developed even to a varicose state. Besides this, they are enveloped in prolongations of the deep pelvic fascia, and thus prevented from retracting or becoming



quickly closed after division. From these causes troublesome venous hæmorrhage may come on in old patients submitted to the operation. Sir B. Brodie lost a patient within a few hours from this cause, having been foiled in all his efforts to restrain the bleeding. It may take place in adults, or even in children, under peculiar circumstances. M. Robert witnessed two examples at the Hôtel Dieu of Paris. In one case, that of a young man, the venous plexus continued to pour forth blood until death ensued. No artery had been wounded. The second case was that of a child addicted to masturbation. The enlarged veins furnished a copious bleeding, which became suddenly fatal after an act of that vice. These are altogether exceptional cases; for we may lay it down as a rule that the danger of venous hæmorrhage is in direct proportion to the age of the patient.

Secondary hæmorrhage sometimes occurs after lithotomy, and probably, as Sir B. Brodie suspects, from the separation of a slough. In one such case Mr. Earle stopped the bleeding by introducing into the bladder through the wound a tent of lint enclosing an elastic gum catheter.]

#### CAUSES OF DEATH AFTER LITHOTOMY.

[The accidents which have been now described—if we except bleeding—are seldom attended by any serious consequences. There are others, however, sometimes primary, more often secondary, which frequently terminate in a fatal manner, and may, therefore, be described under the head of “Causes of Death.”

When we reflect on the immense number of cases in which lithotomy has been performed in private practice, and on the numerous hospital records which must exist relative to long series of cases, it seems strange that there should be any difficulty in ascertaining the precise cause of death after this operation. Yet such is not the case; accurate records are rare. The writer has, however, collected ninety cases (Dupuytren 19, Bryant 40, Teale 13, Dr. Humphry 7, Dr. Barnard 6, Provincial Hospitals 5), and arranged them in tabular form:—

No. of Cases recorded	Cause of Death	No. of Cases Fatal
Dupuytren 19	Infiltration of urine into cellular tissue of pelvis.	22
Bryant . 40	Inflammation of cellular tissue of pelvis . .	
Teale . . 13	Pelvic abscess . . . .	1
Humphry . 7	Erysipelas . . . . .	1
Barnard . 6	From accident . . . .	3
Provincial Hospitals } 5	Hæmorrhage . . . . .	11
90	Pyæmia . . . . .	10
	Shock . . . . .	8
	Disease of Kidneys . .	8
	Peritonitis . . . . .	4
	Cystitis . . . . .	4
	Laceration of Bladder or Prostate . . . . .	4
	Great size of Calculus .	2
	Obstacle in Perineum .	2
	Disease of Prostate . .	1
	Sacculated Bladder . .	2
	Cancer of Bladder . . .	1
	Bronchitis . . . . .	2
	Uncertain . . . . .	3
	Sudden Coma . . . . .	1
		90

Previous to the discovery of chloroform, nervous accidents, the shock, &c., were formidable, and not unfrequently terminated in death. Even now the effect of the operation on the nervous system is not invariably avoided. An example of this kind occurred some years ago in the practice of Mr. Lawrence, at St. Bartholomew's Hospital. Although chloroform had been duly administered, the nervous and irritable state excited by the operation continued, and the patient sunk on the third day from the mere shock. The very fear of the operation has been fatal. (*Gazette Méd. de Paris*, Dec. 7, 1850.) Prolonged operations are always dangerous; and when the obstacles which have caused the delay are great, the patient is sometimes removed from the operation table in a state of prostration from which he never rallies. Such a condition demands instant and unremitting attention. The patient should be carried to bed at once in the horizontal position; he should then be covered with a warm blanket, and bottles of hot water be applied to his feet; while a free access of air to the face is provided for. So soon as he can swallow, small quantities of hot brandy and water, ammonia, &c., are to be given, until reaction sets in.

Hæmorrhage, whether primary or secondary, has been noticed already, under the head of “Accidents.” It seems only necessary to add here that the bleeding which terminates fatally is most commonly the secondary form.

Mr. Cooper states that “the majority of patients who die after lithotomy perish of peritoneal inflammation.” This is an error. The most frequent cause of death is unquestionably inflammation of the cellular tissue of the pelvis caused by infiltration of urine. This inflammation, it is true, may extend to the peritoneum, especially whenever the layer of pelvic fascia close to the peritoneum has been divided; but peritonitis independently of such extravasation is rare.

Infiltration of urine may take place under two different circumstances, which are worthy of notice, as this in some measure explains the variety of symptoms observed in different cases, and the greater rapidity with which some hasten to their fatal termination.

The urine may become infiltrated whenever the internal incision has been carried beyond the limits of the prostate, or when the neck of the bladder and the prostate have been injured during the efforts made to extract a large calculus. In both these cases the fibrous capsule of the prostate is divided, the urine becomes infiltrated into the subjacent cellular tissue, inflammation sets in, and excites, according to its seat or extent, either peritonitis or sloughing of the soft parts within the pelvis. Infiltration, again, may arise from anything which impedes the free discharge of urine through the external wound. Thus the external incisions may have been too small or do not correspond with the internal, or the sides of the wound have been lacerated during the extraction of a large calculus. Here the infiltration does not take place into the sub-peritoneal cellular tissue; yet its effects, though slower than in the former case, are almost equally unfavourable.

The only certain way of avoiding the danger now spoken of is to follow the rule so justly insisted on by Mr. Liston and many other

surgeons: to avoid all interference with the reflexion of the ileo-vesical or pelvic fascia from the sides of the cavity over the base of the prostate and side of the bladder.

In order of frequency after extravasation of urine and hæmorrhage must be reckoned phlebitis or purulent infection of the blood. The frequency of this accident after certain operations on the genito-urinary organs has been generally admitted; but, from the absence of accurate observation, its connection with lithotomy has not been noticed by any systematic writers in this country. All French authors, on the other hand, insist on the occurrence of purulent infection after lithotomy; and its comparative frequency in this country is proved by the records of Guy's Hospital.

In the paper by Mr. Bryant, already alluded to, we find five fatal cases from phlebitis out of forty recorded in the books of that hospital. In Dr. Barnard's cases three deaths out of six are attributed to phlebitis. In Mr. Teale's thirteen cases one occurred from pelvic and crural phlebitis; while two others not examined were probably cut off by the same cause.

To these four causes, viz., shock, hæmorrhage, urinary infiltration, and pyæmia, must be attributed the immense majority of deaths after lithotomy, and to their avoidance should the attention of the surgeon be therefore mainly directed.

Simple peritonitis and cystitis are comparatively rare.

There is, finally, another cause of death after lithotomy, viz. disease of the kidney and pyelitis; but in most cases it will be found that the operation only hastened death, and has not been its actual cause. However this may be, Mr. Bryant's table shows that pyelitis and inflammation of the kidneys were the cause of death in six out of forty fatal cases. This is a very large proportion, yet not to be wondered at when the condition of many patients labouring under stone is remembered. Vesical calculus seldom exists for any considerable time without producing either disease of the kidneys or a tendency to disease in these organs which the slightest exciting cause may light up. Many patients labouring under incipient disease of the kidneys or with suspicious symptoms are thus operated on and compelled to run a risk which in the nature of things it is impossible for them to avoid.

Dr. Humphry records one case of great interest, in which, although but little force was used, the bladder was ruptured by the forceps, and the stone escaped through the laceration into the peritoneal cavity. Mr. Humphry's seven deaths were from a total of 89 operations. Of these 41 were in adults, with 5 deaths, or somewhat less than 1 in 8. (See *Lancet*, vol. i. 1864, p. 461.)

Mr. Gutteridge, of Birmingham, has operated on 127 patients with only seven deaths, an amount of success which we believe has not been surpassed by any operator of the present day. (See *Pamphlet on Lithotomy*, 3rd ed. 1859.)

Mr. Thompson has published in his Lettsomian Lectures some interesting remarks on the causes of death after lithotomy, of which the following is a summary. He commences by remarking that the causes of death are not the same in adult

life and in the period of youth, although it has been the custom to regard the fatal contingencies of all ages in the mass without making this distinction.

The first, and, beyond all doubt, the most frequent cause of death in the adult is acute inflammation of the tissues, especially of the loose cellular tissue about the neck, base, and sides of the bladder. This inflammatory action may be caused by mechanical violence, by urinary infiltration through too deep incisions, by want of reparative power in the patient, from erysipelas, &c.

Mr. Thompson thinks that mechanical violence inflicted for the removal of the stone, especially when the opening is of insufficient size, is much more frequently the cause of this inflammation than the infiltration of urine, to which it is attributed by the majority of authors. In confirmation of this opinion it is remarked "that while it is certain that the boundaries of the prostate are almost universally overstepped by the knife in children, infiltration of urine very rarely occurs in them."

Death from ill-conditioned inflammation produced by urinous infiltration, when the parts have been opened by too deep incisions, although undoubtedly occurring sometimes, does so much less frequently than is usually supposed. If extravasation has been so frequently discovered after death, it has been rather the consequence than the cause of the infiltration which accompanies it. The remaining causes of death are, cellulitis occurring from constitutional causes, inflammation of the bladder extending upwards to the kidneys, absorption of urinary products, phlebitis and pyæmia, shock, hæmorrhage, and exhaustion.

In children the most frequent cause of death is peritonitis; the next cause, probably acting almost as frequently, appears to be constitutional exhaustion or debility.

The following remarks by Mr. Cooper are retained in the present edition; they are interesting as showing the views which formerly prevailed respecting the causes of death after lithotomy and the treatment required. It will be seen, however, that they are considerably at variance with the opinion now generally entertained, and to which expression has been given in the preceding paragraphs.]

There is no doubt that many adults who die after lithotomy perish of peritoneal inflammation. Hence, on the least occurrence of tenderness over the abdomen copious venesection should be put in practice; at the same time from twelve to twenty-four leeches should be applied to the hypogastric region. The belly should be fomented and the bowels kept open with the oleum ricini. The feebleness of the pulse should not deter the practitioner from using the lancet; this symptom is only fallacious, and generally attendant on all inflammation within the abdomen. It is a curious fact that Mr. Martineau, who only lost two out of eighty-four patients whom he operated upon for the stone, should never have found it requisite to bleed; but it appears to me that it is a much better argument in favour of the superior safety of operating with the knife and making a free opening, than reason for discarding venesection when inflammation of the peritoneum has come on, which, however, may not be this gentleman's



meaning, as he says, "I believe it will be found in adults that death follows oftener from exhaustion, after a tedious operation, or from despondency, &c., than from acute disease," (*Med. Chir. Trans.* vol. xi. p. 412), a sentiment which, I am sure, this gentleman would not have entertained had he been present with me at the opening of the many unfortunate cases which used formerly to occur in the practice with badly made gorgets in St. Bartholomew's Hospital. Together with the above measures, the warm bath, a blister on the lower part of the abdomen, and emollient clysters, are highly proper. I have seen several old subjects die of the irritation of a diseased thickened bladder continuing after the stone had been extracted. They had not the acute symptoms, the inflammatory fever, the general tenderness and tension of the abdomen, as in cases of peritonitis, but they referred their uneasiness to the lower part of the pelvis; and instead of dying in the course of two or three days, as those usually do who perish of peritoneal inflammation, they, for the most part, lingered two or three weeks. In these cases opiate clysters and blistering the hypogastric region are the best measures. In some instances of this kind abscesses form about the neck of the bladder.

I shall conclude this article with the following quotation: "Some individuals (as Sir B. Brodie observes) are good subjects for the operation, and recover, perhaps, without a bad symptom, although the operation may have been very indifferently performed. Others may be truly said to be bad subjects, and die even though the operation be performed in the most perfect manner. What is it that constitutes the essential difference between these two classes of cases? It is, according to my experience, the presence or absence of organic disease," especially of the kidneys or bladder. (*Op. cit.* p. 301.) The enlargement of the prostate gland in old men I believe, with Sir B. Brodie, does not increase the danger, though it may the difficulty of the operation. I infer this from a case which occurred in University College Hospital, and in which the patient recovered without any bad symptoms, though the operation was excessively long, and a portion of the enlarged gland, which had been sliced off, fell down upon the floor.

With respect to fistula in perineo, impotency, and incontinence of urine, as consequences of lithotomy, I have seen two or three examples of the first. Mr. Key has not witnessed fistula as a consequence of the operation for vesical calculus. "The operation of extracting prostatic calculi" (he observes) "when they are large, and the gland diseased, is sometimes followed by difficulty in healing the external incision, and the formation of a fistula, through which some drops of urine escape. But in lithotomy the incision, being made through healthy structures, heals quickly by a healthy process of granulation, and fistula is, therefore, a very uncommon occurrence." Mr. Key has known of one instance in which impotency was ascribed to the operation. But, according to his experience, incontinence of urine rarely occurs in the adult. In the young subject partial incontinence will sometimes occur, if the patient is allowed to leave his bed too soon after the operation, before the neck of the bladder is firmly healed, and the sphincter has recovered

its tone. Instances, therefore, are met with of young boys who, if they retain their water inconveniently long, find it dribble away as they move about. In bed the urine is perfectly retained. When they arrive at the age of puberty the power of retaining it becomes increased. (See *Aston Key, in Guy's Hospital Reports*, vol. ii. p. 25.)

#### OF SOME PARTICULAR METHODS AND INSTRUMENTS.

M. Foubert, an eminent surgeon at Paris, devised and practised a plan of his own, which, however, has not been considered by others worthy of being imitated. The patient having retained his urine, so as to distend his bladder, an assistant with a convenient bolster presses the abdomen a little below the navel in such a manner that by pushing the bladder forwards he may make that part of it protuberant which lies between the neck and the ureter. The operator at the same time introduces the forefinger of his left hand up the rectum, and, drawing it down towards the right buttock, pushes in a trocar on the left side of the perineum, near the great tuberosity of the ischium, and about an inch above the anus. Then the trocar is to be carried on parallel to the rectum exactly between the erector penis and accelerator urinæ muscle, so as to enter the bladder in one side of its neck; as soon as the bladder is entered, the operator withdraws his forefinger from the anus.

In the upper part of the canula of the trocar there is a groove, the use of which is to allow some urine to escape immediately the instrument enters the bladder, so that the trocar may not be pushed in any further; but its principal use is for guiding the incision. As soon as the urine began to flow, Foubert, retracting the trocar a little, without drawing it quite out of the canula, introduced the point of a slender knife into the groove in the canula, and by the guidance of this groove he ran it onwards into the bladder, and was aware of the knife having actually entered this viscus by the urine flowing still more freely. Then, raising the knife from the groove, he made his incision, about an inch and a half in length, through the neck of the bladder, by moving the knife from that point at which it had entered upwards towards the pubes. And, finally, by moving the handle more largely than the point of the knife, he opened the outer part of the wound to whatever extent the size of the stone seemed to require, and then, withdrawing the knife, he introduced a blunt gorget to guide the forceps.

An effort was made by Thomas to improve this method, but he failed, and it was never adopted by others. The inability of many bladders to bear distention is an insuperable objection to it, for without this the trocar is liable to pass between the bladder and rectum, and even through the bladder into the pelvis. (*Mémoires de l'Acad. de Chir.*, vol. i. p. 663; *Le Dran's Parallèle*; *Sharp's Critical Inquiry*; *J. Bell's Principles*, vol. ii.)

In the year 1748 Frère Côme's method of performing the lateral operation began to attract considerable notice. It was performed with a particular instrument, called the lithotome caché, by means of which the prostate gland and orifice

of the bladder were divided from within outwards. The lithotome caché is entitled to much attention, because it is still generally used in several parts of the Continent and sometimes in this country, especially in St. George's and the Westminster Hospitals. "In France" (says M. Roux), "if there is any mode of operating more common than others and preferred by the majority of practitioners, it is that in which the instrument named the lithotome caché is employed." (See *Parallèle de la Chirurgie Anglaise &c.* p. 318.) Frère Côme does not ascribe the invention of this instrument to himself, but acknowledges that it resembles the knife for operating upon hernia, said to have been devised by a French surgeon of the name of Bienaise. It consists of a handle and the blade part. The latter is slightly curved, about as thick as a quill, furnished with a beak, and excavated so as to form a sheath for a knife of its own length. By means of a kind of lever the knife can be made to pass out of the sheath; and the distance to which the blade projects also admits of its being regulated with precision. For this purpose the handle is divided into six sides, numbered 6, 7, 9, 11, 13, and 15, and which, according as they are more or less elevated, allow the lever to be depressed in different degrees, and the knife to move out of its sheath in the same proportion. Thus the surgeon can at his option make an incision through the prostatic portion of the urethra and orifice of the bladder of six different lengths.

Sabatier observes that Frère Côme's method possesses all the advantages of the lateral operation, besides being more easy than Cheselden's plan and most of the other modes subsequently proposed for cutting the prostate gland and orifice of the bladder with perfect smoothness, and to a sufficient extent to allow the calculus to be removed without laceration of the parts. (*Méd. Opératoire*, t. iii. p. 199.)

Several objections have been urged against the use of the lithotome caché. 1. Frère Côme made his incision too high, so that an extravasation of urine in the scrotum followed some of his operations; but the above method of operating is free from any objection of this kind. 2. Some surgical writers insist on the danger of cutting the bladder too extensively with the lithotome. 3. The arteria pudica profunda and the rectum, which some authors conceive to be endangered, must always be in absolute safety, if the edge of the knife of the lithotome be turned in the direction above recommended.

I think that for a surgeon who understands the right principles of lithotomy this is one of the best ways of performing the operation.

When I was at Paris in 1815 I saw Dr. Souberbielle operate very skilfully with the lithotome caché. A stone of considerable size was extracted from a gentleman, who was, I should think, not less than seventy. No apprehensions were entertained of ill-success, as I understood that this operator hardly ever lost a patient.

M. Roux when he visited England seems not to have been informed that, at the Westminster Hospital, the lithotome caché had been commonly employed for many years past. It was sometimes used at Guy's Hospital by Sir A. Cooper,

and it is a favourite instrument with my friend Mr. Keate.

Le Cat, a surgeon at Rouen, in Normandy, devised a mode of lithotomy which would be too absurd to be described were it less renowned. He thought the neck of the bladder might be dilated, like the wound, and his operation was deformed with all the cruelty of the Marian method, and every error attendant on the infant state of the latter operation. He first introduced a long wide staff, and then cut forward with a common scalpel through the skin and fat, till he could distinguish the bulb, the urethra, and the prostate gland. Secondly, with another knife, the urethrotome, having a groove on one side, he opened the urethra just before the prostate, and, fixing the urethrotome in the groove of the staff, and holding it steady, rose from the kneeling posture in which he performed the outward incision. Thirdly, holding the urethrotome in the left hand, he passed another knife, the cystotome, along the groove of the urethrotome; and the beak of the cystotome being lodged in the groove of the urethrotome, it was pushed forwards through the substance of the prostate gland into the bladder. Fourthly, drawing the cystotome a little backwards, he gave the staff to an assistant to be held steadily, and, lifting a blunt gorget in the right hand, he placed the beak of it in the groove of the cystotome, and pushed it onwards till it glided from the groove of the cystotome along the groove of the staff into the bladder. Then, true to the principles of the apparatus major, and never forgetting his own peculiar theory—little incision and much dilatation—he forced his fingers along the gorget, dilated the neck of the bladder, and so made way for the forceps. (*J. Bell's Principles*, vol. ii.)

In 1741 Le Dran described an operation, the introduction of which has been claimed by several surgeons of a later period. The plan may be understood by the following brief explanation of it: "The first incision being made, I again pass the point of the knife into the curvature of the staff to the part where it bears against the perineum, and direct it to be held there by the assistant who supports the scrotum. This done, I take a large director, the end of which is made with a beak like that of a gorget, and, conveying this beak upon the blade of the knife into the groove of the staff, I draw the knife out. I then slide the beak of this director along the groove of the staff into the bladder, and I withdraw the staff by turning the handle towards the patient's belly. The following circumstances will sufficiently satisfy us that the director is introduced into the bladder. First, if it strikes against the end of the staff, which is closed. Secondly, if the urine runs along the groove. I next feel for the stone with this director, and, having found it, endeavour to distinguish its size and surface, in order to make choice of a proper pair of forceps, that is, one of a stronger or weaker make, or of a large or small size, agreeably to that of the stone, after which I turn the groove towards the space between the anus and tuberosity of the ischium, and, resting it there, convey a bistoury along the groove, the blade of which is half an inch broad, and about three-quarters of an inch long. I continue the incision made by the knife in the urethra, and entirely divide the prostate gland



laterally, as also the orifice of the bladder. The bistoury being withdrawn, the groove of the director serves to guide the gorget (a blunt one) into the bladder. I then introduce my forefinger along the gorget (which is now easily done, as the urethra and prostate being divided do not oppose its entrance), and with it I dilate the passage for the stone, in proportion to the size of which I discover it to be. This dilatation being made, I withdraw my finger and use the proper forceps." (*Le Dran's Operations*, Ed. 5, 1784. London.)

Pajola, of Venice, was the pupil of Le Cat, and his method resembles that of his master. He is stated to have cut for the stone 550 patients with success, which deserves notice, because his operation has for its principles dilatation, and no division of any part of the bladder. He makes an incision into the groove of the staff with a lancet-pointed double-edged knife, called an urethrotome, the blade of which has upon its centre a groove, that is continued to its point, and serves to guide the beak of another instrument, called the cystotome, into the groove of the staff. As the professed intention of the cystotome is only to cut the prostate gland, its name is ridiculous. It consists of a handle and very slender blade, which is not connected with the handle, but with its sheath, by means of a little joint, close to the beak. When the cystotome is opened as far as possible, the end of the blade, furthest from the beak, is twelve lines from the sheath. In this position it is held by a transverse piece of steel, which admits of being pushed more or less out at the option of the surgeon, and can be fixed by means of a screw. Pajola, like Scarpa, considers cutting the neck of the bladder dangerous, and he merely divides the prostate, after which he introduces a blunt gorget, and along this a species of forceps for dilating the neck of the bladder in all directions. (*X. F. Rudtorffer, über die Operation des Blasensteins nach Pajola's Methode.*) As Langenbeck observes, great as the success of this lithotomist has been, his method of operating has little to recommend it, and everything must be ascribed to his individual skill and intimate knowledge of the parts. Langenbeck even prefers Le Cat's method, in which there is no need of such a multiplicity of instruments. The blunt gorget and dilator are perfectly unnecessary, as the finger would do the purpose of both.

The danger of the beak of the gorget slipping out of the groove of the staff is one of the chief objections urged against the employment of the first of these instruments. In order to obviate this inconvenience, the late Sir Charles Blicke had the groove of the staff and the beak of the gorget so constructed that they locked into each other, and continued fixed, except near the extremity of the staff. This contrivance, though ingenious, is not resorted to, for the point of contact between the beak and body of the instrument is necessarily so small that it is liable to break. It is allowed, however, that this objection might be removed; but another one is still urged, viz. the beak and groove catching on each other, so as to resist the efforts made to introduce the gorget into the bladder. Every operator knows that much of the safety of the lateral operation, as performed at present, depends on the ease with which the beak of the gorget slides

along the groove of the staff. Le Cat in 1747 devised a similar instrument.

Some operators have a good deal of trouble in dissecting into the groove of the staff. Sir James Earle invented an instrument to facilitate this part of the operation. It consists of a short staff with an open groove, connected by a hinge with the handle of another staff of the usual size, shape, curvature, and length, which may be called the long staff. The hinge, by means of a pin, is capable of being disjoined at pleasure. The short staff is sufficiently curved to go over the penis and scrotum, and long enough to reach to that part of the long staff which is just below the beginning of its curvature. The end of the short staff, made somewhat like a pen with the sides sharpened, and finely pointed, is adapted to shut into the groove of the long staff, and its cutting edges are defended from being injured by a proper receptacle, which is prepared for it in the groove of the long staff. When the instrument is shut, the groove of the short staff leads into that of the long one, so as to form one connected and continued groove. The short staff is rendered steady by the segment of an arch, projecting from the long one through it. The long staff, separated from the short one, is first introduced in the usual manner, and, the stone having been felt, the short staff is to be put on the other at the hinges. The incision is then to be made in the usual manner, through the skin and cellular membrane, and a second incision through the muscles, so as nearly to lay bare the urethra. The operator then, being perfectly convinced that the extremity of the long staff is sufficiently within the bladder, must bring the end of the short staff down, and press it against the urethra, which it will readily pierce, and pass into the cavity prepared for it in the groove of the long staff. The two pieces being now firmly held together by the operator's left hand, nothing remains to be done except applying the beak of the gorget to the groove of the short staff, and pushing it on till it is received in the groove of the long one, and if this latter be made with a contracted groove it will just enter where the contraction begins, and thus must be safely conducted into the bladder. (*Earle on the Stone*, Appendix, Ed. 2, 1796.)

The late Mr. Dease, of Dublin, and Mr. Muir, of Glasgow, considering that the gorget was more apt to slip from the staff, in consequence of the latter being curved, and that its beak never slips from the groove of the staff in operating on women, proposed a method which in principle resembles that of Le Dran. They introduce, as usual, a curved grooved staff into the bladder, make the common incisions, and open the membranous part of the urethra, but, instead of introducing a gorget on the curved staff, they conduct along the groove a straight director or staff into the bladder, and immediately withdraw the other. The gorget is then introduced. The operation may be performed with a narrow bistoury, as advised by Mr. A. Burns.

*Of cutting towards the symphysis pubis.*—I have already made reference to the plan of dividing both sides of the prostate gland, as practised in 1804 by Dr. Physick, of the United States, and nearly thirty years ago by Sir Astley Cooper, with a beaked double-edged scalpel, or a double-edged gorget in cases where the stone was large,

and since occasionally adopted by Sir B. Brodie and others. In 1816 Baron Dupuytren made a trial of a method, which had indeed been suggested at an earlier period by Chaussier and Beclard (see *Velpéau, Nouv. Elem. de Méd. Opér.*, t. 3, p. 748), which consisted in making the first incision into the membranous part of the urethra, in a line with the raphe of the perineum, commencing about two inches and a-half in front of the anus, and terminating an inch from it. A second incision made parallel to the first divided the erector penis and the adipous cellular tissue, placed between the bulb of the urethra in front, and the rectum behind. In the third stage of the operation, the membranous portion of the urethra was laid open from the bulb to the verumontanum. The lithotome or bistouri caché was then introduced along the staff, and the latter withdrawn. The edge of the former was then turned upwards, towards the symphysis pubis, and the blade having been made to quit the sheath by pressing on a spring, the instrument was drawn out in this direction, so as to cut the neck of the bladder and part of its anterior parietes, the deepest portion of the upper side of the urethra, the superior part of the prostate, the cellular tissue between the anterior ligaments of the bladder, and the arterial and venous branches of this situation. (See *Clin. Chir.* t. ii., p. 373.)

This method was soon abandoned; in fact, as the opening was situated in the narrowest part of the arch of the pubes, it must have afforded but little room for the extraction of the calculus. The venous hæmorrhage would also be considerable.

**Bilateral Operation.**—In 1824 Baron Dupuytren began to employ his double lithotome with a staff that did not terminate in any *cul-de-sac*, which frequently impeded the disengagement of the lithotome from the deep groove of the instrument. The patient is placed in the usual position for the lateral operation, and the staff held by an assistant exactly in the vertical direction. While the left hand keeps the integuments of the perineum tense, the right makes, with a double-edged knife, a semilunar incision, convex upwards, beginning on the right, between the anus and the ischium, and terminating at the corresponding point on the left, the distance to which it passed from the anus forwards being five lines. The subcutaneous cellular tissue, the superficial fascia of the perineum, and the anterior point of the external sphincter, being divided so as to expose the origin of the membranous part of the urethra, the groove of the staff can be detected with the nail of the left forefinger, which will serve for guiding the point of the knife into it. During all this first stage of the operation care must be taken to depress the lower edge of the wound with the finger, and to keep the rectum away from the edge of the knife.

After the membranous part of the urethra has been sufficiently opened, the same finger-nail serves as a guide for the lithotome, which, held in the right hand, with the thumb below, and the two fingers next to it above, is applied to the staff with its convexity directed towards the anus. The contact of the two instruments having been clearly ascertained, the surgeon takes hold of the handle of the staff with his left hand, and, raising its beak under the symphysis of the pubes, pushes the double lithotome along its groove into the bladder.

The staff is now to be withdrawn, and the lithotome turned, so as to make its concavity face the anus. Its blades are then made to quit the sheath, and it is drawn out horizontally. The left forefinger is then introduced into the wound, so as to ascertain the extent of the incisions made, and to guide the forceps to the calculus. (See *Dupuytren in Clin. Chir.* t. ii., p. 390.)

Baron Dupuytren ascribed the following advantages to the bilateral operation:—

1. The great facility of its performance.
2. The situation of the wound in the widest part of the lower aperture of the pelvis, and consequently the most favourable for the extraction of large calculi.
3. This method makes a shorter and more direct passage into the bladder, whereby the requisite manœuvring with instruments is facilitated.
4. The readier escape of the urine through the wound, and consequently the removal of any risk of its becoming extravasated in the cellular tissue.
5. An opening is made in the neck of the bladder and the prostate, sufficient for the extraction of very large calculi without the wound passing so far on each side as to become dangerous.
6. The ejaculatory ducts are conceived by Dupuytren to be more safe from injury than in the common lateral operation.
7. The method is applicable to both sexes.

The bilateral operation has been performed about seventy times in the Hôtel Dieu and other parts of Paris, and only six of the patients died. In that hospital twenty-six patients were operated upon in succession, with complete success. (See *Dupuytren in Clin. Chir.* t. ii., p. 413.)

[Some abatement must be made from this estimate of advantages. The mortality of the bilateral operation is much higher than that above stated, being rather more than one in five. Dupuytren lost nine male patients out of thirty-eight. Of the forty-seven operations performed by Sanson, Roux, Blandin, and Velpéau, ten proved fatal. Finally, of twenty-three operations performed by Professor Eve, of the Nashville University, four terminated fatally. We have thus a mortality of one in four and two-thirds for the bilateral method.]

The bilateral method does not entirely exempt patients from the danger of hæmorrhage, for Dupuytren himself, Sanson, and others have lost patients from bleeding. There is the risk, if the blades be too widely separated, that they may come in contact with the rami of the ischia as the instrument is being withdrawn, and so divide both pubic arteries. This accident, we believe, happened to Dupuytren himself. With a narrow pubic arch it is not unlikely to occur. To avoid it, the instrument should always be depressed as far as possible while it is being withdrawn, in order that it may pass out through the widest part of the pubic arch. Professor Eve, of the United States, wounded the rectum in one of his operations. The principal advantage of the bilateral operation is, that it affords a free opening for the extraction of large calculi; but Mr. Liston, and many other surgeons in this country, think that it is quite time to divide the right side of the prostate whenever such a proceeding is found to be necessary during the course of the lateral operation.

Mr. Erichsen proposes a combination of the median and bilateral operations, by which he thinks the chief objections to both may be got rid of. It



is easy of execution, and well suited for the extraction of very large calculi from the bladder. The patient having been tied up, and a rectangular staff, deeply grooved, passed into the bladder, the urethra is opened at the membranous part, with the edge of the knife turned upwards, as in the median operation. The double lithotome is then slid along the staff into the bladder, its concavity turned downwards, the blades expanded to but a limited extent, and the prostate and the soft structures between it and the surface incised as it is withdrawn. If the stone be of moderate size the incision may be confined to one side only, and made with a probe-pointed bistoury. It will be found that sufficient space is obtained by the perpendicular incision in the skin, whilst the limited transverse cut removes that tension and resistance of the deeper structures, which in the ordinary median operation interfere seriously with the manipulation of the forceps and the extraction of the stone, and by the division of both sides of the prostate to a limited extent abundance of space is obtained. (*Science and Art of Surg.* p. 1020, vol. iii.)

We cannot quite agree with Mr. Erichsen that this is a combination of the median and bilateral operations, because the essential characteristic of the former is the avoidance of any division of the prostate or neck of the bladder. It is, more properly speaking, the bilateral method, with a median first incision instead of a transverse one. It has, moreover, the disadvantage that the external and internal parts of the wound do not correspond in their direction. M. Nélaton has proposed a similar method when speaking of Vacca Berlingheri's median operation: "Should the calculus prove to be larger than it was supposed to be, the incision may be enlarged by means of the lithotome, and the operation be thus transformed from the median into the bilateral."]

The double lithotome is now well constructed in London; and, when the stone is known to be of ample size, the bilateral operation, I think, merits the preference to all ordinary plans. [The blades are made to protrude in such a manner that they cut the prostate obliquely downwards and outwards on both sides, in which respect the instrument is superior to Sir B. Brodie's double-edged beaked knife for the bilateral section, which made the incisions in the transverse direction.] A posthumous work, illustrative of Dupuytren's bilateral operation, and containing several interesting plates, has been published.

Mr. Liston is of opinion that no complicated machine is requisite to make this bilateral division, and that it is quite time enough to make such division when the necessity for it has been ascertained. The single lateral incision affords sufficient room to admit of the removal of the stone in nineteen cases out of twenty, and there can be no purpose served, therefore, in always making a cut in both sides of the gland, and thus endangering the emasculation of the individual (*On Pract. Surg.* p. 414). I have already explained that several operators are in the habit of cutting the right side of the prostate gland with a knife, when the stone is above a certain size.

[*Quadrilateral operation.*—Under this title M. Vidal de Cassis proposed, in 1828, an extension of Dupuytren's operation, to be resorted to in cases

where the stone is very large. According to M. Vidal, the increased size of the stone does not demand an increase in the *extent* but an increase in the *number* of the incisions. Thus, for small stones one limited incision is sufficient, *taille unilatérale*; for stones of medium size, two limited incisions are required, *taille bilatérale*; for large stones, four limited incisions, *taille quadrilatérale*. In an ordinary case he would adopt Dupuytren's bilateral method; but if the stone were so large that, by attempting to overcome the resistance offered by the base of the prostate, the sides and angles of the incision were likely to be dragged upon and torn, he would introduce a blunt-pointed bistoury along the finger into the wound, and divide the prostate obliquely upwards and outwards, first to the left side (left upper oblique radius), and then to the right (right upper oblique radius). Should he prefer not to release his hold on the stone, he may entrust the forceps to an assistant, and make use of that instrument as a guide for the knife in making the incisions. The operation is quadrilateral, therefore, only as regards the prostatic incisions; the external incision is bilateral, and similar to that of Dupuytren's. It was not intended by its author to supersede other methods, but as an adjunct to them, to be resorted to in exceptional and difficult cases—and as such it is highly deserving of commendation. There need be no difficulty in carrying out the principle with the ordinary unilateral external incision. A four-bladed lithotome has been devised by M. Colombat, but is, we think justly, condemned by M. Vidal—first, because, in cases of very large stone, nearly filling the vesical cavity, there would often be no room to open the blades; secondly, that in withdrawing the instrument, a quadrilateral external incision would be made, which is not only not required, but would be very dangerous to all the arteries of the perineum; and, further, that the quadrilateral section of the prostate should only be regarded as a mode of completing the operation when the other incisions prove insufficient. (See *Traité de Pathol. Externe*, par A. Vidal de Cassis, t. iv. p. 821. Paris, 1860.)]

#### LITHOTOMY THROUGH THE RECTUM.

This method may be said to have been first suggested in a work published at Bale, in the sixteenth century, by an author who assumed the name of "Vegetius:" "Jubet per vulnus recti intestini, et vésicæ aculeo lapidem ejicere," says Haller, in speaking of this writer. (*Bibl. Chir.*, vol. i. p. 102.) Frère Côme cites an instance in which a recto-vesical fistula was kept up by the presence of a calculus, and cured by extracting the foreign body through the rectum. A fistula in the rectum was laid open by Camper, and a splinter of wood thus removed from the rectum. Recto-vesical fistule were several times cured in the Hôtel Dieu by Desault, who divided the sphincter so as to form a wound reaching to the perineum. These facts must have been sources of encouragement to the first regular attempts to perform lithotomy from the rectum. According to Clot-Bey, the recto-vesical operation has been performed from time immemorial in Egypt, where he has seen it practised by empirical persons, to whom an acquaintance with the mode of performing it had descended as a species of family property of very ancient inheritance. (See A. Velpeau, *Nouv. Elem. de Méd. Opér.* vol. iii. p. 782.) But the proposal never re-

ceived much attention in Europe until the year 1816, when M. Sanson, in France, gave an account of this manner of operating, and urged several considerations in favour of it. In that country the operation has been performed about thirty times by M.M. Sanson, Dupuytren, Peserat, Castara, Guillaume, Cazenave, Dumont, Taxil, and a few others. Dupuytren renounced the practice. It was also advocated by Vacca, Farnèse, Giorgi, Giudetti, and Lancisi. Almost as soon as this method was heard of on the other side of the Alps, it was put to the test of experience by Barbantini, in a case where every other plan of operating appeared hardly practicable. "The connection of the rectum with the urethra, prostate gland, and posterior part of the bladder (says M. Sanson), made me easily perceive that, by dividing the sphincter ani and some of the rectum near the root of the penis, I should expose not only the apex of the prostate gland, but a more or less considerable portion of this body, and that I should then be able to penetrate into the cavity of the bladder, either at the neck through the prostate, or at its posterior part." It was the latter method which M. Sanson first tried upon the dead subject. The body was placed in the position usually chosen for the common ways of operating, and a staff was introduced, and held perpendicularly by an assistant. A bistoury, with its blade kept flat on the left forefinger, was now introduced into the rectum, and the edge being turned upwards, M. Sanson, with one stroke, in the direction of the raphé, cut the sphincter ani and the lower part of the rectum. The bottom of the prostate gland being thus exposed, the finger was next passed beyond its solid substance, where the staff was readily perceptible through the thin parietes of the rectum and bladder. While the latter instrument was steadily maintained in its original position, M. Sanson here introduced the knife into the bladder, and, following the groove of the staff, made an incision about an inch in length. At this instance, the flow of urine from the wound indicated that the bladder had had an opening made in it. On examination, the parts divided were found to be the sphincter, the lower part of the rectum, the back part of the prostate, and the adjacent portion of the bladder. A second mode contemplated by M. Sanson was, after dividing the sphincter ani, to cut the termination of the membranous part of the urethra along the groove of the staff held perpendicularly, and by the same guidance to extend the incision in the median line through the prostate gland and neck of the bladder. [The first might with propriety be distinguished as the recto-vesical, and the second as the recto-prostatic operation.]

In Barbantini's case the calculus was so large that it made a considerable prominence in the rectum, where it was felt extending across from one tuberosity of the ischium to the other. On account of its size, its extraction by the lateral operation was considered impracticable; and as it was not thought advisable or easy to break such a mass, and Barbantini regarded the high operation as more difficult and uncertain in its results than the common method, it was determined to operate through the rectum. The attempt was delayed some days, by the impossibility of introducing the staff effectually, which was stopped at its entrance into the bladder by the calculus. But, as a grooved instrument was judged to be an essential guide, Barbantini caused a long director to be con-

structed, which he thought might be passed more conveniently than the staff into the first incision. He also provided himself with long forceps, the blades of which were very broad, and admitted of being put separately over the stone. A staff having been introduced, the operation was done after M. Sanson's manner, except that a wooden gorget was introduced for the protection of the rectum, and the prostate gland was left undivided at the forepart of the wound. When the bladder had been opened at the lower part of the rectum, as far as the groove of the staff served as a guide, the latter instrument was withdrawn, and the long director introduced into the incision, which, under its guidance, was then enlarged to the necessary extent. With some difficulty the stone was then extracted, and found to weigh nine ounces and a half. For about eighteen days the urine passed away by the anus, only a few drops occasionally issuing from the urethra. As this circumstance gave Barbantini some uneasiness, he introduced his finger into the bladder, the inner surface of which, near the wound, he found covered with encysted calculous matter, which was very adherent. At length, however, it was gradually removed, with a portion of new-formed membrane, by attempts repeated with the finger several days in succession. A catheter was then introduced, through which, at first, almost the whole of the urine flowed. But, the tube being afterwards obstructed with mucus, it became necessary frequently to clear it by injecting tepid water. The cure now seemed to proceed with rapidity. When the feces were hard, none of them passed into the bladder; but when they were liquid, a part of them was voided with the urine through the tube, though without any inconvenience. At the end of fifty days scarcely any urine passed out of the wound; the patient, therefore, went into the country, where, in the course of another month, the cure was complete.

A few years ago I saw an example in which a calculus had made its way through the prostatic portion of the urethra, and formed, with the swelling of the soft parts, a considerable prominence within the rectum. If the patient had been under my care, I should certainly have made an incision directly on the tumour just within the sphincter, by which means the calculus might have been removed with great ease, and less risk than dividing the prostate. However, the latter method was followed, and the case had a very favourable termination. In this instance, as the sound, in its passage, only occasionally touched a small point of the calculus, which approached the urethra, and this just at the instant before its entrance into the cavity of the bladder, the exact nature of the case was for some time a matter of doubt to several skilful surgeons who were consulted.

Respecting the merits of lithotomy through the rectum, Scarpa, who decidedly condemns it, acknowledges that a large calculus may indeed be thus extracted more speedily, and with less risk of injury to important parts, than by the high operation; "but," says he, "in addition to the consideration that, in such cases, every mode of operating is contra-indicated by the morbid state of the bladder, it is to be recollected that after the recto-vesical method, there is always left an open passage for the feces from the rectum into the bladder, and for the urine from the bladder into



the rectum. Of three individuals, within his knowledge, who have been operated upon in this manner for very large stones, two died soon afterwards of sloughing of the bladder, and the third led for some time a miserable existence, discharging faecal urine, and urine mixed with excrement. Instructed by these disasters, some Italian surgeons, not declared advocates for the new method, very laudably endeavoured to obviate them in future; and having ascertained that, for the extraction of a stone of moderate size, such as can be conveniently taken out by the perineum, it is not at all necessary to open the fundus of the bladder, they adopted Sanson's second method—viz. that of cutting the sphincter ani from below upwards, and then laying open vertically, from above downwards, the membranous part of the urethra and the prostate gland, so as to let the knife meet the first wound in the sphincter." "In fact (says Scarpa), they really attained their object, namely, that of hindering the faeces from entering the bladder after the extraction of the stone. This was, no doubt, of great importance in their operation, yet, as it seems to me, not a consideration that ought to make the recto-vesical preferable to the lateral operation, whenever the stone can be taken out through the perineum: first, because the vertical section of the membranous part of the urethra, and the prostate gland, cannot be executed without separating the left seminal duct, and sometimes the right one, from the vas deferens and vesicula seminalis of the same side; secondly, because the wound is still exposed to the contact of the faeces." (*Sul Taglio Retto-Vesicale*, p. iv. Also, *Opuscoli di Chirurgia*, vol. i. p. 69). In reply to Vacca's observations, he urges also against the recto-vesical operation, according to Sanson's first method, when the wound must be made extensive enough for the removal of a large calculus, the risk there is of wounding the fold of the peritoneum, which, if the bladder is thickened and contracted, descends lower than is generally supposed (p. 36). This accident really happened in one case, which was dissected by Geri of Turin. (*Report Med. Chir. de Torino*, No. 18.)

Here we discern a strong reason against Mr. Sleight's modification of the operation, in addition to the probability of an incurable communication between the rectum and the bladder, as sufficiently proved in the history of the recto-vesical operation. (See *Scarpa's Opuscoli*, vol. i.) The part of the bladder which Mr. Sleight proposes to divide is the same as in the method first proposed by Sanson, and is bounded laterally by the vasa deferentia and vesiculæ seminales, superiorly by the *cul-de-sac* of the peritoneum, and inferiorly by the prostate gland and the union of the seminal tubes. The chief peculiarity in the plan is that of not dividing the sphincter ani and the prostate gland. Cutting the first part, he conceives, perhaps without sufficient foundation, must seriously increase the patient's sufferings; while dividing the prostate gland vertically cannot be done without injuring one of the seminal ducts, a point on which he is more correct, and in agreement with Scarpa. In endeavouring to avoid this danger, however, he runs into a still more formidable one, viz., that of wounding the *cul-de-sac* of the peritoneum, and exciting fatal inflammation within the abdomen. (See *Sleight's Essay on an Improved Method of Cutting for Urinary Calculi, or the*

*Posterior Operation of Lithotomy*, 8vo. London, 1824.)

Even when the stone is of extraordinary magnitude, it may be doubted whether the recto-vesical method ought to be preferred either to the high or the lateral operation; by which last stones of larger size than that extracted by Barbantini have been successfully taken out by Sir A. Cooper, Mr. Mayo of Winchester, Dr. Klein of Stuttgart, and others. We must agree, I think, with M. Velpeau, that it is quite an error to refer the difficulty of extracting a large calculus to the want of space between the bones; and he, like Scarpa, cannot conceive how, in any method of lithotomy, the lower aperture of the pelvis, if regularly formed, can hinder the extraction of the stone. The embarrassment always arises from the opening in the bladder. In the recto-vesical operation the opening is restricted to the portion of the bladder between the prostate and the *cul-de-sac* of the peritoneum, so that it can be only, at the utmost, from twelve to fifteen lines in extent. Where then, inquires M. Velpeau, is the advantage, since in the bilateral operation an opening may be obtained from fifteen to twenty lines in extent? And if the surgeon chose to cut the neck of the bladder beyond the base of the prostate, an opening two inches and a-half might be formed in the bilateral operation, which in the recto-vesical method would be impracticable, without the greatest risk of wounding the peritoneum. (See *M. Velpeau in Nouv. Elem. de Méd. Opér.* t. iii. p. 791.) Another serious consideration is, whether a large incision forming a communication between the bladder and rectum will generally heal up as well, or even more favourably, than in Barbantini's case. A smaller wound in the same part, it appears, may be soon cured; for, in the instance reported by Sanson, the boy was quite well on the twentieth day. On this point, it must be confessed, modern reports are becoming extremely unfavourable. Of seven patients operated upon with division of the fundus of the bladder (says Professor Vacca), four were left with a recto-vesical fistula, and the fifth was in danger of one. In four cases operated upon, Professor Geri knew of three such terminations. Besides these facts, observes Scarpa, of which I could increase the number by others within my knowledge, it is to be taken into the account that in some individuals the faecal and urinary fistula, after seeming to be closed for some time, has opened again. (*Sul Taglio Retto-Vesicale*, p. 40.) In the School of Practical Surgery at Turin, out of five operated upon through the rectum three died, although eleven other patients, cut in the lateral way, all recovered in a short time. Only one had rather severe symptoms, which were ascribed to a wound of the rectum. Dupuytren, who tried the recto-vesical operation in six instances, as performed by Vacca, lost three of his patients of inflammation within the pelvis. The first patient died a fortnight after the operation, and two on the third day. The three others remained with incurable fistulae, through which the urine continually dribbled, or was partially expelled when the bladder contracted. (See *M. Louis Senn, Parallèle de la Taille*, Paris, 1824; Scarpa, *Opuscoli di Chirurgia*, vol. i. p. 135). Dupuytren, on being asked one day if he would still try the plan, made no answer, but shook his head. Barbantini, who first put

the operation to the test of experience in Italy, has, after further trials of it, and the mature consideration of Scarpa's objection to it, candidly acknowledged its great disadvantages in comparison with the lateral operation. (See *Scarpa's Opuscoli di Chirurgia*, vol. i. p. 100). Riberi also saw two children cut by Sanson at Paris; one died a few days afterwards of peritonitis; and the other had been given up before his departure from that city. (*Ragguaglio di tredici Cistotomie*, Torino, 1822; and *Scarpa, sul Tuglio Retto-Vesicale*, p. 55.)

[Facts such as those above mentioned caused recto-vesical lithotomy to be almost entirely abandoned. Sanson's first method has no advocate among modern authorities; and, with respect to his second plan, the only surgeon who has practised it at all recently is, we believe, the late Mr. Lloyd, of St. Bartholomew's Hospital. Mr. Lloyd's operation closely resembled Sanson's; he commenced with the median incision through the perineum, sphincter ani, and lower extremity of the rectum; he then entered the membranous part of the urethra, and passed his knife onwards into the bladder through the prostate; but it is not clear whether he made a free incision of the gland, or a limited incision combined with dilatation. This recto-prostatic incision is no doubt a far less hazardous proceeding than Sanson's first method of cutting into the bladder behind the prostate, and it is also less likely to be followed by urinary fistula. It is, however, not entirely free from this latter risk; for Mr. J. Lane has recently recorded the case of a youth aged 19, who had been operated upon by Mr. Lloyd two-and-a-half-years previously, in whom there was a fistulous communication between the rectum and the urethra just in front of the prostate. The patient was admitted into St. Mary's Hospital, and the fistulous opening was successfully closed by a plastic operation. (See *Lancet*, Feb. 6, 1864, p. 151.) Dr. Marion Sims has recorded a case in which, in 1859, Dr. Bauer, of New York, removed a stone by the recto-vesical incision behind the prostate, the wound being immediately closed by Dr. Sims with silver-wire sutures. The patient was placed on his left side, and Dr. Sims' speculum was introduced into the rectum, exposing the anterior wall of the rectum, just as it would the vagina in the female. A sound was passed into the bladder. Dr. Bauer entered the blade of a bistoury in the triangular space bounded by the prostate, the vesiculæ seminales, and the peritoneal reduplication. He passed the finger through this opening, felt the stone, and removed it with the forceps. Dr. Sims then closed the wound with silver sutures, introducing some five or six wires with the same facility as in the vagina. There was no leakage of urine. The wires were removed on the eighth day, and on the ninth the patient was able to ride out in a carriage. Dr. Sims remarks, that the facility and safety of executing recto-vesical lithotomy (except in children for anatomical reasons), and the success of closing at once the cut by the introduction of metallic sutures, ought to make this the operation in the male. (See *Lancet*, Jan. 23, 1864, p. 110.) This is an immense improvement on the old recto-vesical operation, not only as regards the immediate closure of the wound, but in the dispensing altogether with the external incision of the perineum and sphincter. But while according to Dr. Sims

the fullest credit for his success in this instance, we are not prepared to endorse his opinion that the plan is one calculated for general adoption, or to admit that it possesses any independent merits of its own which should entitle it to preference over the lateral operation. On the other hand, it is open to some serious objections. In the first place, the attempt to close the wound by suture will be very apt to fail when undertaken by operators less practised in such matters than Dr. Sims, and the difficulty of inserting and fastening the sutures at such a depth within the rectum will deter many from attempting it. But, setting aside this, it must always be remembered that an incision of any extent into the base of the bladder behind the prostate cannot be made without risk of wounding the recto-vesical fold of the peritoneum—an accident which would be pretty surely followed by fatal results. The recto-vesical fold is not placed transversely between the points of entrance of the ureters, but projects forward between them so as to form a *cul-de-sac*, which varies in depth in different individuals. In an empty bladder this fold approaches in the median line to the posterior border of the prostate, and in most persons the bladder must be greatly distended to carry the line of reflection backwards more than an inch from this point. A longitudinal incision cannot therefore be made to the extent of an inch in this part of the bladder without a risk of wounding the peritoneum; and the risk is enhanced in cases where the bladder is irritable, and resents the presence of more than a small quantity of urine, or where it is thickened by chronic inflammation and hypertrophy of the muscular coat—conditions very likely to be present when a stone has been lodged for any length of time in the bladder. If there were any grounds for preferring lithotomy by the rectum to the lateral operation, it would probably be better not to make the incision so far back, but to adopt the *recto-prostatic* incision in preference to the *recto-vesical* incision; omitting, of course, all external incisions of the perineum, but exposing the interior of the rectum with a speculum, and closing the wound by suture immediately after the extraction of the stone. (See *Remarks on Recto-Vesical Lithotomy* by J. R. Lane, *Lancet*, Feb. 6, 1864, p. 151.)]

William Coulson.

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## LITHOTOMY IN THE FEMALE.

Women suffer less from stone than men, and far less frequently stand in need of lithotomy. It is not, however, that their urine will not so readily produce the concretions which are termed urinary calculi. The reason is altogether owing to the shortness, largeness, and very dilatable nature of the female urethra; circumstances which render the expulsion of the stone with the urine the common result. The records of surgery present us with numerous instances where calculi of vast size were spontaneously voided through the meatus urinarius, either suddenly without pain or after more or less time and suffering. Heister mentions several well-authenticated examples. Middleton has also related a case, where a stone weighing four ounces was expelled in a fit of coughing, after lodging in the passage a week. Colot speaks of another instance, where a stone, about as large as a gosse's egg, after lying in the meatus urinarius seven or eight days, and causing a retention of urine, was voided in a paroxysm of pain. A remarkable case is related by Dr. Molineux in the early part of the *Phil. Trans.*: a woman voided a stone, the circumference of which measured the longest way seven inches and six-tenths, and round about where it was thickest five inches and three-quarters; its weight being near two ounces and a half troy. And Dr. Yelloly has related an interesting example, in which a calculus, weighing three ounces three-and-a-half drachms troy, and lodged in the meatus urinarius, was easily taken out with the fingers. (See *Med. Chir. Trans.* vol. vi. p. 577.) Dr. Yelloly also refers to several other remarkable instances, described in the *Philosophical Transactions* (vols. xii. xv. xvii. xx. xxxv. xlii. and lv.), proving what large stones will pass out of the female urethra, either spontaneously or with the aid of dilatation and manual assistance. Were any doubts now left of this fact, they would be immediately removed by other histories, especially those contained in the papers by Sir A. Cooper. (See *Med. Chir. Trans.* vols. viii. and xii.)



Sometimes, after the passage of large calculi, the patient is afflicted with an incontinence of urine; but in general this grievance only lasts a short time.

When surgeons began to consider the magnitude of calculi sometimes spontaneously voided, and the large size and dilatable nature of the female urethra, they suspected that it might be a good practice to dilate this passage by mechanical contrivances, until it would allow the stone to be extracted, and thus supersede all occasion for cutting instruments. With this view, Tolet first proposed suddenly dilating the passage with two steel instruments, called a male and female conductor, between which the fingers or forceps were passed for the removal of the calculus. (*De la Lithotomie*, Paris, 16 l.) But as it was afterwards judged that the dilatation would produce less suffering and injury if more gradually effected, Douglas suggested the practice of dilating the meatus urinarius with sponge or dried gentian root.

Mr. Bromfield published the case of a young girl, in whom he effected the necessary dilatation by introducing into the meatus urinarius the appendicula cæci of a small animal in a collapsed state, and then filling it with water by means of a syringe; thus furnishing a hint for the construction of instruments on the principle of Dr. Arnott's dilator. The piece of gut thus distended was drawn out, in proportion as the cervix vesicæ opened, and in a few hours the dilatation was so far accomplished that the calculus had room to pass out. (*See Chir. Obs. and Cases*, vol. ii. p. 276.)

Mr. Thomas met with a case, in which, after dilating the meatus urinarius with a sponge tent, he succeeded in extracting an earpicker, which lay across the neck of the bladder. The passage was so much enlarged that the left forefinger was most easily introduced, and (says this gentleman) "I believe, had the case required it, both thumb and finger would have passed into the bladder without the smallest difficulty." After adverting to this and other facts, proving the ease with which the female urethra can be dilated, Mr. Thomas remarks: "If these relations can be credited, and there is no reason why they should not, I can hardly conceive any case in a young and healthy female subject, and where the bladder is free from disease, where a very large stone may not be extracted without the use of any other instrument than the forceps, the urethra having first been sufficiently dilated by means of the sponge-tents. For this purpose the blades of the forceps need not be so thick and strong as those commonly employed." (*See Med. Chir. Trans.* vol. i. pp. 123-129.) Many facts of a similar kind are on record, and one, in which a large needle-case was extracted, is referred to in a modern periodical work. (*See Quarterly Journ. of Foreign Med.*, vol. ii. p. 331.)

Some surgeons have extracted stones from the female bladder in the following manner:—The patient having been placed in the position commonly adopted in the lateral operation, a straight staff, with a blunt end, is introduced into the bladder through the meatus urinarius. The surgeon then passes along the groove of the instrument the beak of a blunt gorget, which instrument becoming wider towards the handle, effects

a part of the necessary dilatation. The staff being withdrawn, and the handle of the gorget taken hold of with the left hand, the right forefinger, with the nail turned downwards, is now introduced slowly along the concavity of the instrument. When the urethra and neck of the bladder have thus been sufficiently dilated, the finger is withdrawn, and a small pair of forceps passed into the bladder. The gorget is now removed, and the stone taken hold of and extracted. (*Sabatier, Méd. Opér.* t. ii. p. 103.)

This plan, however, has been objected to on account of the dilatation being too suddenly effected, and the practice of gradually expanding the meatus urinarius with the sponge tent preferred. The retention of urine during the continuance of the sponge certainly causes great irritation; and, if this method be followed, therefore, I consider Mr. C. Hutchinson's suggestion of placing a catheter in its centre, as mentioned by Sir A. Cooper, worthy of attention. (*See Med. Chir. Trans.* vol. viii. p. 433.)

Sir A. Cooper, who is an advocate for the practice of removing calculi from the female bladder by dilating the meatus urinarius, now employs for this purpose "an instrument constructed upon the principle of the speculum ani and speculum oris," and which has the advantage of permitting the urine to escape, whilst it dilates the passage sufficiently for the entrance of the forceps, and the removal of a stone of considerable dimensions. He believes that, "if the stone be small, the dilatation should be accomplished in a few minutes; but that if it be large, it will be better to dilate only a little from day to day, until the greatest degree of extension is accomplished; carefully avoiding contusion, which is much to be dreaded." (*See Med. Chir. Trans.* vol. xii. p. 240.)

Three or four years ago, I assisted Mr. Walne, of Guildford Street, in extracting a calculus, which was an inch and a half in one of its diameters, from the bladder of a girl eight or ten years old. The meatus was first gradually dilated with Weiss's dilator: the incontinence of urine following the operation after a time subsided. I have also seen a piece of spermaceti candle, five inches long, and of the usual thickness, which had accidentally slipped into the bladder, taken out with the finger, after the meatus had been dilated for two or three hours with the same instrument; and in this case no incontinence of urine followed.

Notwithstanding these favourable accounts of the practice of dilating the female urethra, for the purpose of removing calculi from the bladder, there are very good surgeons who deem an incision the best practice. It is certain that some patients have found the method insufferably tedious and painful. But the strongest objection is the incontinence of urine, which occasionally follows a great distension of the urethra and neck of the bladder. Klein, one of the most experienced operators in Germany, states that he has tried both plans, and that the use of the knife is much less frequently followed by incontinence of urine. And Scarpa declares that when the calculus is large, and not soft and fragile, the method of extracting it by dilatation is almost always followed by incontinence of urine. (*Sul Taglio Retto-Vesicale*, p. 49.) On the other hand, Mr. Thomas believes that this unpleasant symptom is quite as often a consequence of the operation of lithotomy as now usually per-



formed (*Med. Chir. Trans.* vol. i. p. 127); and Sir A. Cooper expressly states that the greatest advantage of his mode of extracting calculi with a dilating instrument is the preservation of the power of retaining the urine. (See *Med. Chir. Trans.* vol. xii. p. 240.) Of the propriety of removing calculi under a certain size, and also pieces of broken catheter, &c., in this manner, no doubt can be entertained; but if the foreign body were very large, I should consider an incision the safest and least painful practice.

In females lithotomy is much more easy of execution, and less dangerous, than in male subjects. It may be done in various ways; but the surgeons of the present time constantly follow the mode of making the requisite opening by dividing the urethra and neck of the bladder. Louis employed for this purpose a knife which cut on each side, and was contained in a sheath; Le Blanc, a concealed bistoury, which had only one cutting edge; Le Cat, his gorgeret-cystitome; Frère Côme, his lithotome caché. Of these instruments the best, I think, is that of Frère Côme. But at present every surgeon knows that the operation may be done, as conveniently as possible, with a common director, and a knife that has a long, narrow, straight blade. A straight staff, or director, is introduced through the meatus urinarius; the groove is turned obliquely downwards and outwards in a direction parallel to the ramus of the left os pubis; and the knife is thus conducted into the bladder, and makes the necessary incision through the whole extent of the passage and neck of the bladder.

Louis and Fleurant, as I have said, were the inventors of particular bistouries for dividing both sides of the female urethra at once. The instrument of the former effected this purpose in passing from without inwards; that of the latter in passing from within outwards. Fleurant's bistoury bears some resemblance, in principle, to Frère Côme's lithotome caché, or to the cutting forceps with which Franco divided the neck of the bladder. The reason assigned as a recommendation of these bistouries is, that they serve to make a freer opening for the passage of large stones than can be safely made by cutting only in one direction.

Dubois adopted a method which consists in dividing the meatus urinarius directly upwards towards the symphysis of the pubes, dilating the wound, and then taking out the calculus with the forceps. The invention of this method, which has been referred to Dubois, is at least as ancient as the sixteenth century. Paré assigns the merit of it to Colot, who made a small incision "tout au dessus, et en ligne droite de l'orifice du col de la vessie, et non à côté." This plan, as revived by Dubois, is executed either with a director and bistoury, or a lithotome caché. If the first instrument be used, a director, having a deep groove in it, that is closed at its extremity, is introduced into the meatus urinarius, with the groove turned upwards. The surgeon takes hold of the handle with his left hand, and, by means of the director, depresses the fore-part of the vagina with a certain degree of force. With the right hand he introduces along the groove a narrow sharp bistoury, with which the upper side of the urethra is to be divided through its whole extent, and the adjacent textures as far as the subpubic ligament. "Thus (says M. Velpeau) an opening six or eight lines long may

be formed, or, indeed, one from eight to ten lines in length, when the attempt to draw out the stone is made." However, it appears to him that it would be dangerous to try to extract in this manner any calculus the dimensions of which exceed an inch or fifteen lines. However, he saw M. Bongon remove one of this size from a young woman, who perfectly recovered; and M. Thomas, of Tours, was equally successful in a similar case. In withdrawing the forceps, it is necessary to press forcibly upon the lower side of the meatus, and to draw out the calculus in a sufficiently low direction; for otherwise it would be pulled against the back of the symphysis pubis. In 1824 this occurrence baffled for a considerable time an excellent operator in one of the hospitals in Paris, though the calculus was not larger than a partridge's egg. On changing the direction of the forceps, it was easily extracted. (See M. Velpeau, *Nouv. Elem de Méd. Opér.* t. iii. p. 847.) Lisfranc also carries the incision upwards, and a little to one side of the symphysis of the pubes, because this mode of operating he finds less frequently followed by incontinence of urine than others. When the opening thus made is not large enough, he makes another cut obliquely downwards and outwards. When the stone is known to be very large, Sabatier prefers the apparatus altus.

A case may present itself in which the posterior part of the bladder drawn downwards by the weight of the stone may displace a portion of the vagina, and make it protrude at the vulva in the form of a swelling. Here there would be no doubt of the propriety of cutting into the tumour, and taking out the foreign body contained in it. Rousset performed such an operation, and Fabricius Hildanus, in a case where the stone had partly made its way into the vagina, enlarged the opening, and successfully extracted the foreign body.

Méry proposed to cut into the posterior part of the bladder, through the vagina, after introducing a common curved staff; but the apprehension of urinary fistulæ made him abandon the project.

Extraordinary circumstances may always render a deviation from the common modes of operating, not only justifiable, but absolutely necessary. Thus Tolet met with a case where a woman had a prolapsus of the uterus, with which the bladder was also displaced. In the latter viscus several calculi were felt; an incision was made into it, and the stones having been extracted, the displaced parts were reduced, and a cure speedily followed. (Sabatier, *Méd. Opér.* t. ii. p. 107.)

Incontinence of urine, consequent on lithotomy in women, is by no means infrequent. Mr. Hey cut two female patients for the stone, both of whom were afterwards unable to retain their urine, and were not quite well when discharged from the Leeds Infirmary. These cases led him in a third example to endeavour to prevent the evil by introducing into the vagina a cylindrical linen tent, two inches long and one broad, with a view of bringing the edges of the incision together without obstructing the passage of urine through the urethra. The plan answered, if it be allowable to make such an inference from a single trial. (See Hey's *Practical Obs. in Surgery*, p. 560, ed. 1810.)

[It is well known, as the author has observed,

that women are less liable to stone than men; but beyond this general fact little more precise information has been determined. If we take hospital reports it would appear that for about twenty males operated on for calculus there will be one female; but for obvious reasons it is probable that the proportion of females affected by stone is much higher.

Although the abstraction of a stone from the female bladder is so much more simple than lithotomy in the male, yet the former operation has undergone a much greater variety of modifications than the latter. The various methods which have been proposed will require some further consideration, and it will be convenient to offer a few additional remarks on each separately. In comparing them, there are two points to be borne in mind—first, that the operation should be as far as possible free from immediate danger to the patient; secondly, that it should be as far as possible free from the risk of subsequent incontinence of urine.

*Dilatation of the Urethra.*—It has been shown in the present article that this has for a long time been the favourite method of removing calculi from the female bladder; and there is no doubt that it is still, in the present day, more resorted to than any other. The facility of performance and freedom from danger to life will always strongly recommend it to both surgeon and patient; and for small stones, the opinion is, we believe, unanimous that it deserves preference over every other proceeding. But with a large stone there is always the risk that the excessive dilatation may so far injure the sphincter fibres at the neck of the bladder, that the patient is left with a permanent inability to retain her urine—a condition the misery of which is incalculable, and which surgery can do little or nothing to relieve. Nearly every writer on the subject, both formerly and in recent times, has noticed the liability to this unfortunate accident; and it would be, therefore, highly desirable if we could decide to what extent dilatation may be safely practised. No doubt there are many authentic cases recorded where stones of large size have been removed through the urethra without being followed by incontinence, but this result can never be reckoned upon with certainty, and it in no way alters the fact that it is impossible to say beforehand how much distension any particular urethra will endure without permanent and irreparable damage. We are disposed to fix, as a maximum for this operation, a measurement of about three-quarters of an inch in the short diameter of the stone for an adult, and half an inch in children. For larger stones than this there are other and preferable methods, which will be presently alluded to.

The question next arises, whether rapid or gradual dilatation is to be preferred. On this point there has always been and there still is a considerable difference of opinion.

Mr. Coulson is in favour of immediate or rapid dilatation, and has removed a stone four ounces in weight which had formed round a hair-pin without any incontinence resulting. He thinks that the liability to incontinence after dilatation has been exaggerated.

Mr. Bryant, of Guy's Hospital, is also in favour of rapid dilatation, on the principle that elastic tissues recover their tone more readily when rapidly stretched than when subjected to a slow and tedious process of extension. He

also thinks that the risk of permanent incontinence is not so great as is generally supposed. In corroboration of these views, he has tabulated twenty-eight cases of vesical calculus removed by urethral dilatation, in only four of which was there any subsequent incontinence. In each of these four, the urethra had been *slowly* dilated, whilst in most of the twenty-four successful cases the dilatation had been *rapid*. Two successful cases of his own are recorded in the same paper. (See *Med. Chir. Trans.* vol. xlvii. p. 151, 1864.)

On the other hand, Dr. Humphry, of Cambridge, has recently recorded some very successful cases, in which he dilated the urethra gradually by means of catgut bougies, taking from twenty-four to forty-eight hours to complete the process. The catgut bougies, swelling with the moisture, dilate the passage in the most gentle and gradual manner. After three or four hours, two or three more bougies are to be inserted, and additional ones in such numbers and at such intervals as may be found to be desirable, until the requisite dilatation is effected. Dr. Humphry mentions several cases, in which stones, some of them of large size, were removed in this way. All the patients recovered quickly and completely. (See *Lancet*, July 30, 1864.)

*Incision of the Urethra* is the next method to be considered. The urethra and neck of the bladder have been divided in every conceivable direction for the removal of stone—directly downwards towards the vagina—downwards and outwards parallel with the rami of the pubes and ischium, on one or on both sides—horizontally on one or both sides—upwards and outwards towards the pubic ramus—directly upwards towards the pubic symphysis. Incision also has often been used as an adjunct to dilatation.

The vertical incision directly *downwards* has been recommended by Professor Chelius, of Heidelberg; a grooved staff is introduced into the bladder, and its convexity made to press downwards. The knife or lithotome caché is then carried along the groove into the bladder, dividing directly downwards in the median line the neck of the bladder, the urethra, and the corresponding wall of the vagina.

The incision of the urethra and neck of the bladder downwards into the vagina affords great facility for the extraction of a stone, and is attended with but little if any immediate risk; but it is nevertheless a very objectionable operation. The thin divided edges of the urethra gape widely apart; no union is likely to take place, and incontinence of urine will be the certain result. The attempt has been occasionally made of late years with varying success to remedy this defect, by the immediate insertion of sutures to keep the cut surfaces in contact; but if the stone is to be removed through an incision, and the edges are to be brought together by suture, it is useless to divide the urethra in its whole length. Nothing is gained by commencing the incision farther forwards than opposite the vesical orifice of the urethra; division of that canal affords no additional room for the extraction of a stone, while its cut edges are so thin and delicate, that they are much more difficult to unite by a plastic operation than are the denser textures of the vesico-vaginal septum corresponding to the neck and base of the



bladder. This subject will be again alluded to in speaking of vesico-vaginal lithotomy.

The incision *downwards and outwards* was recommended by Le Dran, and is occasionally employed at the present time; a straight staff is passed into the bladder; the operator then grasps the handle of the staff, and directs its groove obliquely downwards and outwards towards the ramus of the ischium. A probe-pointed bistoury is placed in the groove of the staff, and the whole length of the urethra is divided. The neck of the bladder may also be divided at the same time, if the size of the calculus should render this necessary.

The incision downwards and outwards is, perhaps, slightly less objectionable than the incision directly downwards, but this is all that can be said in its favour.

Dionis practised a double *horizontal* incision of the urethra with a narrow bistoury. He first divided the anterior portion of the canal horizontally on both sides, and then had recourse to dilatation. Dionis, however, candidly acknowledged that three-fourths of the women on whom he operated remained affected with incontinence of urine.

Mr. Liston introduced a modification of Dionis's method by cutting *upwards and outwards*. He notched the neck of the bladder only, on both sides, towards each ramus of the pubis, and then dilated with the fingers. His plan was "to widen the urethra gradually by means of the screw dilator, then by the introduction of a straight blunt-pointed knife to notch the neck of the bladder slightly towards each ramus of the pubes, so as to divide the dense fibrous band encircling it; the dilatation is continued, and, in a few minutes, the finger can be admitted. Incontinence of urine may follow the operation from the distension of the sphincter of the bladder, but in a few weeks this will generally cease." (*Pract. Surg.*, ed. 4, p. 525.)

The incision *directly upwards* dates from the time of Ambrose Paré. Its history has been already alluded to. Sir B. Brodie practised a limited incision in this direction, combining it with dilatation, and appears to have been well satisfied with the result. The combination of incision upwards with dilatation has also been recommended by Sir P. Crampton. (See *Dublin Quart. Jour. of Med. Science*, February 1847.) It does not appear, however, that it can always be depended upon not to produce incontinence of urine. Two average-sized stones were recently extracted by means of the incision upwards by Mr. Ure, in St. Mary's Hospital, with a very satisfactory result, the patient being able to retain her urine almost immediately after the operation. The incision made was a very free one, to which, and the consequent avoidance of distension or laceration, may perhaps be attributed the very favourable termination of the case. (See *Lancet*, Nov. 8, 1862.)

Of all the urethral methods, the incision upwards, and perhaps also that upwards and outwards, are the only ones at all deserving of recommendation. They are not, like the others, attended with the disadvantage of laying one mucous canal open into another when the two are only separated naturally by a thin partition; and they are therefore more likely to heal by granulation, and not to interfere subsequently with the retentive functions of the canal. The free incision upwards may perhaps be not altogether devoid of the risk of urinary infiltra-

tion into the loose areolar tissue between the bladder and the symphysis pubis; but the urethra, which is situated at the bottom of the incision, forms so convenient a groove for the escape of urine, that this risk is probably not very great. It is, however, only adapted for the removal of stones of moderate size, because the bladder and urethra are divided in a direction which affords only a limited space for their extraction.

*Vestibular Operation.*—With a view to reach the neck of the bladder without the disadvantage of laying open the urethra in its whole length, a method which is said to have been practised by Celsus was revived by Lisfranc, under the above title. It is in many respects objectionable, and it is not intended to recommend its re-adoption; but it is of sufficient interest, as one of the modes in which the bladder may be reached, to warrant its description in this place. The *vestibule* is the triangular smooth space bounded on each side by the nymphæ, and below by the meatus urinarius and commencement of the vagina, the clitoris being situated at its superior angle or apex. An ordinary grooved staff is introduced into the urethra, with its convexity turned upwards towards the symphysis pubis—that is to say, its ordinary position as used in the male is reversed. A curved incision, with its convexity upwards, parallel with the arch of the pubes, is then to be made across the centre of the vestibular space, and the tissues intervening between the pubes above and the urethra below are to be divided, until the grooved staff can be felt in the urethra near its vesical termination. The urethra is to be opened on its upper surface, near the neck of the bladder, by cutting into the groove of the staff, and the incision is to be extended through the neck of the bladder either in the transverse or vertical direction. The obvious disadvantages of this method are, that the incision has to be made through so inconveniently narrow a space, and that the stone has to be extracted through the narrowest part of the arch of the pubes. The confined condition of the wound must also create a risk of urinary infiltration about the neck of the bladder. The plan, indeed, seems to have been ultimately abandoned by Lisfranc himself.

*Lateral Operation.*—A very much better method of reaching the neck of the bladder without laying open the urethra may be described under the above title. It is, as nearly as the different structure of the parts will permit, the counterpart of the lateral operation in the male. Its introduction is due to Dr. Andrew Buchanan, of Glasgow, though something very like it appears to have been practised by Frère Jacques; but it was condemned in succession by several writers of note, apparently without sufficient grounds. It may be performed in the following manner:—A grooved staff, either straight or curved as the operator may prefer, having been introduced into the bladder, an incision is to be made on the inner surface of the left nymphæ, commencing half an inch above the meatus urinarius, and passing obliquely downwards and outwards parallel with the rami of the pubes and ischium. This incision should be carried deeply into the space between the rami on the outside, and the vagina on the inside, care being taken not to wound the vagina, which should be protected

and pushed inwards towards the median line by the left forefinger introduced into the wound. With the same finger the staff should be felt for deeply in the wound, and the knife should be made to penetrate the groove at a point corresponding, as nearly as can be judged, to the vesical termination of the urethra. It should then be passed onwards into the bladder, its cutting edge being turned obliquely downwards and outwards towards the left side, just as in lateral lithotomy in the male. The incision may be enlarged, should it be thought necessary, as the knife is withdrawn, by a further division of the tissues in the same oblique direction. The ordinary lithotomy forceps can then be introduced through the wound for the extraction of the stone.

Dr. Andrew Buchanan operated in this way in six cases with very satisfactory results, both as regards the healing of the wound, and the subsequent ability to retain the urine. He used, we believe, the rectangular staff introduced by him for lithotomy in the male. Another case operated on by Dr. George Buchanan is recorded in the *Medical Times and Gazette* of May 3rd, 1862. The patient was a child aged six years. The stone was readily extracted, and the wound healed favourably. The child, who had had incontinence of urine since she had been suffering from stone, began to recover power over her bladder as soon as the wound healed. A case operated on in the same way by Dr. Morton is recorded in the *Glasgow Medical Journal* for January 1855. The patient was a woman aged forty-seven. The wound healed well, and she retained perfect power over her urine.

This plan of operation is not so well understood as it deserves, and it is well worthy of further consideration by the profession. It is not likely to cause any permanent injury to the retentive power of the bladder, as no part of the bladder or urethra is laid open into the vagina; while the track of the wound, passing as in the male through a considerable depth of tissue, is pretty certain to heal by granulation. Experiment on the dead body will satisfy anyone disposed to adopt it of the facility with which it may be accomplished. It seems especially well adapted for children. The risk attending it is probably considerably less than in lateral lithotomy in the male, and it has already been shown that in children this is not very alarming.

**Vesico-vaginal Lithotomy.**—In cases of very large calculi the vesico-vaginal method, first practised by Rousset and Hildanus, and already alluded to by the author, may be employed with advantage. It consists of an incision from the vagina in the median line into the neck and base of the bladder, the urethra not being interfered with. It may be performed in the following manner. The patient is placed in the usual lithotomy position, and a wooden gorget, or, still better, the speculum used by Sims and Bozeman in operations for vesico-vaginal fistula, is introduced into the vagina, so as to expose its anterior wall. A straight staff is then passed into the bladder with the groove directed downwards, and made to press against the vagina. The staff being held by an assistant, the operator passes a sharp-pointed knife through the vesico-vaginal septum into the groove of the staff opposite the neck of the bladder—that is to say, an inch or rather

more behind the meatus urinarius—from which point he carries his incision backwards through the septum for an inch or more, according to the size of the stone to be extracted.

This incision of the vagina in the median line affords great facilities for the extraction of a large stone; it is not likely to be attended with serious bleeding, for the vessels are small in the median line; and is not likely to be followed by urinary infiltration, in consequence of the density of the tissues composing the vesico-vaginal septum. Velpeau, who inquired carefully into the history of this operation, was struck with its great immunity from danger, and with the slight degree of constitutional disturbance which it entails; in fact, he did not meet with the record of a single fatal case. It has, however, never taken its place as an approved and recognised operation, in consequence of the difficulty of securing the closure of the wound, and its being consequently so often followed by the distressing condition of a vesico-vaginal fistula. Notwithstanding this, it has been practised occasionally, from a very early date, in exceptional cases, and for the removal of large stones. The cases of Fabricius Hildanus, Rousset, and Méry have been already mentioned. In 1740, Gooch extracted a calculus through the vagina weighing three ounces, which had caused ulceration through the septum. M. Velpeau gives the names of various operators who have since adopted the vesico-vaginal method of lithotomy; and amongst them, M. Faure, who made his incision in the median line, but very obliquely through the septum; that is to say, directing the edge of his knife towards either the right or left side, so as to produce a broader cut surface, and to give the wound a somewhat valvular arrangement. He thus, in 1808, succeeded in curing a patient without the formation of a fistula. (See *Velpeau, Elem. of Op. Surg. Mott's translation*, vol. iii. p. 967; also *Bourgery, Méd. Opér.* t. ii. p. 289.)

Most of the earlier operators speak only of the removal of the stone, and say nothing about the result as regards the formation of a fistula. Chelius, however, more recently, says that the production of a vesico-vaginal fistula, which has been objected to this operation, cannot be considered as the usual consequence. He advocates it as causing no bleeding and no incontinence of urine, while it affords facilities for the removal of very large stones. (See *Syst. of Surg. translated by South*, vol. ii. p. 617.) Velpeau's conclusion, after looking into the cases recorded by different operators, is not so favourable; he thinks that a fistula is met with in at least one case out of four. Both statements are, however, without doubt far too favourable, for if no steps are taken for the immediate closure of the wound, a fistula must always be reckoned upon as the rule, and its absence the exception. The general conviction that this is the truth has caused the vesico-vaginal method to be always regarded with disfavour, and to be reserved as a kind of last resort for the removal of very large stones. The dread of fistula has even induced many authorities, and among them Velpeau himself, to prefer the high or supra-pubic operation, notwithstanding its greater danger; and a similar opinion has been recently expressed by Mr. Erichsen.

The time, however, has arrived for forming a different estimate of the desirability of this method, and advantage may now be taken, in



appropriate cases, of the great facilities which it affords, and of its freedom from danger, without the distressing result of a permanent and incurable incontinence of urine. The experience of the last ten years has abundantly shown that almost every case of vesico-vaginal fistula, even when attended with great loss of substance, may be firmly and permanently closed by the improved plastic procedures now in use. We may therefore very fairly feel confidence in our ability to close the clean longitudinal incision made for the extraction of a stone, which is attended with no loss of substance, and with no cicatricial contraction or induration. Even if the whole length of the wound should not immediately unite, its closure may be effected with certainty by a subsequent operation. Without waiting, therefore, the chance of spontaneous closure, sutures should be inserted and the edges of the wound brought into accurate contact immediately after the extraction of the stone. The most approved methods of doing this will be described in detail in the article on vesico-vaginal fistula.

M. Coste, many years ago, appears to have been the first to suggest the immediate application of sutures after this operation, but was deterred from attempting it by the *then* almost invariably unfavourable termination of operations for vesico-vaginal fistula. The merit of first carrying into effect the idea of immediate closure of the wound after vaginal lithotomy belongs to Dr. Marion Sims, who operated in this manner, in 1850, on a negress *æt.* ten years, in Montgomery, Alabama. The incision made was in the median line, and about one and a quarter inches long. The stone, a flat oval, an inch long, three-quarters of an inch wide, and nearly as thick, was easily removed, and the incision was immediately closed by four or five interrupted silver sutures. A small fistulous opening remained near the neck of the bladder, but was closed by a subsequent operation. The writer is informed by Dr. Sims that the operation has been successfully practised by Dr. Emmet and himself five or six times at the Woman's Hospital, in New York, and also by Dr. Bennett, of Connecticut, and others in America. Dr. Sims is a strong advocate for this mode of operation.

M. Vallet, of Orleans, who published a paper on the subject in 1856, operated in this way in two cases with success. In one of them, however, a second application of the sutures was necessary for the closure of a portion of the wound. M. Vallet made a transverse instead of a longitudinal incision, thinking he could select a part of the base of the bladder where the septum was thicker than elsewhere. The longitudinal incision, however, seems much to be preferred. The transverse one must necessarily be attended with greater risk of hæmorrhage, and, if made far back, also with the risk of possible injury to the entrance of the ureters.

The writer was the first who practised the operation in this country, in November 1861, in St. Mary's Hospital; it had, however, been recommended previously by Mr. Baker Brown and others. The patient had been the subject of stone for nine years; and, at the time of the operation, the symptoms produced by it were exceedingly severe. A calculus measuring two inches in one diameter by an inch and a half in the other was

removed by an incision in the median line of the vagina, commencing an inch and a quarter behind the external meatus, and extending backwards nearly to the cervix uteri. The wound was immediately closed by twelve silver-wire sutures. The irritation of the bladder immediately subsided, and no bad symptoms followed the operation. The wound healed by first intention, with the exception of a small portion anteriorly, which required a second application of sutures for its closure. (See *Lancet*, Oct. 4, 1862, p. 371, and Jan. 10, 1863, p. 34.)

In March 1862, Mr. Fergusson removed a stone by the vaginal incision in a child aged nine years and a half. Only one suture, however, was applied, and was removed the next day. The wound consequently did not unite. In August 1862, Dr. Robert Nelson operated in the same way, and succeeded in obtaining immediate union. (See *American Monthly Med. Jour.*, Sept. 1862.) Another case, with an equally good result, by Dr. Lyon, of Glasgow, is recorded in the *Lancet*, Nov. 1, 1862. Mr. Baker Brown, in September 1863, removed, by vaginal incision, a stone weighing two ounces five drachms in a lady *æt.* forty-four. Seven silver-wire sutures were applied, and, when they were removed on the seventh day, the wound was found to be perfectly united. The patient recovered without a bad symptom. (See *Trans. of Obstet. Society*, vol. v. p. 217.) The expediency of this mode of proceeding was also recognized in 1859, by Mr. Paget, of Leicester. He adopted, however, the incision of the urethra instead of the vagina, and the results obtained were, in consequence, not so satisfactory. His first patient was a child aged three-and-a-half years; it was found impossible to bring the edges of the urethra together, and incontinence of urine was the result. In a second case, in a patient aged eighteen, five sutures were inserted. The anterior part of the urethra did not unite, and there was more or less of incontinence for some months.

For the success of the operation, it is important that the incision should not implicate the urethra. Incision of the urethra affords no additional room, but increases the length of the wound without any compensating advantage whatever; while the urethral portion of the wound, from its edges being so thin and delicate, is incomparably more difficult to close than that which is deeper in the vagina. The incision of the base of the bladder should be sufficiently free to allow the extraction of the stone, without bruising or otherwise damaging the edges of the wound. There is no fear of injuring the peritoneum, for its line of reflection from the uterus to the bladder is nearly an inch higher up than the attachment of the vagina to the cervix uteri.

The cases suitable for this operation are those in which the stone is of large size, and the patient is an adult. In such cases the writer is of opinion that it is the safest and best proceeding that has as yet been devised. It is not, however, applicable to children, nor is it well adapted for young unmarried women, in whom the difficulties of the operation are necessarily greatly increased. Each time that it has been performed in an appropriate case, and conducted on proper principles, success has been obtained, while the instances of failure seem fairly attributable, either to the injudicious selection of the case, or to the manner in which the

details were carried out. In no case do any dangerous or alarming symptoms appear to have been observed.

The following conclusions may be drawn with respect to the comparative eligibility of the various methods of removing stone from the female bladder; bearing in mind that, although the first object is to select an operation as little as possible dangerous to the life of the patient, it is of almost equal importance to avoid permanent injury to the retentive function of the bladder and urethra:—

1st. That dilatation of the urethra is the best operation for the removal of stones of limited size; but that it cannot be employed for the removal of large stones without serious risk of incontinence of urine.

2nd. That incisions of the urethra in the downward direction should be discarded altogether, but that the incision upwards may be practised with but little danger to life, and little risk of incontinence of urine. It is not, however, adapted for the removal of stones of any considerable magnitude.

3rd. That the vestibular operation of Lisfranc possesses no merits of its own to compensate for its manifest disadvantages.

4th. That the lateral operation of Dr. Buchanan is founded upon sound anatomical and surgical principles, and is an excellent operation in children. It is also well adapted for young unmarried women in cases where dilatation is unsuitable, and in whom the small size of the vagina would contraindicate the vesico-vaginal method.

5th. That the vesico-vaginal incision, with immediate closure of the wound by suture, is admirably adapted for the removal of large stones in the case of adult women, in whom the vagina is of average capacity; that it is attended with but little immediate risk, and no risk at all of permanent incontinence of urine.

6th. That the high operation is the most dangerous of all the various methods which have been proposed, and that almost the only conceivable case in which it would now be justifiable, would be one in which, with a deformed pelvis and a very large stone, extraction per vaginam was impracticable.]

James R. Lane.

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**LITHOTRITY** (from *λίθος* a stone, and *τερέω* I pierce).—**LITHOTRIPSY** (from *λίθος* a stone, and *τριβω* I break.)

[The article of Mr. Cooper on Lithotrity, having been written nearly thirty years ago, is so meagre and imperfect that it has been thought necessary to replace it entirely.

The modern operation of lithotrity consists in introducing certain instruments into the bladder through the urethra, in seizing the calculus with these instruments, in reducing it to detritus and powder, and lastly in promoting the expulsion of the detritus from the bladder through the natural passages.

Lithotrity, in one sense of the term, is not a modern operation. Its germ may be found in the old idea of extracting calculi from the urethra without having recourse to a cutting operation. The method described by Albucasis was confined to urethral calculi. In the year 1561 Franco seems to have extended this method to the extraction of calculi from the bladder, and invented a four-branched forceps inclosed in a canula, for that purpose. Hildanus reduced the branches of this instrument to three, and Mr. Hales to two.

But the older surgeons did not confine their practice to the simple extraction of calculi from the urethra. The extraction of calculi from the bladder without breaking them was practised in Egypt from time immemorial; and the French surgeons who accompanied Bonaparte in his Egyptian expedition saw the operation there. Indications of the practice of breaking small calculi in the bladder may, however, be found in the writings of many ancient authors; but the operation was not seriously proposed or discussed until 1813, when a Bavarian surgeon, M. Gruithuisen, published an account of his instruments for perforating and crushing vesical calculi. (*Salzburg Med. Chir. Zeitung*, vol. i. p. 289. 1813.)

In 1819 Mr. Elderton published in the April number of the *Edinburgh Med. and Surg. Journal* his proposal for attacking calculi with a curved two-branched instrument and perforator. But the means proposed by the German as well as the English surgeon were incapable of being practically applied. To M. Civiale is due the merit of having taken up the question in 1817; of having devised instruments by which the operation might be performed; of having been the first to perform the operation on the living subject (January 13, 1824); and, finally, of having by the labour and perseverance of forty years firmly established the operation in the rank which it occupies at the present day.

Lithotrity is chiefly made up of two principal parts—viz. seizing the stone in the bladder, and reducing the stone into powder. This latter process may be effected by perforation, by percussion, or by crushing.

The earlier operations of M. Civiale, M. Leroy d'Etiolles, and others were performed with perforating instruments. In 1832 Baron Heurte-loup introduced his method of percussion. Both methods are now abandoned for the more simple and effectual one of crushing the stone into small fragments and powder by means of pressure.

Previously to the year 1824 all the crushing



forceps employed acted by lateral pressure in an imperfect manner. The first crusher of any value—that is to say, one in which the blades are placed one over the other and have a gliding movement forwards—was invented by the late Mr. Weiss in the year 1824. In the year 1825 Dr. Haygarth invented a sliding instrument for the extraction of small calculi from the bladder. At Mr. Hodgson's suggestion a screw was added, that it might be employed for crushing, and Mr. Hodgson tried the improved instrument on a patient in the Birmingham Hospital. To a provincial English surgeon is thus due the honour of having been the first to perform the operation of crushing as it is now employed, and of appreciating the value of the screw as an auxiliary. But the principal improvement consisted in making the male branch of the forceps slide along the female branch in such a manner that the one could not possibly escape from the other. This simple improvement was effected by making the edges of the female groove overlap the body of the male branch—an improvement effected by Dr. Costello. Since that period, viz. 1832, various changes and modifications, which it is unnecessary to notice here, have been made. It will suffice to state that the instruments now generally employed are the improved screw lithotrite of Weiss, or M. Civiale's instrument, which may be used for crushing with the hand or screw, or even as a percussor.

Sir B. Brodie employed Weiss's screw forceps; Mr. Fergusson employs the rack and pinion, whilst the writer and other surgeons in this country prefer the well-known lithotrite of M. Civiale.

In M. Civiale's lithotrite the action of the screw is brought into play by a fly-wheel at the end of the instrument, while, by a peculiar contrivance, the screw action can be at any time instantly suspended, so as to allow the male blade to be moved backwards or forwards without the slower process of unscrewing. In the English instrument, or Weiss' lithotrite, the action is developed by means of a cross handle, as in the case of the common corkscrew. But this instrument is open to the objection of not being provided with any means of converting the screw movement into a sliding one. Recently, however, Mr. Weiss and Mr. Coxeter have devised ingenious contrivances for setting the screw free. Lastly, Mr. Fergusson originally proposed and still employs a rack and pinion for the purpose of developing his force.

Lithotrites also may be distinguished into two kinds, according as the curved extremity of the female blade is fenestrated or not. The opening in the female blade is formed for the purpose of allowing the fragments of stone to escape from the jaws of the instrument. The stem, or ascending branches, are long and strong, and this form of lithotrite is chiefly suited for large or hard calculi, and for the earlier manipulations. The lithotrite with solid blades is chiefly suited for crushing small calculi or reducing fragments to powder. In the first case, the female blade should be somewhat wider than the male; in the latter, both blades may be of the same width. As provision is seldom made in this latter class of instruments for the escape of detritus between the blades, care should be taken that the female blade

be not too concave or hollowed out, for in such case the detritus is apt to become lodged between the blades of the instrument and occasion much inconvenience, if not danger, in the working of the instrument.

Whatever instrument be chosen, there are some general points to which attention should be paid. The instrument itself should have been well proved for strength. The male branch should glide easily along the female, and not give rise to any grating sound at the screw part. The edges of the blade should be well rounded off, so as not to hurt or irritate the bladder; and when shut, they should perfectly meet. The cavity in the female branch must not be too deep, so as to become filled with detritus; nor should the eye at the extremity of the instrument be too large; for, if so, the fragments may be too large and angular to pass the urethra.

The first duty of the surgeon is, of course, to consider and decide whether the case before him is one suited to lithotrity, a question which will be discussed more conveniently under the head of indications. Let us suppose the case suitable for the employment of lithotrity, and that the general health of the patient has been brought, by preliminary treatment, into a favourable condition; in other words, that proper means have been employed to remove all such local or general disorders as are likely to exercise any dangerous influence on the result of the operation.

It is the more necessary to attend to these points, because, before proceeding to operate, the surgeon should, by a careful examination of the urinary organs, obtain some notion of the capacity and contractile power of the bladder; the condition of the prostate; the size of the stone; in a word, of various circumstances connected with the substance on which he is about to act and the organs in which he is about to operate. For practical purposes it is not necessary to ascertain the size of the calculus within a few lines; all we want to know is whether it be a large or a moderately sized one; and likewise to obtain sufficient knowledge relative to the sensibility and contractile powers of the bladder, &c. &c. Before operating, however, an important question presents itself. Should the patient be submitted or not to the influence of chloroform? M. Civiale and Sir Benjamin Brodie have both pronounced against the use of chloroform in lithotritic operations. The feelings of the patient are a most useful guide in two essential matters; they serve to indicate whether an injury is being inflicted on the soft parts, and they assist us in determining whether the operative proceedings are continued beyond what the bladder and constitution are capable of enduring. On the other hand, the use of an anæsthetic agent is attended by many palpable advantages. Children are so unmanageable that they should be rendered insensible when submitted to lithotrity; and in the female also several advantages will be gained by chloroform. In males of a nervous temperament, and who cannot bear the least pain, the use of chloroform is of great service throughout the whole of the sittings. In cases also where the stone has been partly crushed without the aid of chloroform, and great irritability of the bladder supervenes, chloroform may become indispensable in the subsequent operations. Lastly, in the examination of

the bladder, at the close of the treatment, for the purpose of ascertaining whether any fragments remain, great assistance may sometimes be derived from the use of chloroform.

The instruments required for lithotripsy are an ordinary catheter to draw off the urine, an injecting syringe, a large-eyed catheter for washing out the bladder, and a lithotritic forceps.

The positions of the operator and patient are of importance. The surgeon places himself on the right side of the patient—not between his legs. The patient is to be placed on his back on a bed or couch, with the pelvis slightly raised by an unyielding cushion, so as to bring the most depending part of the bladder on a line with the internal orifice of the urethra. The head and shoulders should be supported by pillows, so that there be no strain on any part of the body, and the patient may feel himself at ease. The legs of the patient are to be separated, and the thighs slightly flexed.

Everything having been prepared, the catheter is now introduced into the bladder, and the urine drawn off. The quantity of urine which comes away enables the surgeon to form some estimate of the quantity of tepid water which may be injected into the bladder. This will vary in different cases, according to the capacity and irritability of the bladder; generally speaking, four to six ounces will be borne without distress; but in old cases of stone the bladder is often contracted and very irritable. As soon as a few spoonfuls of fluid are thrown in, the bladder contracts and ejects the fluid. In cases of this kind the operation should be abandoned, or at all events deferred.

Sir Benjamin Brodie, however, informs us that the power of the bladder to retain the fluid may always be restored by keeping the patient in a recumbent posture for from seven to fourteen days, and daily injecting some water into the bladder.

Having injected a sufficient quantity of fluid to guard the walls of the bladder from injury, the operator next takes the lithotrite, which has been warmed and well oiled, and passes it into the bladder.

This part of the operation should be conducted in the following manner. The surgeon, standing on the right side of the patient, opposite the anterior superior spinous process of the ilium, takes the penis between the fore and middle fingers of the left hand, and holds the lithotrite lightly but firmly between the fingers of the right hand, in the same manner as he would hold a pen. Drawing the penis towards the ilium, the operator introduces the instrument laterally till he reaches the bulbous portion of the urethra, when he brings the penis and lithotrite perpendicular to the median line. He now removes the left hand from the penis, and makes gentle pressure with it over the symphysis pubis, in order to relax as much as possible the triangular ligament, and to relieve the straining sensation which is often experienced at this stage of the operation. With the right hand he first gently depresses the lithotrite between the thighs of the patient, and carries it forward, the curve of the lithotrite, as it were, being accommodated to the curve of the urethra by the depression of the handle of the instrument.

By this mode, the end of the lithotrite gradually rises without experiencing any obstacle

through the prostatic portion of the urethra and neck of the bladder into the cavity of the organ. No fixed rule can be laid down for the amount of depression to be employed, as this will chiefly depend on the condition of the prostate and the kind of instrument used. The more enlarged the prostate, and the more acute the angle formed between the blades and shaft of the lithotrite, the greater will be the amount of depression required. By a slight rotatory motion the surgeon soon knows that the instrument has entered the bladder.

There is seldom any difficulty in passing the instrument, at least in ordinary cases; and it seems almost unnecessary to mention that these proceedings should be conducted slowly and in a cautious manner. The membranous portion of the urethra has been lacerated more than once, but such an accident is now of rare occurrence.

The lithotrite being in the bladder, the next step is to find and seize the calculus. Different methods are employed to effect this, the most important part of the operation. In ordinary cases the beak of the lithotrite soon meets the stone, or, if not immediately, after a few movements with the blades slightly separated. Should any delay occur, the writer follows closely the method recommended and practised by M. Civiale.

The blades are to be separated from each other about half or three-quarters of an inch. The instrument is held lightly between the thumb and fingers of the left hand, which are applied to the square and round portions of the female blade, the back of the hand being directed upwards; whilst the fly-wheel, which drives the screw, is held by the thumb and first two fingers of the right hand. The instrument is then made to revolve slowly in the bladder with the blades a little open. This revolution is effected by movements of the thumb and two fingers of the left hand, as if we were revolving a pencil or any cylindrical body between them. It is made at first to one side, say the right, and while this is being done the male branch is at the same time gently moved forwards and backwards several times to the extent of half or three quarters of an inch. The object of these movements is, that the male branch may meet the stone, which it generally does while traversing the different spaces. If the stone be not caught in this situation, the instrument is rotated, in the same way, on the opposite side of the bladder, the male blade being moved forwards and backwards as before. The whole of the floor of the bladder, with the exception of its central part, is thus explored; and if the patient has been a little inclined to the right side, the stone will, in most cases, be caught with ease on the right side of the floor of the bladder. Let us suppose, however, that the calculus is not discovered in either of the situations mentioned; that it lies in the centre of the floor, or just behind the prostate, which is probably somewhat enlarged. In a case of this kind an attempt may be made to dislodge the stone by elevating the pelvis more than in ordinary cases. The mere change of position may displace the calculus and enable us to seize it. Should this, however, fail, we must have recourse to the following proceeding:—The revolution of the instrument, which in the two cases formerly spoken of was such as only to command the sides of the floor, is continued until the point of the



instrument and the concave surface of the blades are directed immediately downwards, at the same time the handle of the instrument is slightly elevated so as to bring the end into the hollow behind the prostate, and thus command the central portion of the floor of the bladder. The male branch is again moved to and fro, as before, until the stone is caught or fished up from the depression in which it lay, behind the prostate. The manipulation is easily and safely performed, and M. Civiale has recourse to it in almost every operation which he performs, in order to seize any fragments that might have escaped the instrument during its lateral revolutions. It is particularly necessary when the calculus is lodged in a depression behind the prostate.

There is little difficulty in finding a large calculus, but it may not be so easy to seize the foreign body. In such cases M. Civiale recommends us (*Traité Pratique et Historique de la Lithotritie*, 1847, p. 66) to apply the branches of the instrument, slightly separated, on the surface of the stone; the branches are then further separated by drawing one branch backwards, while the other is pushed forwards, until the edges of the stone are cleared; the instrument thus opened is pressed laterally on the calculus, until the branches become placed between the stone and the walls of the bladder.

Sir B. Brodie and many English surgeons, on the other hand, have recourse to a different method during this part of the operation. They object to the manœuvre of turning down the point of the lithotrite at any time towards the floor of the bladder, and think it much more safe to depress that part of the organ with the convex extremity of the forceps. Sir B. Brodie thus describes the operation (*Medico-Chirurgical Trans.* vol. xxxviii. 1855, p. 169):—

“The patient lying on his back, the handle of the forceps is elevated, which of course brings the convex part of the curved extremity of it in contact with the posterior surface of the bladder, where it is contiguous to the rectum. The forceps is then to be opened by withdrawing the sliding blade to a greater or less extent, according to the probable size of the calculus, the fixed blade being at the same time pressed gently downwards, in the direction of the rectum.

“The object of the manipulation is, that, the forceps being below the level of the other parts of the bladder, the calculus may fall into it by its own weight; and it is generally successful. If it should not do so, the forceps, without being moved from its situation, may be gently struck by the hand on one side, or on its anterior part, and the slight concussion thus communicated to the bladder will probably be sufficient to dislodge the calculus, and bring it within the grasp of the instrument. If it should be otherwise, the forceps being closed may be very gently and cautiously turned to one side or the other, so that the curved extremity of it may make an angle of twenty-five or even thirty degrees with the vertical line of the body, then opened and pressed in the direction of the rectum in the manner already described. When firmly fixed between the blades of the lithotrite, the calculus may be crushed either with the hand alone, or with the aid of the screw. The hand may be tried first; and, if the calculus resist, the screw can be brought into play without any loss of time.”

When M. Civiale's instrument, which the writer was the first to use in this country, is employed, and pressure with the hand is adopted, the following manipulation becomes necessary. The female branch is held firmly by the left hand, applied to the square portion; the circular projection immediately behind this square part is embraced between the index and middle fingers of the right hand, which are hooked on it, and use it as a *point d'appui*; the extremity of the male branch rests in the palm of the same hand, the palm being turned upwards. In this position, by strongly contracting the flexor muscles of the fingers, the male branch is driven forwards by a kind of jerk on the stone, when the latter, if not too hard, is readily broken by a few contractions of the kind mentioned. The action is one of percussion followed immediately by compression or crushing.

Should the stone not yield to this action of the hand, nothing is easier than to bring the screw of the instrument into action. The catch-box is turned from right to left. By a peculiar mechanism this allows the screw to act, and its action is developed by simply turning from left to right the wheel attached near the extremity of the male branch.

It is important to remark that the act of crushing should be performed at as great a distance as possible from the neck of the bladder. Hence care must be taken not to draw the forceps forwards during this part of the manipulation, so as to press on or irritate the more sensitive parts of the bladder.

Before withdrawing the lithotrite, it is necessary to ascertain that the branches are perfectly closed, and that no fragments of the stone are retained between them. The scale marked on the handle of the instrument enables the operator to determine this point. A few turns of the screw backwards and forwards commonly suffice to clear the instrument, or the action of the screw may be suspended and slight percussion be exercised on the extremity of the male branch.

The completion of these manipulations implies that a certain portion of the stone has been sufficiently reduced to pass off by the urethra without difficulty. The last step of the operation, therefore, consists in immediately freeing the bladder from the detritus. If the operation has proceeded in a favourable manner, the patient is placed in the erect posture, and a full-sized metallic catheter, with a wide slit on the upper surface near its extremity, is then introduced. The fluid which is in the bladder being withdrawn, some tepid water is repeatedly injected until the patient complains of fatigue or no detritus comes away. It will, however, often occur that the quantity of debris which comes away with this injection is small compared with what exists in the bladder, and is expelled two or three days afterwards by the natural efforts of micturition. In some complicated cases, where considerable enlargement of the prostate exists, it will be much easier to introduce the catheter while the patient is in the recumbent posture, and in this position wash out the bladder. These injections are particularly useful in cases where the bladder is unable to expel the urine or debris by its own natural efforts.

The propriety of injecting the bladder before the operation, and washing it out after each sitting, for the purpose of removing a portion of

the débris, has been insisted on by most of the great authorities on lithotritry. M. Civiale in his last pamphlet (*Création d'un Service Spécial*, &c. Paris, 1864) observes: 'Almost always at the termination of the sitting I pass one or more injections into the bladder by means of a full-sized catheter with large orifices at the extremity. This is a method which I have employed ever since the commencement of my practice with advantage, and which has been adopted by a great number of other surgeons. These injections seldom give rise to any pain, and are useful in cases where the bladder is disposed to contract with force, more especially whenever any considerable portion of the calculus has been pulverised during the sitting. A portion of the débris is thus expelled with the injection, and the danger of their accumulation in the urethra is diminished.' Of late, however, some writers on this subject have advocated a different practice. Mr. Thompson as a general rule does not approve of the preliminary injection of the bladder, considering that 'sufficient benefit does not accrue from it to compensate for the advantage sacrificed by not adhering to one of the great principles before enunciated, viz., always to effect our object with the smallest amount of instrumental interference.' An atonic state of the bladder, according to the same author, constitutes an exceptional case. (*Practical Lithotomy and Lithotritry*, 1863.)

Mr. Pollock, of St. George's Hospital, states that he has for some time discontinued the use of injections prior to the operation of lithotritry, believing it to be not only a superfluous interference but an unnecessary prolongation of operative manipulation. If the bladder will not hold more than a small quantity of urine, it will probably not hold more tepid water; and so to the operator, the evil is equally balanced between the capacity of holding the one or the other. (*Lancet*, March 12, 1864.) Mr. T. P. Teale, of Leeds, also disapproves of the preliminary injection of the bladder. Before the operation, he desires the patient to allow his bladder to become as fully distended with urine as it will easily bear, and states that by observing this precaution he very rarely has to inject the bladder with water. The irritation caused by the introduction of a second instrument is thus avoided, and he imagines that the bladder is more tolerant of the presence of urine than of the foreign fluid water. (*Lancet*, March 26, 1864.) On the other hand, Mr. Charles Hawkins says that he has found the bladder more readily retains the water injected, than the urine that may be in the bladder when the lithotrite is introduced. (See *Article Lithotritry in Holmes's Syst. of Surg.*, vol. iv.)

Mr. Fergusson says that for twenty years or more he has rarely used injections as a preliminary step. He thinks the presence of a large quantity of fluid is objectionable, and increases the difficulty of securing the stone. He therefore often draws off some of the urine with a catheter, when he fancies the quantity too large, taking care of course that enough should be left to enable the blades of the lithotrite to be used with facility. (See *Report of Lectures delivered at the Coll. of Surgeons*, *Lancet*, June 17, 1865.)

With regard to washing out the bladder after the first sitting, Mr. Thompson lays it down as a rule that, 'on no account should the bladder be injected or washed out after the first sitting; because, in the

first place, it is on this occasion particularly desirable to avoid unnecessary irritation; and secondly, because the first object being merely to make fragments, no great amount of small detritus capable of removal would probably be found' (l. c. p. 182). There can be no doubt about the correctness of the rule, that the smaller the amount of instrumental interference the better; but there can be little doubt also that the débris of the earlier sittings are those which are most likely to cause irritation. Whether the one inconvenience does not greatly outweigh the other is a question for experience to decide; and it will require more than the experience of a single surgeon to establish the revival of a practice which prevailed in the infancy of lithotritry.

A very ingenious and effectual apparatus for washing out the bladder has been devised by Mr. Clover. It consists of a glass cylinder, one end of which is attached to the neck of an india-rubber bottle, and the other closed by a stopper perforated by a tube which fits over the end of the catheter, and which projects about an inch into the cylinder. The instrument is filled with warm water, and after the urine has been drawn off it is applied to the catheter, and the bladder injected by pressing the elastic bottle. On removing the pressure the water is drawn back rapidly, bringing with it the small particles of stone which happen to be near the eye of the catheter. The pieces fall to the bottom of the glass cylinder, and are at once seen by the operator, but are not re-injected when the bottle is again compressed.

Mr. Fergusson advocates the immediate removal of the fragments by means of lithotrites and scoops of small size. The 'scoops' which he uses are instruments of the nature of forceps, but with the blades shaped and moving like a lithotrite, and varying in size from a No. 3 to a No. 6 catheter; with these he seizes the fragments and withdraws them through the urethra. 'The lithotrites generally in use,' he observes, 'can be withdrawn from the bladder only when shut. If a fragment rests between the blades, it must be comminuted before these can be closed. The same remarks are applicable to ordinary scoops. Comminution must be so effectual that the blades may be closed or nearly so, and all that can be brought away is the small bruised portion held between the blades. With a small lithotrite and scoop such as I am in the habit of using, a fragment of considerable size may remain betwixt the blades, and yet the united size or diameter may readily pass or be drawn along the urethra. In the last sixty cases I have adopted this practice generally, and with few exceptions have every reason to be satisfied.' (See *Lancet*, vol. ii. 1864, p. 4.) 'I have generally, as a first step, introduced a lithotrite of considerable size, equal to a No. 10 or 11 bougie, and broken the stone into various fragments. Next I have taken the smaller lithotrite, above referred to, attacked these fragments, and then have used the small scoop with the object of removing several fragments, so that the patient might have satisfactory evidence that the stone had been crushed. In a few days after the small crusher and scoop have again been used—particularly the scoop—where with the fragments which have been found sufficiently small have been extracted singly, or two or three at a time. Thus instead of waiting for the spontaneous escape of the fragments, a process usually both uncertain and tardy,



the stone has been got rid of by direct and precise surgical interference. (*Loc. cit.* p. 3.)

The account recently given by Mr. Fergusson of his experience in operations for stone in the bladder by lithotomy as well as by lithotrity is well worthy of notice in this place. He says, 'I can give a list of lithotomy and lithotrity conjoined, which, in as far as I know, has fallen to the lot of few other men in Britain. I have personally by operations treated 271 cases—162 by lithotomy, and 109 by lithotrity. Although having been little more than half the time of Crichton's experience, I have had 70 cases of the disease more than he had. Of the 271, I have lost 47; and that shows a mortality of something more than 1 in 7—not a bad average as operations for stone go; but lithotomy cases being included, I consider it low indeed. And I have now to state that which I look upon as of high interest in the modern history of surgery. Of these 271 cases, 217 were adults; 110 have been treated by lithotomy, and of that number 33 have died; 109 have been treated by lithotrity, and of that number 12 have died.' (*Lectures on the Progress of Surgery during the present Century, Lancet, June 24, 1865.*)

Lithotrity, from its nature, is not one of those operations which can be completed without interruption. Whenever the stone is small and friable we may get rid of it by a single manipulation, and such cases occasionally present themselves; but as a general rule, the surgeon should content himself with making the first sitting short, about five or six minutes. The calculus is thus reduced into moderately sized fragments, and subsequently, when the organs have become less irritable, the manipulations may be prolonged for ten minutes at a time. This is a rule from which M. Civiale and the most successful operators never deviate. 'I have come to the conclusion,' says Sir B. Brodie, 'that it is a more prudent, and in the end a more expeditious mode of proceeding, to be content, on any one occasion, with crushing the calculus only to a moderate extent.'

It is not possible to lay down any fixed rule as to the time when the second operation may be commenced, or as to the intervals which should elapse between the several sittings. These must depend on the circumstances of each case, principally on the amount of irritation which has been produced. However, from three to eight days should, generally speaking, elapse between each operation, to allow the fragments or detritus to come away, and any irritation excited by the manipulations to subside.

The symptoms which follow the operation of lithotrity may next be noticed; and to prevent confusion, it is necessary to observe that lithotrity is really made up of a succession of operations. The term operation will, therefore, be confined to the whole proceeding, from commencement to cure; while the successive operations which make up the whole may be called either sittings or manipulations.

In very favourable cases the operation can hardly be said to be followed by any symptoms at all. A single manipulation may suffice; the patient is not confined to bed, and walks about in three or four days. Slightly increased frequency of micturition, with perhaps a little scalding are the only symptoms noticed.

But from the nature of the complaint which the

surgeon is called upon to treat, he cannot expect to meet often with such favourable cases. The manipulations must necessarily produce more or less irritation of the bladder, followed by some pain, increased desire to pass water, and frequently a slight degree of fever. These symptoms generally appear on the day following the first sitting, and subside in five or six days.

In other cases the symptoms of reaction are more severe, for the manipulations have been more difficult. The bladder contracts strongly, the scalding is severe, the desire to make water frequent; the febrile symptoms more marked. Here, the second sitting must be deferred for several days, during which appropriate treatment is employed.

Finally, in a small number of cases, the irritability and contractile disposition of the bladder are excited by the first manipulation to such a degree that the operation must be abandoned. Any attempt to continue it would be highly imprudent.

Each manipulation, as we have remarked, consists—in the introduction of certain instruments into the bladder—in seizing the calculus—in breaking and pulverizing it—finally, in promoting the discharge of detritus. Whatever impedes any of these several proceedings may become an obstacle to the successful completion of the operation; but the principal obstacles are connected with the state of the prostate, the condition of the bladder, and the size, consistency, or position of the stone.

Any considerable enlargement of the prostate, especially of its middle lobe, not only produces a mechanical obstacle, but several other unfavourable effects. 'It diminishes the capacity of the bladder, deepens its floor, and tends to conceal the stone in a cavity behind the enlarged gland. This condition sometimes causes a difficulty in seizing the calculus, arising either from its lying behind that part of the gland which projects into the bladder, or from the impediment which it offers to the elevation of the handle of the instrument.' (Brodie.) In such cases Sir B. Brodie recommends us to lower the shoulders and elevate the pelvis. 'If the calculus does not at once drop into the blades of the forceps, the patient may be directed to walk round the room, or to change his position as he lies, by turning first on one side and then on the other, the bladder being afterwards emptied by the catheter and then again injected with tepid water.'

In the writer's opinion, however, when the prostate is enlarged, the method recommended by Sir B. Brodie does not meet the difficulties of the case. The handle of the instrument should be depressed so as to raise the beak from the floor of the bladder; and whilst in this situation it should be completely rotated, the concave part being turned downwards. The handle should then be raised, so that the instrument incline to the floor of the bladder, and the male blade be drawn forwards as far as the prostate. By this manipulation a stone or fragment is more easily picked up from the depression behind the gland.

The condition of the bladder itself may be the cause of certain obstacles which must be taken into account. In many old cases of stone the bladder is hypertrophied, its fleshy columns are strongly developed, while the organ is at the same time much contracted and irritable. It is then difficult to make the bladder retain a sufficient quantity of

fluid, and the proper working of the instruments within its cavity is greatly impeded.

A sacculated condition of the bladder presents a serious, if not an insurmountable obstacle, to the performance of the operation, in all cases where the stone is impacted in the sac, or for the most part contained within it. Even when we do succeed in partially breaking up the calculus, the effects are of a formidable kind.

Sir B. Brodie relates a case, in his own practice, which illustrates the difficulty of freeing the bladder when such an obstacle exists. The calculus had been crushed, but much irritation of the bladder remained; the patient died after some months; a fasciculated and sacculated condition of the bladder was found, and a fragment of the calculus impacted in one of the sacculi. (*Med. Chir. Trans.* : l.c.)

It seems almost unnecessary to remark that excessive size and hardness of the stone constitute obstacles which cannot be overcome without much risk. In order to crush the stone, the operator must be able to seize it between the blades of his forceps; but hardness alone is not an absolute impediment, provided the other conditions be favourable.

A correct knowledge of the obstacles which the surgeon may meet with in the performance of lithotripsy is necessary to a right understanding of many of the accidents which sometimes occur during the operation and after it. At an early period, when lithotripsy was in its infancy, many accidents, such as laceration of the urethra, injury to the bladder, &c., were of frequent occurrence; but that these depended rather on the operator than on the operation is proved by the fact that they seldom occur at the present day. On the other hand, it is evident that such an operation as lithotripsy, performed for the cure of a serious and often long standing complaint, must occasionally give rise to certain accidents which are legitimately attributable to it. These are of a local or general kind. Pain, hæmorrhage, suppression and retention of urine, are the chief local accidents connected with lithotripsy; while the constitutional effects may be comprised under rigors, febrile attacks, and disturbance of the nervous system.

The operation of lithotripsy always produces more or less uneasy sensations; but when it has been properly conducted, and the patient is in a favourable condition, the amount of pain is usually so trifling that it need hardly be taken into account.

Excessive pain, whenever it does occur, should lead the operator to suspect either that the case is not suited for lithotripsy or that there is some defect in his mode of operating. In a few cases, however, a peculiar sensibility of the neck of the bladder causes the manipulation to be attended with a great degree of suffering.

More or less loss of blood from the urethra or bladder was formerly a frequent occurrence, from some injury inflicted on these parts; but like those accidents which rather depend on the operator than on the operation, hæmorrhage now seldom takes place, at least to any considerable degree. In some cases, where the mucous membrane of the bladder has been for a long time in a state of congestion, any strong action of the organ is apt to be attended with exudation of blood from the mucous surfaces. However slight in itself, this form of hæmorrhage must not be neglected, for the coagula may give

rise to retention of urine, or by entangling the fragments of the calculus, may impede their discharge from the bladder. The evacuation of these coagula will be assisted by the frequent injection of tepid water; but when they depend on the effusion of blood from its mucous surface connected with violent action of the bladder, it will be necessary to keep that organ in a state of repose, with the aid of the catheter.

The condition of the bladder, not only after the first manipulation, but during the whole course of the operation of lithotripsy, should be constantly watched by the careful surgeon, for retention of urine may supervene at any period; and hence the practical rule, never to be neglected, that the operator should determine after each manipulation, whether or no the bladder is able to expel the fluid which may be contained in it.

The causes of this retention may be mechanical, but more frequently they may be traced to a spasmodic condition of the urinary passages, or to sluggishness and partial paralysis of the bladder. The latter cause is the more serious, as it is often attended by a sub-acute inflammatory state of the bladder; and any long continued retention of urine may then be attended by the most disastrous results. It will seldom be advisable, in these cases, to leave a catheter permanently in the bladder; but the urine must be drawn off as often as it accumulates.

In a few rare cases complete suppression of urine ensues. In the present state of our knowledge it is impossible to account for the occurrence of this fatal accident, which may probably be traced to some latent affection of the kidneys. It will, however, be observed that in the records of fatal cases, a certain number is set down to coma, an effect evidently dependent on suppression of urine.

The constitutional accidents of lithotripsy are rigors, febrile attacks, and disturbance of the nervous system. Sir B. Brodie insists on the propriety of our avoiding everything which may create rigor. This symptom is likely to occur if the operations be prolonged too much, or if the urethra be over-stretched. To obviate the danger of rigor he advises, 'that the patient should be immediately placed in bed; with an additional blanket over him, the bed itself being previously warmed in cold weather.' A tumbler of hot wine and water or of brandy and water, which Sir B. Brodie considers preferable to an opiate, should also be given. In some cases these rigors are the forerunners of pyæmia. Of the general effects of lithotripsy, irritative fever is the most frequent. It is usually ushered in after the first sitting by rigors, but these may show themselves after any of the subsequent operations. Generally the feverish attack disappears in two or three days; but, on the other hand, it may hang about the patient for some time, returning regularly after each sitting. In many cases the febrile attack simply consists in shivering, followed by perspiration, and nothing more; or the patient may experience a single shivering fit, without consecutive perspiration. This form is probably rather connected with shock than irritation. In other cases, soon after the first operation a violent shivering fit sets in; this either terminates in sweating and recommences, or is followed by febrile action, loss of sleep, thirst, and diminution of strength. Or we may have another form of a more unfavourable character: the rigor is short and



not violent, but no perspiration follows; the febrile symptoms are more continuous, without being severe; the tongue is white; there is thirst; and the patient is restless at night. This state continues for several days, after which the symptoms subside. —Lastly, the fever may attain a high degree, and present itself with the well-known characters of constitutional irritation.

The practical conclusion to be drawn from the nature and causes of this fever is, that, to prevent it, we should avoid everything calculated to excite or increase irritation of the bladder during the sittings. Formerly, when the manipulations were long, or repeated at short intervals, irritative fever was of much more frequent occurrence than it is now.

The treatment of this condition is modified chiefly according to the severity of the symptoms. Many practitioners give a dose of opium after the first sitting, as a means of diminishing the tendency to rigor; or a tumbler of brandy and water. The principal remedies are, of course, such as are best suited to calm the local irritation on which the irritative fever depends.

This fever often puts on the intermittent type, commencing with rigors, ending with perspirations, and appearing at tolerably certain intervals; and this form usually yields to quinine. The reason why this irritative fever is so apt to assume the remittent or even the intermittent type is unknown, but the same forms prevail after irritation of the urethra produced by simple sounding or the passage of the catheter. The irritation of a calculous bladder increased by frequent manipulations, may pass quickly into inflammation, in which case we have fever of a different kind. We have at first the same rigors, feverish paroxysms, and perspirations as in the former kind, but the attack soon becomes more permanent, and the peculiar signs of local inflammation are superadded; or the inflammatory fever may assume a very different form, likely to deceive the most observant practitioner. In these cases the initial rigors are irregular, or very slight; the fever is not high, but it is continuous; there are no perspirations; the signs of vesical disease are not very prominent, yet the patient rapidly sinks. Latent disease of the kidney has probably been developed under the influence of the operation.

The most violent fever which occurs during lithotripsy is that which is symptomatic of acute cystitis, but this is fortunately rare. The fever in these cases is of the pure inflammatory type: the skin is hot, the tongue dry, the pulse quick, above 120. This state continues for a short time only, for unless the inflammation be speedily arrested, symptoms of sinking set in, the pulse becomes small and weak, there is delirium, and, after the most intense local suffering, the patient dies in a state of coma. The severity and continuous type of this febrile attack, in conjunction with the local symptoms, will serve to distinguish it from any other form.

But, dangerous as is the symptomatic fever of acute cystitis, the danger of pyæmic fever is much greater, while the difficulty of forming a correct diagnosis can only be appreciated by those who have had to deal with this unfortunate complication.

Sir B. Brodie says that 'inflammation of the mucous coat of the bladder occasionally exists, after the cure is completed or supposed to be com-

pleted.' This is indicated by a frequent desire to make water, and a deposit from the urine of adhesive mucus. The inflammation may arise from the presence of a fragment which has been overlooked, or because the calculous disease has been complicated with disease of the prostate or of the bladder itself. It may again arise from rough manipulation or too protracted operations. If merely the result of the operation, these symptoms, Sir B. Brodie says, 'generally subside in the course of a fortnight with little other treatment beyond repose on a sofa.'

As the operation of lithotripsy cannot be considered to be complete until the whole of the fragments and detritus have been discharged from the bladder, any impediment to such evacuation becomes the cause of an accident. It is one, the frequency of which has been over-stated; yet it requires attention, as fatal effects have more than once arisen from impaction of fragments in the canal of the urethra.

Many surgeons formerly held that, even if the calculus be broken up without difficulty into small fragments, some of the detritus must inevitably be detained in the bladder. In practice this is not found to occur. There is more danger of over-action on the part of the bladder than of atony. But this latter condition may exist; and, when the prostate is more or less enlarged, the fragments do not come away readily. Sir B. Brodie recommends 'that the patient should be directed to void his urine stooping forwards, or even in the recumbent posture, lying with his face downwards. Tepid water should, also, be injected through a large silver catheter, having a wide aperture near its extremity on the concave side; by which means fragments below a certain size may be washed out of the bladder. This may be done daily, the injection being repeated on each occasion, three or four times.'

The bladder, however, may act with sufficient force, but the fragments become impacted at some point of the canal of the urethra. The most common seats of impaction are the neck of the bladder, the membranous portion, the middle of the spongy portion, and the fossa navicularis. The accident occurs more frequently in the young than in the adult; and when it does happen, means must be promptly adopted for its effectual relief. The foreign body may be pushed back into the bladder, extracted through the orifice of the urethra, or cut out. The choice of method will be chiefly influenced by the seat of the impacted body. In a great many cases it will be found near or just behind the fossa navicularis, when its removal can be effected by a pair of long narrow dressing forceps. When the fragment lies deeper, that is, at a point between the fossa and the bulb, its extraction presents more difficulty, to overcome which a great variety of instruments have been invented. M. Civiale employs a modification of Hunter's urethral forceps; the branches approach each other more closely at the extremities than at the centre, and effectually prevent escape of the fragment. A central stylet is added, to push back the fragment if necessary, or to determine its actual presence in doubtful cases. M. Civiale has also constructed a small urethral lithotrite, the curved portion of which is extremely short. M. Leroy d'Etiolles recommends a pointed cuvette, which is introduced straight into the urethra, and then bent at the extremity to a right angle by a simple contrivance. The

instrument is thus converted into a blunt hook ; and indeed, any instrument constructed on this principle seldom fails in the hands of a skilful operator. In case of being unable to dislodge the fragment, we should not for a moment hesitate to remove it by external division ; but we have never yet failed with the instrument just described. In dividing, however, that part of the urethra which is covered by the scrotum, the surgeon must not overlook the possible occurrence of infiltration of urine and urinary abscess. The danger of these accidents ensuing was long since pointed out by Deschamps, and in later times has been dwelt on by Sir B. Brodie and Mr. Liston.

When the fragment is arrested in the membranous or prostatic portion of the urethra, we should attempt, in the first instance, to push it back into the bladder ; and if this fail, the fragment must either be extracted with the instruments already noticed, or crushed *in situ*. The propriety of crushing, however, when the foreign body is seated so far back in the urethra, though recommended by M. Civiale, seems doubtful to many English operators.

Before the surgeon can determine whether the operation of lithotritry has been completed in a satisfactory manner, he must assure himself that all the fragments of the calculus have been expelled from the bladder. Great irritation may be excited and kept up by a small portion of the stone which may have been overlooked ; or the fragment may become the nucleus of a new formation, and relapse of the disease be the result.

The ordinary method of sounding, as employed by lithotomists, does not suffice to determine in all cases whether or not the cure be perfect. M. Civiale has devoted a chapter of his work on Lithotritry to this important point, from which the following remarks are condensed :

‘If the ordinary sound be employed to explore the bladder, certain modifications of the method hitherto followed must be had recourse to. The patient should be placed in the recumbent posture, and the bladder explored while the urine is flowing away ; several injections of tepid water are then thrown in rapidly one after the other, and while the fluid is coming away the researches with the sound are continued. When the contractile power of the bladder has been thus excited, the cavity of the organ becomes so reduced that the sound has barely room to move in it, and a practised hand frequently detects the smallest calculi or fragments of the stone. Should any doubt remain, M. Civiale has recourse to his three-branched instrument, or to a small lithoclast with short flat and broad branches. This instrument is hollow in the centre, to permit the escape of fluid while it is in the bladder. Several injections of tepid water are first thrown into the bladder to excite its contractility, and bring away any mucus or clots of blood which may be present in it. From two to three ounces of fluid are now injected, and the lithoclast introduced before the fluid has come away. When the operator feels that the coats of the bladder have contracted round the instrument, he rotates the latter slowly in the bladder, allowing at the same time the fluid to escape through the central cavity ; he directs the point now to one side, now to another, and finally to the floor of the bladder, while the blades of the lithoclast are separated or not according to the presumed size of the fragment.’ (Civiale, l. c. pp.

83, 230.) By cautious proceeding in this way the smallest fragments are usually detected ; but in some exceptional cases, when the prostate is greatly enlarged, or the bladder encysted, &c., the exploration does not lead to satisfactory results.

‘In these cases, if the patient continues to experience any uneasy sensations at the time of passing water or afterwards, and if the urine be turbid or ammoniacal, we may conclude that the bladder has not been entirely freed from the foreign body.’

*Lithotritry in Females and Children.*—The conditions of simplicity which distinguish the female urinary apparatus from that of the male, would lead to the conclusion that lithotritry must be more applicable to the former sex than to the latter. But the question has not yet been definitively settled either in this country or abroad.

The operative proceeding is the same for the female as for the male. The introduction of the lithotrite into the bladder is usually easy, for the urethra is short and straight, and the absence of a prostate prevents the occurrence of many obstacles to the introduction and working of instruments. However, the depression just behind the neck of the bladder caused in the male by tumefaction of the middle lobe of the prostate, sometimes exists in the female also, though from a different cause. M. Civiale has drawn attention to this circumstance. ‘The neck of the uterus often projects into the posterior and inferior wall of the bladder, dividing its floor into two cavities, in each of which the operator is obliged to search for the fragments.’ (l. c. p. 259.) ‘In some aged females, also, the walls of the bladder are very flaccid, and a depression is formed behind the internal orifice of the urethra, in which the operator sometimes finds it difficult to seize a small calculus or fragments of the stone.’ On the other hand, as the writer has elsewhere observed, lithotritry has been successfully applied to cases of stone in the female bladder under circumstances which would certainly have contra-indicated the operation in the male. There are two principal reasons for this. In the first place, the operation can be terminated, *cæteris paribus*, much more rapidly in the female than in the male ; it is easier to seize the calculus, it is easier to crush the calculus into fragments. All these advantages render it much less likely that the operation will be followed by irritation of the urinary organs, or by any dangerous accidents. In the second place, the fragments of the calculus are much less liable to be retained in the bladder, or to become impacted in the urethra ; and it has been shown that many of the evil consequences of an operation in the male depend on the irritation caused by these two accidents. In the female they are rare. There is no impediment to the free evacuation of the detritus, no curved canal to arrest their discharge, while the great dilatability of the urethra in the female renders it less necessary to break up the calculus into very small fragments, and thus contributes to render the operation less protracted in difficult cases.

The main objection brought forward against the expediency of applying lithotritry to the female is derived from the alleged difficulty of making the female bladder retain the fluid injected into it.

It would certainly appear from many cases on



record that some operators have found it impossible to make the female bladder retain the fluid which they injected; and hence reject lithotritry altogether for the female. It may happen that the bladder of a female patient is small, contracted, excessively irritable, and incapable of retaining the injection. This occurs in the female as well as in the male, and when it does occur lithotritry should not be undertaken. But this is no reason for converting the exception into a rule. Under ordinary circumstances the female bladder will retain the injection well enough; and if the bladder show any disposition to reject it, this can be overcome by elevating the pelvis a little more than usual, and by confining the quantity of fluid thrown in to four or five ounces. The rapidity with which the operation may be completed in the female renders it much less necessary to have the bladder distended with fluid.' (l. c. p. 265.)

Lithotritry has been applied to females with success in many of the London Hospitals within the last few years. In several of these cases the density of the calculus was great, and would have presented an almost insurmountable obstacle in the male. To obviate the difficulty arising from these very hard calculi, Mr. Skey proposes the use of a very short and strong lithotrite, with the blade more scoop-shaped than in the ordinary instrument. (*Lancet*, Nov. 10, 1855, p. 438.)

Lithotritry has been frequently employed with complete success in female as well as in male children; but many surgeons prefer lithotomy for the young subject.

The following are the chief objections against the propriety of applying lithotritry to the young subject. The genito-urinary organs of the child are not fully developed before the age of puberty. The diameter of the urethra is small, the antero-posterior diameter of the bladder is also short; the bladder of children is very irritable, and the neck of this organ is very dilatable, a circumstance which greatly favours the impaction of fragments in the urethra after the stone has been broken up. Finally, the indocility of the child is a great obstacle, and often renders it impossible to manipulate the lithotrite in the bladder. On the other hand, it is well known that lithotomy is highly successful in children, not more than one in twenty-five or thirty dying after the operation, when performed on subjects under fourteen years of age.

M. Civiale, however, is of opinion that no valid reasons exist why children should be excluded from the benefits of lithotritry. The indocility of the child can be overcome by proper means. The instruments can be proportioned to the size and development of the genito-urinary organs. The curve of the urethra and the elevation of the summit of the bladder in the child are not insurmountable obstacles, as has been asserted.

There are, however, two circumstances connected with lithotritry in children, which should not be overlooked. The first relates to the density and size of the calculus. As the instruments employed must, of necessity, be small, a great number of manipulations would be required in all cases where the stone is hard and large. This would be attended with greater inconvenience, inasmuch as the manipulation itself is more painful and difficult than in the adult. In the next place, it is well known that the neck of the bladder in children is very dilatable, and hence it allows of the passage

of large fragments which become impacted in the urethra. This is the most serious disadvantage connected with the application of lithotritry to the young subject. (*Civiale*, l. c. p. 270-272.)

Within the last few years lithotritry has been applied to children in many of the London Hospitals, and the results have not been unfavourable. Several cases operated on by Mr. Fergusson, Mr. Curling, and other surgeons, are recorded in the *Lancet* for 1855. In many of these chloroform was employed with advantage to ensure docility, and in some of the female cases the urethra had been previously dilated by means of Weiss's instrument.

On the other hand, it would appear that laceration of the urethra in boys has occurred on more than one occasion. Mr. Wormald has stated that he examined a child after death whose urethra had been lacerated during the passage of the lithotrite, and who died of extravasation of urine.

The youngest patient was a female child, two-and-a-half years old, on whom Mr. Poland, of Guy's Hospital, operated with success. The cure was effected in two sittings, without any unpleasant symptom whatever. It should be observed, however, that the urethra had been slit up, not for the purpose of facilitating the introduction of the lithotrite, but to permit extraction of the stone entire, which could not be effected.

From what has been said in the preceding pages, it must be evident that lithotritry is not an operation to be undertaken on light or insufficient grounds. Its success will mainly depend on its being applied in a proper manner, that is to say, on a strict observance of the indications which experience has established.

In what cases then, it may be asked, is lithotritry applicable? In what cases should it be rejected? What are the principles to guide the surgeon in his selection of cases, in accepting some and rejecting others?

Sir B. Brodie, in the paper already alluded to, expresses himself in general terms to the effect that 'lithotritry, if prudently and carefully performed, with a due attention to minute circumstances, is liable to smaller objections than almost any other of the capital operations of surgery, the cases to which it is not applicable being very few indeed, and chiefly those in which, from the calculus having attained an unusual size, the danger and difficulty of lithotomy are so great that no surgeon would willingly undertake it.'

To explain the application of lithotritry, M. Civiale divides cases of stone into two classes, the simple and the complicated; and examines for each the circumstances which are favourable or unfavourable to the operation.

The first class comprises three series of cases. In the first or most simple of all, the bladder is healthy and of ordinary capacity, the prostate is not enlarged, the urethra is free, the stone small and of moderate consistency, the digestion and general health are good.

These are the most favourable cases that can present themselves, and a cure is usually soon effected, without the patient's suffering much inconvenience.

In the second series the organs are still sound, or at least not affected in any serious manner, and the general health is good, but the stone is larger than in the former series of cases; it measures from

three-quarters to one inch in diameter, and is sufficiently hard to resist moderate pressure. In these cases the broad flat-beaked lithotrite is the most useful instrument. M. Civiale says that he never met with a stone less than an inch in diameter, which resisted the instrument of this kind that he employs. But the first fragments are too large to pass through the urethra; they must be seized at once and reduced in size. The manipulation does not commonly require more than five minutes, and the whole treatment does not last more than eight to fifteen days.

In the third series of simple cases the organs are still comparatively sound and the general health good, but the stone is moderately hard, from one inch to two inches in diameter. In this series difficulties may arise from the size and shape of the stone; but they may be overcome, and the calculus may generally be crushed without danger in five or six sittings. The operation is more painful and difficult, but the result is generally satisfactory. In some few cases, however, the irritation and contraction of the bladder continue; and if the size and hardness of the stone be such as to render a long treatment inevitable, M. Civiale advises that lithotomy should be had recourse to without delay.

This question of the performance of lithotomy after lithotritry is an important one, though it is neglected in most of our standard works. In many cases of vesical calculus, the bladder, as a consequence of prolonged disease, is either permanently contracted, or has a tendency to contract strongly on slight irritation. Whenever no organic mischief exists, and the stone is small, lithotritry may be attempted and persisted in so long as unfavourable symptoms do not arise. But the case must be watched with great care, and every precaution used to avoid increasing the sensibility of the bladder which already exists. With all our care, however, the irritability of the bladder may increase to a severe degree. The stone may have been broken, and on the next or following day great pain and irritation may arise from the presence of the fragments, with a constant desire to pass urine, and considerable difficulty in voiding it. A little later more unfavourable symptoms set in—high irritative fever, extreme local irritation, with great pain in passing the fragments, or rather, in the efforts to pass them, few or none being voided. Now, in a case of this kind, what is to be done? The attempt to break the stone cannot be renewed, and the patient's strength, which before the crushing was good, is now rapidly sinking. Under these circumstances are we justified in resorting to lithotomy? *A priori*, it might be thought that the succession of one capital operation to another must be attended with too great risk; that the mischief set up by the previous lithotritry must render the subsequent lithotomy dangerous, if not fatal; but such is not the case.

Lithotomy after lithotritry, though a last resource, is far from being a hopeless undertaking. The rule for the guidance of the surgeon is that whenever lithotritry has given rise to unfavourable symptoms, which continue in spite of all treatment, and lead to serious apprehension, the general health being pretty good, lithotomy should be employed without delay. It may be required in two classes of cases. In one, when the stone is large,

and the first operation is unexpectedly followed by severe symptoms, such as general fever, with great irritation and violent contraction of the bladder, the irritability of the organ being so great that even the introduction of an instrument cannot be borne. If this state continues for many days, decisive measures must be adopted. The local and general condition of the patient evidently depends on the irritation kept up by the fragments of the partially crushed stone. The bladder, therefore, must be speedily relieved, and this can only be effected by continuing lithotritry at all hazards, or by falling back on lithotomy. The latter is the most prudent course. If the stone were small and friable, a renewed attempt at crushing might succeed; but where the stone is large and hard, several sittings at prolonged intervals would be required. The manipulations would keep up, if not increase, the local irritation; inflammation of the bladder, renal disease, or purulent infection, would probably set in, and the result be fatal.

In another class of cases, independently of the size and density of the stone, the first sitting is followed by violent and permanent contraction of the bladder. The neck of the bladder is extremely sensitive; attempts to pass an instrument excite great pain. In a case of this kind, many surgeons would administer chloroform, and continue the crushing; but if there be the least suspicion that the irritability of the bladder is complicated with any organic change, however slight, lithotritry cannot be persisted in without great risk. Relief should at once be given by the knife, provided the general condition be favourable.

The following case illustrates the principles which have just been laid down:—On October 18, 1859, the writer attended a patient 67 years of age, stout and of healthy constitution. The prostate was enlarged and the bladder irritable, but the calculus was of moderate size. On the 20th, it was crushed, but some difficulty was experienced in seizing the stone, caused by the irritability of the bladder. Great care was, therefore, observed, and the calculus was simply crushed during the first sitting, no attempt being made to pulverise the fragments. There was no discharge of blood, either at the time of the operation or subsequent to it. For three days little or no local irritation supervened. Some fragments were passed without difficulty, and the general health was not disturbed; on the 24th, however, he was seized with frequent desire to pass water, great straining in the efforts, and great pain afterwards, but no more fragments came away. Perfect rest was enjoined, hot baths and fomentations employed, and opiates were administered by the mouth and rectum, but the symptoms continued without any relief. For two days, complete retention supervened, probably caused by the opiates, but on each occasion of drawing off the urine, the spasm was very severe. The irritable condition of the bladder returned with augmented severity, the urine being passed every ten minutes with great pain and straining; and the general health of the patient, which had hitherto been good, now began to give way. The urgency of the case required prompt measures, and lithotomy was proposed and acceded to. The operation was performed on November 6th, and presented no difficulty. On extracting the foreign body it was found broken, one-half of the stone being entire,



and the other portion reduced to fragments. It was a lithic acid calculus of oval shape and moderate size. The symptoms were immediately relieved by the operation; the urgent straining, irritability, and pain ceased. The patient made a good recovery, and at the end of six weeks returned to the country perfectly cured. At the present time, more than five years after the operation, he continues to enjoy good health, and is free from all symptoms of stone.

The advantages of having recourse to lithotomy in this case are manifest. It was the only resource. The mortality of lithotomy after lithotripsy is much less than could, *à priori*, have been expected. M. Civiale has had twenty-eight cases: of which nineteen recovered, and nine ended fatally. M. Souberbeille succeeded in ten out of twelve cases. M. Velpeau had three cases, which did well. In M. Bancal's work on lithotripsy there are three cases related where excessive irritation of the bladder compelled him to give up crushing and have recourse to lithotomy. These cases terminated favourably. The writer performed lithotomy in three cases after the first sitting in lithotripsy; two recovered; and in the case which terminated fatally, the stone was large, weighing a little above four ounces.

From the above it will be seen that M. Civiale regards all cases as simple, in other words, as eminently suited for lithotripsy, when the stone is of moderate size and density, and the organs free from serious disease.

What serious diseases he here includes are not described, but on looking at the observations attached to the tables we find 'irritability of the organs, enlargement of the prostate, catarrh of the bladder, sluggishness of the bladder, constitution somewhat enfeebled by the disease, yet not contra-indicating the operation. It would appear indeed, that M. Civiale looks rather to the degree than to the nature of the affection of the genito-urinary organs, the influence of which is to be taken into consideration.

Complicated cases, as distinguished from simple, present themselves whenever the existence of stone is attended by certain morbid states which compel the surgeon to modify the manipulations, rendering these latter very painful, difficult, or even impossible. M. Civiale passes in review these various states, commencing with the least serious; each state constitutes a series.

1. *Excessive sensibility of the Urethra and neck of the Bladder, with or without increased contractility of the Bladder.*—These conditions do not contra-indicate lithotripsy, but when they exist the surgeon must be prepared to find that he is compelled to abandon the operation, especially in those cases where the excitability of the organs depends on organic disease. The degree of irritation and its effects offer the principal circumstances to be taken into consideration, but in all cases it is necessary that the stone be small and not hard.

2. *Atony of the Bladder.*—This condition is not rare amongst calculous patients, and it renders the manipulations easy; but it is always an unfavourable circumstance, as it may at any time give rise to complete retention of urine. Atony of the bladder does not contra-indicate lithotripsy, but the results of the first manipulation must be watched, as they will show what the surgeon has to expect from the operation. Success is the rule, if we can prevent

accumulation of urine in the bladder and the arrest of fragments in the urethra; but in some cases, nervous or inflammatory accidents supervene with such intensity that the operation must be abandoned, and lithotomy becomes our sole resource.

3. *Strictures and other abnormal states of the Urethra.*—The complication of stone with stricture of the urethra is extremely frequent, yet preliminary treatment seldom if ever fails to bring the canal into such a state as will admit the introduction of instruments.

4. *Enlargement of the Prostate Gland.*—This complication exercises a great influence over the performance and the results of lithotripsy. As the obstacle is chiefly of a mechanical nature, its influence is to be estimated by its extent. At the same time the co-existence of organic lesion of the bladder must be taken into account. The first point which the operator has to determine is whether the size of the gland be sufficiently great to prevent the working of the lithotrite in the bladder without danger. He should then ascertain the degree of sensibility of the parts, the size, density, and number of the calculi, and other circumstances calculated to impede the operation. If these circumstances be not of sufficient importance in themselves to contra-indicate the operation, it may be proceeded with.

Considerable enlargement of the prostate will often render necessary the employment of a peculiar lithotrite, which the writer introduced to the notice of surgeons some years ago (*Lancet*, Jan. 30, 1858). A constant effect of prostatic enlargement is elongation of the urethra. This lengthening of the canal may be connected with several conditions of the enlarged gland; it is, however, mainly confined to the prostatic portion of the urethra, and occurs in one of two ways. As the enlargement pushes the neck of the bladder under the arch of the pubes, it necessarily draws up and elongates the vesical end of the urethra; or, while the gland is slowly enlarging from before backwards, that portion of the urethra which traverses it must necessarily follow the abnormal development of the prostate, and become elongated. In his work on the prostate (*The Enlarged Prostate*, p. 23, 1858), Mr. Thompson observes that 'in some preparations which he examined, the urethra measured three inches from the orifice of the bladder to the membranous portion, instead of an inch and a half, which is the normal length.' In all cases of this kind, more especially when the middle lobe is affected, the orifice of the bladder is thrown backwards in proportion to the development of the enlarged lobe; and hence the point of any instrument used is apt to catch against the walls of the canal before it enters the bladder. The effects of the morbid growth on the cavity of the bladder will depend on the degree of prostatic enlargement, and on the lobe principally affected. When the enlargement is chiefly confined to the middle lobe of the prostate, which encroaches on the floor of the bladder, the capacity of that viscus at its lower part is proportionably diminished, and the effect of this extension of the middle lobe of the prostate backwards is to form a reservoir or sac behind the enlarged gland. The floor of the bladder is here greatly depressed; the urine remains as in a sac; and here a calculus may be lodged, the detection of which is often extremely difficult.

The necessity of employing special sounds and catheters in cases of enlarged prostate is well known to all practitioners. The increased length of the urethra, and the encroachment of the enlarged lobe on the floor of the bladder, compel the surgeon to use a much longer catheter than usual. In such cases, then, the surgeon requires a long catheter of peculiar shape to draw off the urine. For the same reason—viz., the increased length of the urethra, and the depression in the floor of the bladder—he will require a long lithotrite of peculiar shape, in order to catch and crush the stone with ease to himself and safety to his patient. The additional length to be given to the instrument will, of course, depend on the elongation of the urethra; but for ordinary cases, an increase of two inches in the length of the stem will suffice. With a long lithotrite of this kind, the surgeon gets readily into the bladder; but to overcome the impediments likely to arise from an enlarged middle lobe, a peculiarly formed beak is necessary, and the pelvis must be raised. The beak or curved part of the lithotrite must be short, and the curve sharp. With an instrument of this kind the surgeon will often be able to 'fish up the stone from the depression behind the enlarged prostate.' By turning the point down, and elevating the handle of the instrument, the stone will commonly be found in the position already mentioned. But when the middle lobe of the prostate is much enlarged, and extends some way into the bladder, the point of the instrument cannot be turned downwards in such a way as to reach the stone. In such cases, the pelvis of the patient must be raised so that the calculus shall be displaced towards the posterior wall of the bladder. Especial care must be taken that the pelvis itself is raised, and not merely the lower extremities. The influence of the enlargement of the prostate in preventing the evacuation of fragments must not be overlooked. Atony or catarrh of the bladder accompanied by great irritability of its neck contra-indicate the operation, as likewise do considerable size and hardness of the stone.

5. *Fungous Tumours*.—What has been just stated relative to the enlarged prostate, also applies to those tumours which are usually attached near the neck of the bladder. They are not absolutely opposed to the application of lithotrity, but they contribute in general to render the operation more difficult and painful; they may even compel the surgeon to abandon it altogether. M. Civiale thinks lithotrity applicable in those cases only where the tumour is small, slightly sensitive, not subject to bleed, while at the same time there is a prospect of being able to destroy the stone in a few sittings. In some rare cases, however, the surface of the bladder presents a number of fungoid excrescences which are incrustated with calcareous deposits in such quantity that the presence of a large stone may be suspected. As this condition indicates an advanced stage of disease, it contra-indicates lithotrity absolutely.

6. *Columnar and Sacculated Bladder*.—These conditions of the bladder are well known, and the former very often accompanies vesical calculus. M. Civiale does not regard them as contra-indicating *per se* the operation, and details several cases in which he succeeded in crushing calculi that were distinctly sacculated. Still it would appear that only the projecting portions of the calculi were

destroyed.<sup>3</sup> When this condition of encysted stone is accompanied by atony of the bladder, with or without catarrh, M. Civiale thinks that the operation had better not be attempted.

7. *Catarrh of the Bladder*.—Catarrh of the bladder often complicates stone, of which it may be either a cause or an effect. To determine the influence which it may exercise over the results of the operation, it is highly necessary to examine whether it be a mere effect of the presence of a foreign body in the bladder, or the result of some morbid condition of that viscus. It is especially necessary to distinguish the catarrh connected with atony of the bladder from that form which is associated with hypertrophy. However, if an operation be attempted, it is an indispensable condition that the stone be small. To this rule M. Civiale points out an exception. When the formation of stone is an effect of the catarrhal state it is usually soft and phosphatic, and hence its size forms no objection. Purulent catarrh is a very serious complication. When the bladder contracts violently, and the expulsion of urine is accompanied by considerable pain, the existence of ulceration is to be feared; and in such case, as well as in all others where the contractility of the bladder is greatly augmented, lithotrity is inapplicable, unless, indeed, we have the certainty of being able to destroy the stone in a short time.

8. *Renal Disease*.—Of all the affections by which stone may be complicated, renal diseases are the most frequent, the most serious, and at the same time the most insidious. These affections can, however, only influence the results of the operation, and the only question which the surgeon has to determine is how far the existing disease of the kidney may be aggravated by the manipulations necessary for the destruction of the calculus. Upon this point M. Civiale does not express any decided opinion.

In the writer's opinion, lithotrity is indicated in all cases where the operation can be performed in a safe manner and with a reasonable expectation of deriving from it those results which it is capable of yielding. Now, to ensure these results and the safe execution of the manipulations, certain conditions are requisite. Thus, we must be able to introduce our instruments into the bladder. Having introduced them, we must be able to seize and fix the calculus. Having fixed the stone, we must be able to break it up into small fragments, and the fragments thus comminuted must have a ready exit from the bladder. Finally, these various steps of the operation must be performed without exciting any serious disorder in the urinary organs, without aggravating in a dangerous way any disorder which may already exist, or without inflicting any important injury on the general health of the patient. To perform lithotrity in a successful manner, the different conditions which have been just enumerated must be strictly fulfilled; and we have, therefore, only to ascertain what circumstances prevent the fulfilment of these conditions, in order to discover the indications and contra-indications of lithotrity. Whenever in any given case the surgeon cannot entertain a reasonable hope of attaining the conditions which are essentially necessary to a successful performance of the operation, the latter is contra-indicated.

The chief circumstances on which the applicability of lithotrity in any given case mainly de-



pends are the nature, position, &c., of the calculus, the condition of the urinary organs, and finally, the general health of the patient. In passing these various circumstances under review, we arrive at conclusions which differ but slightly from those adopted by M. Civiale. Excessive size and hardness of the stone contra-indicate lithotripsy, because one of the conditions above enumerated cannot be attained, viz., that of not inflicting any injury on the urinary organs or on the general health of the patient. A large dense stone cannot as a rule be reduced to powder without a considerable number of manipulations, and the risk of over-exciting the bladder by these repeated manœuvres is so great that lithotomy is preferable.

The condition of the urinary organs is the next point examined in reference to the indications of lithotripsy. Few calculous patients are altogether free from some disorder of the urinary apparatus, while many affections of the bladder merely influence the results of lithotripsy without absolutely contra-indicating the operation. Hence it is a matter of great importance to ascertain what morbid conditions of the genito-urinary apparatus are incompatible with the safe and successful application of lithotripsy.

Enlargement of the prostate gland is an unfavourable circumstance in all cases, but it is not an absolute contra-indication. The surgeon will first determine, by careful examination, the precise nature and extent of the obstacles which it may create; and having done this, he proceeds to consider how far this unfavourable element may influence other conditions. For example, when the enlargement is moderate, and does not therefore much impede the working of the instruments in the bladder, lithotripsy is not forbidden, provided the stone be small and the organs not extremely sensitive. On the other hand, when the prostatic enlargement is considerable, we should not have recourse to lithotripsy if there is reason to suppose, from the size or density of the stone, &c., that the operation will require a number of manipulations for its completion. Finally, lithotripsy is contra-indicated in those cases where any serious disorder of the urinary organs coexists with such an enlargement of the prostate as may tend to protract the operation.

Respecting the influence of chronic inflammation or catarrh of the bladder, it is of very frequent occurrence in calculous patients, and it is therefore of importance to examine how far such a condition may influence our choice of the operation to be selected. Simple calculous catarrh of the bladder, instead of being aggravated by lithotripsy, is almost always alleviated by comminution of the foreign body. It is satisfactory to be enabled to state that this opinion has been fully confirmed by the experience of Sir B. Brodie. He expresses his opinion that 'inflammation of the mucous membrane of the bladder, induced by calculus, and indicated by great irritability of the organ and the copious secretion of mucus, does not form any absolute objection to the operation, although it is doubtless a reason for proceeding with more caution; for, on the contrary, it often happens, under such circumstances, that the crushing of the calculus is followed by an alleviation of all the bad symptoms.'

According to the writer's own experience, it is only where the chronic inflammation of the bladder has been of long standing, or is complicated with other lesions, that it becomes necessary to reflect whether the state of the vesical mucous membrane will admit of instruments being employed without danger. If the catarrh were accompanied by any organic or severe affection of the neck or body of the bladder, lithotripsy should certainly be abstained from.

Purulent catarrh of the bladder we also hold to be a positive contra-indication. In this we know that we differ from a high authority; but experience has taught us that a purulent secretion from any part of the genito-urinary system may, under the influence of an operation, become a determining cause of purulent infection of the blood.

Another condition of the bladder which contra-indicates lithotripsy is hypertrophy, with diminution of the cavity and extreme irritability of the bladder. It is unnecessary to point out how dangerous any manipulations would be in an organ thus affected.

Small fibrous tumours about the neck of the bladder may impede the operation without absolutely contra-indicating it; but vascular or cancerous tumours in the body of the bladder should be regarded as positive contra-indications.

We agree with Civiale in thinking that paralysis of the bladder does not contra-indicate lithotripsy, although it is a serious condition, which requires great care. The sittings should be short and the bladder washed out daily with a large-eyed catheter, to promote the evacuation of the detritus.

But it happens much more frequently that the bladder of calculous patients is in a condition directly opposed to the one just noticed. The constant irritation of a foreign body produces increased sensibility of the urinary organs, and this is soon followed by hypertrophy of the bladder with diminution of its cavity. In cases of this kind the mucous membrane of the bladder is often the seat of chronic inflammation, or at least highly disposed to take on inflammatory action under any increase of irritation. The general principles already laid down explain why such a condition of parts when highly developed contra-indicates lithotripsy: thus it has been stated, that 'the play of the instruments in the bladder must be sufficiently free to allow of our breaking up the stone without inflicting any injury on the bladder, or irritating that organ in any dangerous way.' It is evident that this condition cannot be fulfilled when the bladder contracts with such force as to leave no space between its walls and the surface of the stone, and it would be folly to attempt an operation under circumstances which are directly opposed to its successful performance.

As the extent to which the prostate may be enlarged varies, and the abnormal states accompanying this lesion are also of various kinds, each case must be decided on according to its conditions; but here, as well as in most other series of cases, the general rule is applicable to determine how far the lesions and disorders which are present may impede the manipulations or influence the results of the operation.

Certain conditions of the general health contra-indicate lithotripsy. When patients have suffered from a calculous affection for many years the

general health is often greatly deteriorated, although no signs of any organic disease may be discoverable in the bladder or kidneys. The patient is much reduced in flesh and strength, he is nervous, the digestive organs are deranged, attacks of fever occur every now and then, the bladder is contracted, and the desire to pass water is frequent. Lithotomy holds out greater chance of relief in these unpromising cases.

Disease of the kidney often accompanies calculus; the affection is sometimes manifest, often it is latent; or disease may be developed under the influence of an operation. What indications are to be drawn from the existence of renal disease in a person labouring under stone? and what from the possibility of its being lighted up by an operation in persons predisposed to such malady? Should lithotomy be preferred to lithotripsy in cases of this kind? These are practical questions extremely difficult to answer. M. Civiale thinks that lithotripsy has less tendency to exasperate any existing lesions of the kidney, yet when we reflect on the nature of the two operations we find it difficult to understand how this can be the case. If we select lithotripsy, it should, in the writer's opinion, be when the renal disease is not far advanced, and when the condition of the bladder and nature of the calculus lead to the conclusion that the operation may be completed within a short period.]

(William Coulson.)

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**LOTIO ALUMINIS.**—℞. Aluminis 3ij. Aquæ destillatæ Oct. j. Misce.—Sometimes used as an astringent injection; sometimes as an application to inflamed parts.

**LOTIO AMMONIÆ ACETATIS.**—℞. Liq. ammon. acetatis; Spirit. vin. rectific.; Aquæ destillatæ; sing. 3iv. Misce.—Properties discutient.

**LOTIO AMMONIÆ HYDROCHLORATIS CUM ACETO.**—℞. Ammon. hydroch. 3ss. Aceti, Spirit. vinos. rectific. sing. Oct. j. Misce. This is one of the most efficacious discutient lotions. It is an excellent application for promoting the absorption of extravasated blood, in cases of ecchymosis, contusions, sprains, &c.

**LOTIO BORACIS.**—℞. Boracis 5j. Aq. simplicis 3iiss. Ol. Amygdalæ 3iij. vel Glycerine. Misce.—This lotion is recommended as one of the best applications to sore nipples.

**LOTIO ACIDI PYROLIGNEI.**—℞. Acid. pyrolign. 3ij. Aq. destillat. 3vj. Misce.—This is injected into the meatus auditorius by Mr. Buchanan, for the purpose of improving the secretion within the passage, and stopping morbid discharge from it. (See his illustrations of *Acoustic Surgery*, 8vo. Lond. 1825.) In particular cases, attended with much irritability, he uses the following formula.—℞. Plumbi acet. gr. x. Acid. pyrolign. m xx. Aq. destillat. 3vj. Misce.

**LOTIO NIGRA.**—℞. Liq. calcis 3x. Hydrargyri Chloridi 3j. Misce.—The common black wash.

**LOTIO ACID. TANNICI.**—℞. acid. Tannici 3i.—3ii. Aquæ dest. 3vj.—3viij.—This astringent lotion is used with the view of removing the relaxed state of the parts, in prolapsus ani, prolapsus uteri, &c.

**LOTIO HYDRARGYRI AMYGDALINA.**—℞. Amygdalarum amararum 3ij. Aquæ destill. lbj. Hydrarg. Bichloridi 9j. Beat the almonds into an emulsion with the water, strain the liquor, and then add the bichloride of mercury. Useful in several cutaneous affections.

**LOTIO HYDRARGYRI BICHLORIDI COMPOSITA.**—℞. Hydrarg. bichlor. gr. x. Aq. destillat. bullientis 3iss. Tinct. canthar. 3ss. Misce.—Applied to scrofulous swellings.

**LOTIO POTASSII SULPHURETI.**—℞. Potassii sulph. 3ij. Aquæ destill. lbj. Ol. Lavand. m iv. Misce.—Used in cases of porrigo, psoriasis, lepra, &c.

**LOTIO OPII.**—℞. Opii purif. 5jss. Aquæ destillatæ lbj. Misce.—A good application to irritable painful ulcers. It is best to dilute it, especially at first.

**LOTIO PICIS.**—℞. Picis liquidæ 3iv. Calcis 3vj. Aquæ ferventis lbj. To be boiled till half the water is evaporated. The rest is then to be poured off for use. This application is sometimes employed in tinea capitis; and for the removal of an extensive redness, frequently surrounding old ulcers of the legs, in persons whose constitutions are impaired by copious porter drinking, gluttony, and other forms of intemperance.

**LUMBAR ABSCESS.** *Psoas Abscess. Chronico Psotitis.* By these terms are understood chro-



nic collections of matter, which form in the cellular tissue of the loins, behind the peritonæum, and descend in the course of the psoas muscle. According to Professor Gibson, this disease, which is remarkably common in Europe, is rarely met with in the United States. In the course of thirteen years, during which he has been connected with extensive hospitals, he has seen only four cases; and Dr. Physic had never attended an instance of psoas abscess in America, unconnected with disease of the spine. (See *Gibson's Institutes, &c. of Surgery*, vol. i. p. 214. 8vo. Philadelphia, 1824.) This remark is curious, because psoas abscess takes place mostly in scrofulous individuals, who, I believe, abound in some parts of the United States, as well as in other countries. Patients, in the incipient stage of the disease, cannot walk so well as usual: they feel uneasiness about the lumbar region, but in general no acute pain, and this sometimes, even though the abscess may have acquired such a size as to form a large tumour, protruding externally. The psoas abscess is one of the best instances which can possibly be adduced, in order to illustrate the nature of those collections of matter, which are called chronic, and which form in an insidious manner, without serious pain, or any other attendant inflammation. Sometimes, however, the patient experiences severe and acute pains in the loins and back long before the abscess produces any external swelling.

The abscess sometimes forms a swelling above Poupart's ligament; sometimes below it; and frequently the matter glides under the fascia of the thigh. Occasionally, it makes its way through the sacro-ischiatic foramen, and assumes rather the appearance of a fistula in ano. When the matter gravitates into the thigh, beneath the fascia, Mr. Hunter would have termed it a disease *in*, not *of*, the part. The uneasiness in the loins, and the impulse, communicated to the tumour by coughing, evince that the disease arises in the lumbar region; but, it must be confessed, that we can hardly ever be sure of the existence of the disorder, until the tumour, by presenting itself externally, leads to such information. The symptoms are commonly of the following kind: pain in the lumbar region, shooting to the groin and thigh, and stiffness and pain in the course of the spine; which symptoms are exasperated by extension of the thigh. The patient cannot stand well on the foot, and either limps in walking, or cannot walk without stooping. Any effort causes an increase of pain. Sometimes the inguinal glands are enlarged. According to Dr. Kyll, of Wesel, the disease admits of being discriminated from others, even in its early stage, by the following circumstances: the patient cannot walk in the upright position; he always leans a little forward; he can only straighten himself to a certain point, and he is stopped by a tearing pain, which is felt at the same instant in the groin and loins. The patient can go up stairs more easily than he can come down, because in the latter movement he is obliged to hold himself up. These symptoms are usually preceded for several weeks, or even months, by dull pain in the lumbar region.

Lumbar abscess may be mistaken for rheumatism, affections of the kidney, coxalgia, lumbago, hæmorrhoidal pains, glandular swellings, and hernia. I have known the latter mistake frequently

made, when the abscess had formed a small swelling below Poupart's ligament. The points of difference are noticed in the article *HERNIA*.

I have attended several patients, each of whom had a double lumbar abscess. Two such cases were lately under me, in University College Hospital, and ultimately recovered. In the same hospital, we have seen patients, whose thighs were drawn into complete contact with the belly, from the effects of lumbar abscess; yet after the discharge of the matter, the limbs gradually resumed their proper position and use. The lumbar abscess is sometimes connected with diseased vertebræ, which may either be a cause or an effect of the collection of matter. The disease, however, may be unattended with this complication.

Chronic abscesses perpetually form in the loins without vertebral disease, and get well with ordinary care. (*Mayo, Outlines of Human Pathology*, p. 124.)

The generality of lumbar abscesses, and others in the iliac fossa, are not accompanied by disease of the hip; but now and then such a case presents itself. They are more commonly associated with and dependent upon disease of the vertebræ.

When the bodies of patients with lumbar abscesses are opened, it is found that the matter is completely enclosed in a cyst, which, in many cases is very extensive. If the contents of such abscesses were not circumscribed by a membranous boundary in this manner, we should find that they would spread among the cells of the cellular tissue, just like water in anasarca. The cyst, which, in its texture, bears some resemblance to a mucous membrane, is both a secreting and an absorbing surface, as is proved by the great quantity of matter, which soon collects again, after the abscess has been emptied, and by the occasional disappearance of large and palpable collections of matter of this kind, either spontaneously, or in consequence of means which are known to operate by exciting the action of the absorbents. In fact the cyst becomes the suppurating surface, and suppuration is mostly believed to be a process, similar to glandular secretion. While the abscess remains unopened, its contents are always undergoing a change, fresh matter is continually forming, and a portion of what was previously in the cyst is undergoing the necessary removal by the absorbents. This is not peculiar to lumbar abscesses; it is common to all abscesses, both chronic and acute, and to every bubo. It is true, that, in acute abscesses, there often has not been time for the formation of so distinct a membrane as the cyst of a large chronic abscess; but their matter is equally circumscribed by the cavities of the cellular tissue being filled with a dense coagulated lymph, or fibrine; and though it generally soon makes its way to the surface, it also is sometimes absorbed.

When a common abscess, the result of acute inflammation, is small, and tending to burst quickly, without any disposition to spread under the integuments, or under a fascia, the surgeon may often suffer the abscess to break of itself, by an ulcerative process. But, in chronic abscesses, the matter has not that strong tendency to make its way outward; its quantity is continually increasing; the cyst is, of course, incessantly growing larger and larger; in short, the matter, from one ounce, often gradually increases to the quantity of a gallon. When the disease is at length

opened, or bursts by ulceration [if the entrance of atmospheric air be not prevented], the surface of the cyst inflames; and its great extent in this circumstance is enough to account for the terrible constitutional disorder, and fatal consequences, which too frequently soon follow the evacuation of the contents of such an abscess. Hence, in chronic suppurations of every kind, and not merely in lumbar abscesses, it is frequently the surgeon's duty to observe the opposite rule to that applicable to acute cases; and he may be called upon to open the collection of matter [this, however, must be done with great caution] as soon as he is aware of its existence, and its situation will allow it to be done.

The practice of opening abscesses connected with the larger joints, is considered by Dr. McDowell to be in general decidedly objectionable; but, says he, 'when we consider the fatal consequences which may result from the unchecked progress of the deep iliac abscess, and take into the account the very great sufferings of the patient from pressure of the anterior crural nerve and its filaments, I believe this to be a case in which surgical interference is called for. The puncturing of this abscess, however, requires much caution. In superficial purulent collections in the iliac fossa, the peritoneum is detached, and pushed upwards and inwards sufficiently to permit the incision above Poupart's ligament being made with perfect safety: not so in the deep collections; there is then no separation of the peritoneum, and the opening must be made below Poupart's ligament, and of course with great caution. (See *McDowell, in Dublin Journal of Med. Science*, vol. iv. p. 13.) Sir Astley Cooper's doctrine respecting the practice of opening abscesses, connected with large joints, I have noticed in the article JOINTS, DISEASES OF THE.

This view of the principle, on which the treatment of a lumbar abscess should be conducted, is not, however, adopted by all surgeons. Kirkland believed that the patient had the best chance of recovery when the abscess was allowed to burst spontaneously, and the matter to be gradually discharged through a small opening (*Kirkland's Medical Surgery*, vol. ii. p. 199); and Mr. Pearson, in comparing the results of his own experience, declares them to be in favour of the same practice. The generality of modern surgeons, in this country, differ on this point from Kirkland and Pearson; yet, while they advocate the utility of an early puncture, they admit the danger [from the admission of atmospheric air] of suddenly discharging the contents of the abscess through a large opening, which is afterwards left unclosed.

Certainly, it would be highly advantageous to have some means of ascertaining whether the vertebrae are diseased; for, as in this instance, the morbid bones would keep up suppuration, until their affection had ceased, and there would be no reasonable hope of curing the abscess sooner, it might be better to avoid puncturing it under such circumstances. The propriety of this conduct seems the more obvious, as issues, which are the means most likely to stop and remove the disease of the spine, are also such as afford the best chance of bringing about the absorption of the abscess itself. However, if the collection cannot be prevented from discharging itself, and ulceration is at hand, it is best to meet the danger, make an open-

ing with the lancet in a place at some distance from where the pointing threatens, and afterwards heal it, in the way which will be presently detailed.

Though I have recommended generally opening chronic abscesses while small, the deep situation of the lumbar one, and the degree of doubt always involving its early state, unfortunately prevent us from taking this beneficial step in this particular case. But still the principle is equally praiseworthy, and should urge us to open the tumour as soon as the fluctuation of the matter becomes distinct, and the nature of the disease is evident. For this purpose Mr. Abernethy employed an abscess lancet, which made an opening large enough for the discharge of those flaky substances so frequently found blended with the matter of lumbar abscesses. Such flakes seem to consist of a part of the coagulating matter of the blood, and are very commonly secreted by the peculiar cysts of scrofulous abscesses. The puncture must be of a certain size, in order to allow the clots of blood, occasionally mixed with the matter, to escape. Mr. Abernethy considered the opening of a lumbar abscess a very delicate operation. Former surgeons used to make a large opening in these cases; let out the contents; and leave the wound open: the usual consequences of which were, great irritation and inflammation of the cyst: immense disturbance of the constitution: putrefaction of the contents of the abscess, in consequence of the entrance of air into its cavity; and too often, death. While such practice prevailed, very few, afflicted with lumbar abscesses, were fortunate enough to escape. The same alarming effects resulted from allowing the abscess to attain its utmost magnitude, and then burst by ulceration. If then a more happy train of events depend upon the manner in which lumbar abscesses are punctured, the operation is certainly a matter of delicacy.

Until the collection has been opened, or burst, the patient's health is usually little or not at all impaired; indeed, we see in the faces of many persons with such abscesses what is usually understood by the picture of health. Hence, how likely our professional conduct is to be arraigned when great changes for the worse, and even death, occur very soon after we have let out the matter, seemingly, and truly, in consequence of the operation. Every plan, therefore, which is most likely to prevent these alarming effects, is entitled to infinite praise; and such, I conceive, is the practice recommended by Mr. Abernethy.

This gentleman's method was to let out the matter, and heal the wound immediately afterwards by the first intention. He justly condemned all introductions of probes, and other instruments, which only irritate the edges of the puncture, and render them unlikely to grow together again. The wound is to be carefully closed with sticking plaster, and it will almost always heal.

These proceedings do not put a stop to the secretion of matter within the cavity of the abscess. Of course, a fresh accumulation takes place; but, it is obvious that the matter, as fast as it is produced, will gravitate to the lower part of the cyst, and, consequently, the upper part will remain for some time undistended, and have an opportunity of contracting.



When a certain quantity of matter has again accumulated and presents itself in the groin, or elsewhere, which may be in about a fortnight after the first puncture, the abscess is to be punctured again, in the same manner as before, and the wound healed in the same way. The quantity of matter will now be found much less than what was at first discharged. Thus the abscess is to be repeatedly punctured at intervals, and the wounds as regularly healed by the first intention, by which method, irritation and inflammation of the cyst will not be induced, the cavity of the matter will never be allowed to become distended, and it will be rendered smaller and smaller, till the cure is complete.

In a few instances, the surgeon may, perhaps, be unable to persevere in healing the repeated punctures which it may be necessary to make; but, after succeeding once or twice, the cyst will probably have had sufficient opportunity to contract so much, that its surface will not now be of alarming extent. It is also a fact, that the cyst loses its irritability, becomes more indolent, and less apt to inflame, after the contents have been once or twice evacuated in the above way; and its disposition to absorb becomes also stronger. [In the present day valvular trocars are used to evacuate the matter, which effectually prevent the entrance of air.]

The knowledge of the fact, that the cysts of all abscesses are absorbing surfaces, should lead us not to neglect other means, which Mr. Abernethy suggested as likely to promote the dispersion of the abscess, by quickening the action of the absorbents. Blisters kept open with savine cerate, issues, electricity, occasional vomits of the sulphate of zinc, are the means most conducive to this object. [The injection of tincture of iodine, diluted with two or more parts of water, has a powerful effect in lessening the secretion of the matter.] When the vertebræ are diseased, issues will often prove serviceable, more especially before the abscess has been opened, or when the discharge is not very copious.

In the latter complication, the case is always dangerous. If an opening be made in the abscess, the cyst is at first more likely to be irritated than when the bones are not diseased, and the affection of the spine is not rendered more likely to undergo any improvement, in consequence of the mere formation of an outward communication. The same may be said of necrosis; in which case but little benefit arises from the presence of unhealed fistulæ and sores, which lead down to the disease.

Mr. Crowther succeeded in dispersing some large lumbar abscesses [when not connected with diseased bone] without opening them. Large blisters applied to the integuments covering the swelling, and kept open with the savine cerate, effected the cure. When this gentleman punctured such collections of matter, he used a small trochar, which he introduced at the same place as often as necessary. He observes, that the aperture so made does not ulcerate, and allows no matter to escape after being dressed. It must be remembered that, in the use of the trochar, when the tumour is not very prominent, on account of the quantity of matter being small, suddenly plunging a trocar into the swelling might even endanger parts the wounding of which might lead to fatal consequences.

Some surgeons open lumbar abscesses with a seton. The matter being made to form as prominent a swelling as possible, by pressing the abdomen, and putting the patient in a position, which will make the contents of the abscess gravitate towards the part where the seton is to be introduced, a transverse cut is first made in the integuments down to the fascia. A flat trocar is next to be introduced within the incision, which should only be just large enough to allow the instrument to pass freely under the skin, for at least three-quarters of an inch; when the hand is to be raised, and the trocar pushed obliquely and gently upwards, till the canula is within the lower part of the sac. The trocar must now be withdrawn, and the matter allowed to flow out gently, stopping it every now and then for some minutes. The assistant must now withdraw his hand, to take away the pressure, and place the thumb of his left hand upon the opening of the canula, holding it between his fore and middle fingers. It must then be pushed upward, nearly to the top of the tumour, where its end may be distinctly felt with the fore-finger of the right hand. As soon as it can be plainly felt, it must be held steadily in the same position, and the trocar is to be introduced into it again, and pushed through the skin, at the place where it is felt, and the canula along with it. The trocar being next withdrawn, a probe, with a skein of fine soft silk, dipped in oil, must be passed through the canula, which being now taken away, leaves the seton in its place. A pledget of mild ointment is then to be applied over the two openings, the more completely to exclude the air. A fresh piece of the silk is to be drawn into the abscess, and that which was in before cut off, as often as necessary. (See *Latta's Surgery*, vol. iii. p. 307.)

Deckers, who wrote in 1696, discharged a large abscess in a gradual manner, with a trocar, the canula of which was not withdrawn, but stopped up with a cork, and the matter let out at intervals. B. Bell also advises the canula not to be taken out.

I cannot quit this subject without mentioning a remarkable case of lumbar abscess, which I saw, many years ago, in Christ's Hospital, under the care of the late Mr. Ramsden. The tumour extended from the ilium and sacrum below, as high up as the ribs. The diameter of the swelling from behind, forward, might be about six or eight inches. It was attended with so strong a pulsation, corresponding with that of the arteries, that several eminent surgeons in this city considered the case to be an aneurism of the aorta. After some weeks, as the tumour increased in size, the throbbing of the whole swelling gradually became fainter and fainter, and at length, could not be felt at all. The tumour was nearly on the point of bursting. Mr. Ramsden suspected that it was an abscess, and determined to make a small puncture in it. The experiment verified the accuracy of his opinion; a large quantity of pus was evacuated at intervals; but as the boy's health declined, he went to his friends at Newbury, and I did not afterwards hear the event. I have never seen any popliteal aneurism, whose pulsations could be more plainly seen and strongly felt, than those of the abscess we have just been describing.

In an example of iliac abscess, which occurred in the Richmond Hospital, Dublin, ulceration took

place in a portion of the ilium, adhering to the cyst of the abscess; and the contents of the bowel, after having passed into the abscess, escaped through a fistulous opening near the spine of the ilium. Ulceration also of the external iliac artery followed, about an inch and a half above Poupart's ligament, and sudden death resulted from the blood escaping in large quantity into the cavity of the abscess. The parts are preserved in the Museum of Richmond Hospital. (See *M'Dowel in Dublin Journ. of Med. Science*, vol. iv. p. 912.)

In December 1837, I visited, with Mr. Heale, of Staines, a farmer's son, at Stanwell, whom I had seen with the same gentleman eight or ten months previously. It was a case, in which a soft and partly reducible tumour presented itself below Poupart's ligament, and was mistaken by another practitioner for a hernia. Having examined the swelling, I recommended it to be opened, as it appeared to me from the symptoms to contain matter, and to be an abscess connected with the loins. A puncture was made, and about a pint of matter discharged. A copious evacuation of pus continued for a good while afterwards, and at length matter presented itself at another point, which was also opened. This was behind the quadratus lumborum of the side, not corresponding to that of the original swelling. Then ulcerated openings, five or six inches long, formed over each crista of the ilium, and from these now project two large oblong fungous masses of the same length, and three inches in height and breadth, which appear to extend to a considerable depth, as if proceeding from a cyst or diseased surface within the pelvis. The skin around them is also extensively undermined. The fungous growths are not very sensible, nor do they bleed in any material degree. In addition to all this mischief, the slightest motion causes severe agony, and there is sloughing and ulceration over the sacrum. The patient, though suffering from hectic, still retains his appetite. I have never seen another case corresponding to this, which, I apprehend, will soon prove fatal.

See *Kirkland's Med. Surgery*, vol. ii. Trans. of the King's and Queen's College of Physicians in Ireland, vol. ii. p. 26, &c. 8vo. Dublin, 1818. *F. Schoenmezel*, Obs. de Musculis Psoa et Iliaco suppuratis, Frank. Del. Op. *V. R. Beckwith*, De Morbo Psoadico, Edinb. 1784. *Abernethy's Surgical and Physiological Essays*, parts 1 and 2. *Crowther*, On White-Swelling, &c. 1808. *Latta's Surgery*, vol. iii. *Callisen's Systema Chir. Hodiernæ*, vol. i. p. 370. *Pearson's Principles of Surgery*, p. 102. edit. 2. *Richter's Anfangsgründe der Wundarzneikunst*, b. 5. 113. Göttingen, 1801. *John Lizars*, Case of Double Psoas Abscess, Edinb. Med. Surg. Journ. No. 84. *A. Copland Hutchinson's Practical Obs. in Surgery*, ed. 2.

**LUNAR CAUSTIC.** (See NITRATE OF SILVER.)

**LUPUS.** LUPUS, or EATING TETTER, has been defined a tubercular disease, inducing ragged ulceration of the skin. Dr. Bateman in his Synopsis has touched very lightly upon it, and assigns as a reason, that he can mention no remedy which has been of any essential service in the cure of it. To portray the amount and intensity of its depredations, analogous to the gnawing of some voracious animal, or the ravages of some insect, the epithets *lupus vorax* *formica corrosiva* were bestowed upon it by the ancient medical writers. By the Greek translators of the works of the Arabian physicians it is de-

scribed as the *ἔρπης εσθιομενος* corresponding to the Latin *herpes exedens*. In France it is called *dartre rongeante*; in Germany, *die fressende Flechte*.

The common locality of lupus is some portion of the face. I have, however, seen it attack the nates; and Mons. Alibert mentions an instance of its occurring on the breast. It is for the most part solitary, confined to a single point of the integument. There all its virulence seems concentrated.

Lupus is in general a disease of adolescence, attacking both sexes indiscriminately, at the period of life when there exists the greatest predisposition to affections of the cutaneous and glandular systems. It would seem, however, to be rather more common in the female than in the male. According to Mons. Devergie (*Traité Pratique des Maladies de la Peau*, p. 558), in forty-seven cases of lupus twenty-five occurred in females, and twenty-two in males. This is no doubt due to the greater preponderance of the lymphatic system in the former than the latter sex. Lupus is most frequently met with in individuals from fifteen to thirty-five years of age, as reckoned from thirty-six cases out of forty-four. It is, however, chiefly developed between the fifteenth and the twenty-fifth year.

The individuals most liable to suffer from lupous ulceration, which the writer has designated *erosive ulcer of the derma* (*Lond. Med. Gaz.* vol. xix. p. 329), are those of the lymphatic temperament; of a fair, occasionally rosy complexion, with light auburn hair, grey or blue irides, and a tender skin. To a superficial observer, the general health seems unaffected; but on minutely investigating the state of the different functions, more or less derangement will, in the majority of instances, be detected in those of the chylopoietic viscera. The tongue is redder than natural, especially along the margins, and towards the extremity; its central portion presents a cream-coloured fur, through which the red papillæ project. The breath is more or less offensive, the evacuations from the bowels irregular and unhealthy. To these may be found super-added other signs indicative of what has been termed strumous dyspepsia.

From the survey of a considerable number of cases of this variety of erosive ulcer, I am led to coincide with those authors who look upon it as a symptomatic affection. It is usually dependent on some disorder in the functions connected with assimilation and nutrition. If, indeed, ever truly localised, it has been preceded or accompanied, during some period of its course, by unequivocal marks of those errors of function to which allusion has just been made, and which point to some unhealthy condition of the economy at large.

Dr. Macfarlane, in his Clinical Reports, mentions that in Glasgow, during the years 1818 and 1819, when the working-classes were exceedingly ill-fed, he had occasion to see a greater number of cases of lupus among the district poor under his charge than at any former or subsequent period. According to Mons. Rayer, it has been at times extremely prevalent among the indigent in some parts of France, particularly the sterile mountainous regions of the Haute Auvergne, from scanty and unwholesome nourishment. It appears to originate more frequently in winter than at any other season of the year, and is more common among those who live in the country than in towns.



Lupus is seated in the dermoid texture, the result, according to Wedl (*Rudiments of Pathological Histology*, Syd. Soc. p. 383), of a new formation of connective tissue radiating from a point, and subsequently accompanied with suppuration. The disease commences like a reddish nodule in the skin, having no defined limits, and soon increases in size. The section of one of these nodules shows the tissue of the *corium* softened by an infiltration, expanded and succulent. On minute examination, the *areolæ* in the true substance of the *corium* will be found more or less distended, and filled with young connective tissue elements. The *essential nature*, therefore, of what has been described as the "lupous efflorescence" consists in a new formation of connective tissue in the *corium*, which grows sometimes outwards, sometimes inwards into the subjacent organs. In the former case the *corium* and epidermis are broken through, and an ulcerated spot appears, on whose surface *pus* is usually formed, whilst the new-growth continues to advance in the substance of the *corium*. When the suppurative process commences at the surface of the *corium*, and the superjacent *epidermis* is gradually thrown off, the ulcerous lupus is produced.

On attentively examining the process set up prior to the ulcerative absorption of the epidermic layers, the following phenomena will be remarked. In some point of the attenuated and delicate integument investing the nose, cheek, or lip, a minute yellowish speck appears, surrounded by a reddish halo. The point of the skin corresponding to this tiny abscess is removed by absorption. A mode of ulceration is at length established which is generally superficial, not extending beyond the areolar tissue of the derma, and, though accompanied with preternatural redness, yet without any notable swelling of surrounding parts. It is characterised by its ragged edges, on a level with the base; by its pale mammillary surface, whence issues that peculiar secretion which rapidly concretes on exposure to the air into greyish-yellow crusts; and, lastly, by its being the seat of hot smarting pain and occasional pruritus. The crusts are soon detached, and fresh ones reproduced to supply their place; the affection creeping on meanwhile with insidious certainty.

After having subsisted for some time the original type of the disease is modified, and in some measure obscured; the surface acquires a pink glassy aspect, and loses the papillary appearance it originally presented. When situate in a part where there is much loose areolar tissue, the adjunct textures become indurated, condensed, and assume a dusky red or purplish hue.

Ulcers of this kind differ extremely one from another in their degree of virulence. If the nose is primarily invaded, and particularly the inferior portion of the septum, as frequently happens, the ulceration advances by imperceptible steps, corroding and consuming every tissue, muscle, and cartilage down to the very bone, which at times participates in the devastation. The mutilation thus produced is often hideous and irreparable.

That this is not purely a local malady seems further ascertained from the obstinacy with which it resists topical agents. I have seen nearly every description of stimulant tried, and myself employed powerful caustics, but never have known any permanent benefit accrue, unless measures have been

conjointly taken to modify the state of the system at large.

An opinion is entertained by some medical men that this species of lupus must run a certain course, or exhaust itself, ere its career can be put a stop to by any method of art. This is based, however, rather on imperfect truth than on fundamental error. When the disease is long left uncontrolled, a morbid habit is superinduced, which ordinary means fail to eradicate. But if measures be taken at an early stage to alter and thus amend that peculiar condition of the system upon which the ulcerative process seems to depend, or with which it is associated, we have every reason to expect that that course will be materially abridged, and much mutilation and disfigurement prevented.

Now, the chief indication is to invigorate the system by a light nourishing diet, residence in a pure dry air, free out-door exercise; due attention being paid to the state of the cutaneous exhalation and the alvine evacuations. Much benefit will be derived in many cases by substituting for a stimulating animal diet one composed of farinaceous articles and milk. The patient must strictly abstain from fermented liquors; have occasional recourse to bathing, particularly sea-bathing, should the strength permit; the employment of the *douche*, and to gentle laxatives. Various alterative and tonic medicines will each in its turn, according to circumstances, constitute valuable auxiliaries. Cod-liver oil has been found beneficial when given in moderate doses, and its use persevered in for a length of time. On the whole, owing to the close affinity subsisting between this disease and scrofula, the remedies chiefly indicated are the preparations of iodine, such as the iodide of potassium or of sodium; of iron, such as the tincture of perchloride or the saccharated carbonate; and the vegetable tonics, either alone or conjoined with mineral acids or with chloride of calcium.

When a visible melioration is perceptible in the general condition of the patient, when the different functions are properly performed, then is the favourable time for resorting to those topical remedies which act, not exactly as caustics, but as powerful alteratives of the organic relations of the part, as *modifiers* of diseased action. Among these arsenic ranks high. Sir E. Home was in the practice of employing an aqueous solution of arsenious acid. Dr. Macfarlane likewise advocates the use of the arsenical solution, because he has never known it produce local mischief or constitutional disturbance. His formula prescribes six grains to the ounce of distilled water. I can from experience attest its efficacy. The favourite application of Dupuytren was a powder consisting of one part of arsenious acid, finely pulverised, in ninety-nine parts of calomel. The chloride of antimony has been found to answer well in certain cases applied as follows:—The whole extent of the affected part is to be touched with a pencil imbued with the chloride; about a couple of minutes after, the pain thus produced is to be allayed by laying on compresses dipped in cold water. In this way the energetic chloride is at once transformed into an inert subchloride. This operation is to be repeated once every ten days, until the sore is cicatrised. Mons. Cazenave, perceiving that erysipelas usually exercised a healing influence on sores of this description, ascertained that an analogous action could be produced by means of biniodide of mercury. He directed an

ointment composed of fifteen grammes of biniodide of mercury, ten grammes of oil of almonds, and five grammes of prepared lard, to be laid on the part with a brush. The application is followed by violent pain, beginning in about ten minutes and attaining its height in half an hour, and soon after by swelling and an erysipelatous blush, which last about three days. The remedy thus employed determines a local irritant as well as general action, by which the ulceration is powerfully modified, and a smooth solid cicatrix without loss of substance or deformity obtained. In one case which he details, he found it necessary to apply the ointment fifteen times at suitable intervals.

I have witnessed an analogous effect produced by using a solution of half a drachm of iodine and half a drachm of iodide of potassium in a drachm of glycerine. The beneficial action thence resulting was sustained by the occasional application of simple tincture of iodine to the part. (See Report of Case in *Lancet*, vol. ii., 1864, p. 152.)

As a general rule, in this form of lupus, caustics ought to be applied often and sparingly. Before resorting to topical measures, it is expedient to remove the crusts by means of emollient poultices. If there be much pain and heat about the sore, cold poultices ought to be employed till these subside. It is sometimes advantageous to add a narcotic solution to the cataplasm. It deserves notice that a topical agent of acknowledged utility in interrupting the progress of lupus is the red-hot iron; this often exerts a most salutary effect in modifying the nature of the sore, producing healthy granulation and prompt cicatrization.

The stability of the cure may be inferred from the character of the cicatrix. When the new skin is soft, free from tenderness, and nearly of the natural colour, it may be considered comparatively sound; but when it remains preternaturally red, and indurated, or, on the other hand, presents a delicate membranous aspect, like an *arachnoid* web traversed by minute tortuous blood-vessels, there is every likelihood of relapse. Under such circumstances it is incumbent on the patient to persevere in the use of the hygienic and therapeutic means above pointed out, otherwise the prospect of a cure is very doubtful.

This disease sometimes yields to the administration of internal remedies alone; sometimes, again, it spontaneously gets well. Dr. Trüstedt, of Berlin, mentions his having cured lupus by means of the *decoctum Zilmanni* (a compound slightly purgative preparation of sarsaparilla). (*Med. Zeit. f. Heilkunde in Preussen*, No. 11.)

Another variety of lupus has been described by the writer as *erosive ulcer of the follicles* (*Op. Cit.* p. 332). This frequently originates like a catarrhal affection of the Schneiderian membrane. By and by, the inflammation, being, as it were, concentrated in one particular point, leads to erosive ulceration, which almost invariably terminates in perforation of the cartilaginous septum. The only circumstances whereby the patient's attention is directed to the mischief going on, are a degree of tenderness and fulness in the membrane, felt more especially on exposure to cold air, and the constant reproduction of crusts on the point of lesion. After a time, from cold or other determining cause, some portion of the external surface of the nose becomes inflamed, and ulcerates. One or other ala, by continuity of tissue, is commonly attacked. Small

red, angry-looking tubercles make their appearance, and are speedily converted into a spreading ulceration. The ulcer all along preserves the tubercular character: the apices of the tubercles are more or less concealed by dry, hard, tenacious crusts, which consist of albumen and mucus. As the disease proceeds, fresh tubercles are developed, and encroach more and more upon the integument of the upper lip and cheek. The confines of the sore have a dusky red hue. This ulceration is always attended by loss of substance, and the havoc committed by it when unrestrained is often very great. The parts ordinarily destroyed are the cartilaginous septum and ala. According to M. Rayer, it may begin externally, and spread to the lining membrane of the nostrils secondarily. The gums are occasionally affected. The disease was considered by Sir A. Cooper to consist in ulceration of the sebaceous follicles. Hence, whenever the pre-existing irritation passes along from the internal mucous cryptæ to the external ducts, the inflammation ere long set up induces occlusion of the orifices, succeeded by ulcerative absorption of the follicles, previously atrophied through the inroads of the newly-formed connective tissue. The papillæ, endued with a higher degree of sensibility, and seemingly a greater capacity for resisting the process of disorganisation, may now and then be recognised forming little vascular eminences, the adjacent textures having been supplanted, so to speak, by the newly-formed connective tissue.

The present variety of corroding ulcer is seldom met with before puberty. It begins, like other varieties of lupus, most frequently between the ages of fourteen and thirty; rarely after the fortieth year, although M. Alibert has adduced cases where it occurred at a later period in life. As with the former, so also with the present form, the subjects chiefly predisposed to it are those of a blond complexion, with light hair and irides, and marked development of the sebaceous follicles of the nose. The latter may be said to characterise and accompany this form of ulcer. The patient is seldom of robust constitution, feels languid, most usually suffers from disorder of the assimilative functions, and rarely if ever displays the clear and blooming complexion indicative of health and vigour.

As regards the intensity of its progress, great variation may be noted. In one individual its course is so slow as to seem almost stationary, while in another, it runs on with rapid strides.

In combating this form of ulcer, so obstinate and intractable in its nature, it is indispensable towards restoring a healthy action that we should not only destroy the morbid habit of the part, but at the same time modify the organic relations of subjacent textures. This done, the lesion will spontaneously heal. Now, this twofold object can be at once accomplished by employing the chloride of zinc.

An escharotic paste is conveniently obtained by mixing one part of chloride of zinc with two or three parts of the powder of tragacanth, or of slippery-elm bark (*Ulmus fulva*), or the powdered root of marsh mallow, triturated with a very small quantity of water. This possesses the advantage of forming a dry eschar, and leaving a firm cicatrix after the separation of the eschar, which usually takes place from the twelfth to the eighteenth day. During the above period no poultice, lotion, or any



topical measure is to be resorted to. The rule is on no account to disturb the eschar. I have found this treatment most successful in tubercular lupus, and where different remedial means had failed in checking the disease. Sulphate of zinc has been also resorted to as a remedy in lupus. For this purpose, the dried salt should be finely levigated; a caustic paste may be made by incorporating an ounce of the powder with a drachm of glycerine; and a caustic ointment, by thoroughly mixing the same quantity of the powder with four drachms of lard. (*Dispensatory of United States of America*, 1865.)

Mr. Bransby Cooper extols a paste made with ten grains of oxalic acid, two grains of powdered opium, and a sufficient quantity of wheaten flour. This is to be applied in the same manner as the chloride of zinc; and he states, that he has found it more effectual. The escharotic action of the above compound was first mentioned to him by Mr. Camps, of Fenny Stratford (*Principles and Practices of Surgery*, p. 391). I tried it with one patient, who greatly complained of the pain which it caused.

MM. Recamier, Jules Clequet, and Velpeau recommend for the cure of lupus the acid nitrate of mercury, made by dissolving a drachm of the nitrate of mercury in an ounce of nitric acid. The ulcerated surface is to be touched with it by means of a dossil of lint, and some scrapings of lint, moistened with the same solution, are then to be laid on the part. This has been found an excellent application for the destruction of the soft flabby edges of unhealthy, imperfectly formed cicatrices.

Although internal remedies are here of minor importance, still the permanence of cure will be confirmed by a judicious application of the hygienic and therapeutic precepts formerly laid down. A milk and farinaceous diet by rendering the blood less stimulating exerts a decided influence upon the state of the cutaneous capillaries. This is exemplified by the fact, that nothing tends more than such a diet to subdue that capillary congestion, that turgescence of the follicles, and also to diminish that morbid secretion of the skin which may accompany or follow this affection.

There is one symptom which the surgeon is frequently called upon to treat, as concomitant or sequela to the ulcer, namely, a sense of tenderness or rawness of the pituitary membrane, depending on chronic inflammation. It is allayed by protecting the part against external impressions, and especially that of cold by plugging the nostrils with scraped lint, or the fleecy down of finely carded cotton-wool. Where the irritation has persisted for a period of years, and is attended with superficial ulceration or erosion of the mucous membrane, some astringent lotion ought to be thrown up once or twice every day. I have prescribed with advantage a liniment made by incorporating fifteen grains of chloride of zinc with an ounce of olive oil. The morbid surface is to be pencilled over with the liniment once a day; in the course of a few weeks, by pursuing this plan, the membrane will be restored to a sound condition.

Having now considered in detail the two leading varieties of lupus—namely, the *superficial* or *erythematous*, characterised by the ulcerous action spreading along the surface, and the *deep eroding*, of which the tendency is to destroy layer after layer,

not sparing even bony texture in its insidious and destructive career—I shall in conclusion point attention to the so-called *lupus with hypertrophy*. This is a very rare form of the disease. Its peculiarity consists in the development of tubercles which never ulcerate, but are often attended with notable swelling of the part affected. Its exclusive locality is the face. The tubercles are prominent, flattened, of a fawn colour, united at the base, and sessile on a surface which, at first, is slightly bloated. The subjacent areolar tissue becomes the seat of a fulness which remains always indolent, but slowly increases in size, and may acquire a considerable bulk. In contemplating, says M. Cazenave, an extreme case of this nature, one may form a notion of the hideous deformity which it entails. The skin assumes a violet hue, passing into black. The eyes are hid amid the prominences resulting from the enormously swollen condition of the forehead and eyelids. The cheeks are expanded by an unsightly turgescence; the lips thickened and everted so as to represent two smooth, tense cushions, which give a most repulsive aspect to the individual. Again, on the deformed surfaces are seen here and there fawn-coloured spots, sometimes slightly prominent, which are merely tubercles imbedded in the hypertrophied mass. These obviously penetrate deeply into the tissues, and determine a more or less abundant desquamation, showing that a process of destruction is going on. In some parts they are replaced by slightly depressed cicatrices. According to Mons. Cazenave lupus with hypertrophy is always a tedious and obstinate malady, and consequently difficult of cure. It may generally be traced to a scrofulous taint; and is developed during the first and second childhood, rarely in the adult subject. It may persist, however, till an advanced period of life. It is more common in women than in men, and among individuals who live in unhealthy localities, and are ill supplied with the necessaries of life. It is said to be occasionally hereditary.

Preparations of iodine and of mercury have been recommended for the treatment of lupus with hypertrophy.]—  
Alexander Ure.

[See Bateman's *Synopsis of Cutaneous Diseases*, ed. 3rd; Rayer, *Mal. de la Peau*, t. i., 8vo., Paris, 1826; Houghton, in *Cyclop. of Practical Medicine*; Jacob, in *Dublin Hospital Reports*, vol. iv.; Dupuytren, in *Leçons Orales de Clinique Chir.*, t. iv., p. 471; Neligan, *Pract. Treatise on Diseases of the Skin*, Dublin, 1852; Devergie, *Traité Pratique des Maladies de la Peau*, Paris, 1854; Hebra, *Atlas der Hautkrankheiten*, Lief. I. *Lupus*, Wien, 1856; Cazenave, *Leçons sur les Maladies de la Peau*, Paris, 1856; Gibert, *Traité Pratique des Maladies de la Peau*, t. i., Paris, 1860; A. Ure, *Diseases of the Nose*, in *Holmes' Sys. Surgery*, vol. iii.]

LUXATION. (See DISLOCATION.)

MAMMA, DISEASES OF. Various causes combine to render the female breast peculiarly liable to disease. Its situation exposes it to frequent variations of temperature, to painful confinement or pressure from the dress, and to accidental injuries. It is an organ powerfully influenced by emotions of the mind; and it is connected by close links of sympathy with the whole apparatus of reproduction. To these causes of its liability to disease, must be added the alternating states of long-



continued activity and repose, in which it is placed as an organ of secretion. (See *Cumin*, in *Edinb. Med. and Surg. Jour.* vol. xxvii. p. 225.)

*Inflammation of the Mamma.* [Inflammation may assail either the subcutaneous cellular tissue, the submammary cellular tissue, or the mammary gland itself. It is an affection of frequent occurrence during lactation, and commonly terminates in the formation of matter. The first form presents the characters of phlegmonous inflammation in general. This is seldom limited to its original seat, but usually combined with analogous processes in the proper glandular substance. The inflammation may be restricted to the connective tissue underlying the areola, or may extend throughout the mamma. The subareolar phlegmon occurs in the course of pregnancy and lactation, as the result of excoriations, fissures, and ulcers of the nipples; in such cases, the areola assumes a dusky red, or livid hue, becomes painful, and swollen; and if the inflammation do not yield within three or four days, small circumscribed abscesses make their appearance, which, left to themselves, generally burst in from six to ten days. The proper subcutaneous phlegmon is mostly a secondary affection, the sequel of inflammation of the mammary gland, of erysipelas, or of eczema. It is susceptible of being resolved, but generally terminates in suppuration, and even under favourable circumstances the duration of the complaint is from six to fourteen days. The wider spread the inflammation, the more speedily fever sets in, and the more violent it becomes. While the subareolar abscess rarely exceeds the size of a walnut, that of the other may surpass that of the fist; the integument may give way spontaneously in the course of twelve days, but sometimes not before the lapse of a month. In order to ascertain the presence of matter, the surgeon ought to press the breast in the direction of one of its principal diameters. In doubtful cases, it is advantageous to have the aid of an assistant, who fixes the breast or compresses it in the direction of the presumed abscess; while the surgeon, having his hands at liberty, can more readily determine the fluctuation of fluid. Velpeau witnessed some cases in which the inflamed cellular tissue sloughed (phlegmonous or gangrenous erysipelas), and which led to partial or total destruction of the substance of the gland, or ended fatally, typhoid symptoms having supervened.

In the treatment of these forms of inflammation the main indication for the practitioner is to procure a speedy outlet for the accumulating purulent matter, and this is furthered by the continued application of warm fomentation and poultices. When fluctuation is distinctly perceptible, a free incision should be made through the thinnest integument at the most dependent part of the swelling. In the instance of *subareolar* inflammation, the mother is usually compelled to wean the child on account of the sharp pain which accompanies the act of suckling. This does not apply to phlegmon situate elsewhere in the breast. Where gangrene threatens, compresses soaked in camphorated spirit ought to be diligently applied.

*Inflammation of the submammary connective tissue.* This may occur as a primary affection, or may be associated with inflammation of the gland-

ular substance, or of the subcutaneous connective tissue; it occasionally follows caries, and necrosis of the ribs, and empyema or pulmonary abscess perforating the wall of the chest. It is not confined to pregnant or suckling women. It is generally ushered in with rigors, a sense of weight and tension in the breast, unattended, however, in the first instance, with any notable redness, or tenderness on pressure. By-and-by, pain is felt in the part, and in the instance of abscess forming underneath the mamma, the latter, when compressed towards the wall of the chest, imparts the sensation of resting on a bladder filled with liquid. At this period, a faint red, cedematous swelling may be perceived in the breast, but no distinct fluctuation of fluid. The abscess, which often attains a large size, generally opens in some point of the circumference of the mamma; sometimes instead of a single large abscess being formed, there are several of smaller dimensions, and which do not always communicate with each other. This affection may terminate fatally through pleuritis supervening, through perforation of the intercostal muscles and the pleura with effusion of pus into the cavity of the pleura, or the anterior mediastinum, and lastly through pyæmia.

The peculiar resiliency of the gland, as Mr. Nunn observes, renders the early recognition of an abscess placed beneath it a matter of considerable difficulty, and the obscurity as to where the pus will spontaneously escape by no means simplifies the matter. Whenever the abscess is fully formed, an incision ought to be made in order to evacuate the contents; and the most convenient situation for this purpose is at the outer and lower circumference of the mamma, unless some other point presents in which fluctuation is impending. A piece of oiled lint is to be introduced within the wound, and poultices applied. The closure of the cavity of the abscess will be promoted by the employment of a suitable compressive bandage. (*On Inflammation of the Breast*, p. 51.) An interesting case of this kind was sent to town to be under the writer's care in St. Mary's Hospital, some years back, by Mr. Harbroe, of Dorking. An unmarried female, 26 years of age, had a tumour about the size of the fist, occupying the outer portion of the left breast. The tumour was irregular to the feel, being in some parts hard, in others soft and elastic. Slight tenderness on pressure was experienced at a spot situate in its axillary border. In the upper and also in the lower portion of the swelling was an obscure feeling of fluctuation. The tumour was freely movable over the pectoral muscle, and not adherent to the skin. The cutaneous veins were prominent; the nipple was retracted; slight lancinating pain was felt in the part, just before and during the flow of the catamenia. A tumid gland was perceived in the axilla about a fortnight before she came under my observation. She was of a spare make, and of a nervous temperament; had a clear florid complexion; her general health was and had been good. Three years previously she had a little pain and swelling in the breast, but these subsided. About a year preceding, the nipple began to fall in; nine months later the swelling was observed, and had rapidly increased in size. After making a careful examination of the tumour, I introduced an exploratory trocar through the tender point above described,



and passed it inwards for nearly an inch and a half, in a slanting direction. On withdrawing the stilet, out came a drop of pus. I next enlarged the orifice with a narrow bistoury, and gave exit to about a couple of drachms of purulent matter. By suitable treatment, the abscess healed up, the intumescence subsided, and the patient left the hospital cured, after the lapse of a few weeks.

As a general rule in the instance of abscess situate behind the gland, care should be taken in pressing out the purulent matter that no air be allowed to enter, as is prone to happen through expansion of the mammary gland on the pressure being removed. If air finds admission, the pus becomes decomposed, and induces serious constitutional disturbance, as well as a persistence of the secretion of matter, thus rendering the case both more tedious and severe.

*Inflammation of the Mammary Gland. Mastitis.* This is of frequent occurrence during lactation, and usually terminates in the formation of matter, varying in quantity and situation. The glandular abscesses form in the adipose cavities, which are channeled in the thickness of the fibrous capsule of the glandular mass.

M. Giralde (Mém. de la Soc. de Chir. t. ii. p. 198) describes these as commencing in shut sacs and tortuous cavities which traverse the whole thickness of the gland. In the first case the inflammation assails the cells in *cul-de-sac*, the pus is pent up by the fibrous bands which connect the gland with the skin. The cells do not communicate with each other; thus, the opening of one cell does not allow of the discharge of pus contained in the contiguous cell. When the inflammation is seated in the depth of the parenchyma of the gland, the pus makes way round the inflamed tissues, and reaches before long the subcutaneous fatty layer; it there forms a second collection, which communicates with the first by a canal more or less straight or winding. The pus is found mixed with a certain quantity of milk, depending on the rupture of one or several of the lactiferous tubes. Women who have never been pregnant are liable to mammary abscesses depending upon derangement of the health, gastric, or uterine disorder; and even men now and then have abscesses of the breast.]

When the breast inflames, the part enlarges, becomes hard and painful, as the inflammation assails each lobule in an isolated manner, and by the side of an inflamed lobule may be found a healthy one. The enlargement is proportionally irregular, and seems to consist of one or more hard tumours situate in the substance of the part. The pain often extends to the axillary glands. The secretion of milk is gradually lessened, and usually suppressed as the complaint gains ground. When the symptoms of inflammation continue to increase for four or five days, suppuration may be expected; unless the progress of the inflammation be slow, and its degree moderate; in which circumstances, resolution may often be obtained, even as late as a fortnight after the first attack. Acute inflammation of the breast is generally attended with more or less sympathetic inflammatory fever. Sir Astley Cooper describes the inflammation as adhesive in the first stage, suppurative in the second, and ulcerative in the third. Swelling is followed by a blush of inflammation upon the surface of the breast, and very acute throbbing pain. "A particular prominence and smoothness are observed at

one part of the tumour, with a sense of fluctuation from the presence of matter. The constitution is also highly irritated, which is evinced by the occurrence of shivering, succeeded by heat and profuse perspiration. Over the most prominent part of the swelling, the cuticle separates, ulceration follows in the cutis, and the matter becomes discharged through the aperture thus produced." (*Illustrations of Diseases of the Breast*, p. 7.)

Women are most liable to mammary abscesses within the first three months after parturition; but they are also much exposed to the disorder so long as they continue to suckle.

The most common causes of mammary abscess, as enumerated by writers in general, are—repressing the secretion of milk at an early period, mental disturbance, fright, &c., exposure to cold, moving the arms too much while the breasts are large and distended, and external injuries. The causes are not always obvious. [M. Nelaton considers that, in a majority of cases, the real starting-point of suppurative inflammation of the mamma is an excoriation of the nipple, kept up by the efforts of suction on the part of the infant, and unceasingly fretted by the contact of milk and saliva. Inflammation of the absorbents is set up ere long, and rapidly spreads to the depths of the organ. The course of the lymphatics accounts for this particular circumstance. M. Sappey has, in fact, demonstrated that nearly all these vessels originate in the areola, or in the nipple itself.] In Sir Astley Cooper's opinion, the principal cause of acute inflammation and suppuration of the breast, is "the rush of blood, which takes place each time the child is applied to the bosom, and which by nurses is called the *draught*, and is the preparatory step to the secretion of milk." He also adverts to the frequent exposure of the bosom in suckling, and the active exertions of the child in sucking, as promoting the origin of the complaint. The nurse, he says, often produces these abscesses immediately after the lying-in, by not putting the child soon enough to the breast, and by giving the mother strong drink. (See *Illustrations of Diseases of the Breast*, p. 8.)

The matter is sometimes contained in one cyst, or cavity—sometimes in several, but the abscess generally breaks near the nipple.

As all inflammations of the mamma are attended with considerable induration, they should be carefully distinguished from other swellings of a more incurable kind. Glandular tumours of the mamma, which have existed a long while, often disappear after the occurrence of a milk abscess.

*Treatment of Mastitis.* [In treating this affection it does not appear that much advantage is gained from even local abstraction of blood. Warm fomentation, saline purgatives to unload the bowels, antimonials to diminish the impulse of the heart, and promote cutaneous secretion, a spare diet, to abate the flow of blood to the part, and rest in the recumbent posture, are the principal means for the purpose of procuring resolution in the early stage. It is also recommended to have the milk, when overabundant, tenderly sucked out at proper intervals.

A speedy check may often be put to an incipient mastitis by rubbing the affected organ thoroughly, several times a day, with warm oil and laudanum, or mild ammoniacal liniment, the friction being made in the direction of the lactiferous ducts, that

is, from above downwards towards the nipple, by the nurse, as she stands behind the patient, and supports the posterior surface of the breast with one of her hands. This mode of treatment, which is particularly insisted on by Dr. S. C. Foster of New York, generally exerts a powerful effect upon the indurated gland, softening it in a short time, reducing the swelling, and promoting the flow of milk. (*Gross, System of Surgery*, vol. ii. p. 1054.)

When matter cannot be prevented from forming, an emollient poultice is the best application; or the surgeon may apply fomentations of poppy decoction, and poultices made with the same decoction, mixed with bread, which last should be renewed three or four times a day. In order to lessen the patient's sufferings, Sir Astley Cooper prescribes opium combined with the *liquor ammoniac acetatis*, or simple saline draughts with small doses of sulphate of magnesia. Some practitioners think that the abscess should be allowed to break of itself, unless it be rather chronic, in which case it may be opened in a depending part with a lancet. Much difference of opinion prevails respecting the practice of opening abscesses of the breast. Subjoined are Sir Astley Cooper's directions:—"If (says he) the abscess be quick in its progress, if it be placed on the anterior surface of the breast, and if the sufferings which it occasions are not excessively severe, it is best to leave it to its natural course. But if, on the contrary, the abscess in its commencement be very deeply placed, if its progress be tedious, if the local sufferings be excessively severe, if there be a high degree of irritative fever, and the patient suffer from profuse perspiration, and want of rest, much time is saved and pain avoided, by discharging the matter with a lancet." (See *Illustrations of Dis. of the Breast*, p. 10.) The same experienced surgeon disapproves, however, of introducing the lancet through a thick covering of the abscess, as the opening will not procure a free discharge of the matter, but will heal by adhesion, after which the accumulation of matter will continue. The opening, he says, should be made where the matter is most superficial, and the fluctuation is distinct, and its size should be in proportion to its depth.

[According to Mr. Syme, the cavity of the abscess generally heals sooner when evacuation of the matter is not hastened by using the knife before the suppuration is so far completed, that the thin superadjacent integuments project or point. When the process is thus far advanced, a free incision should be made, since it will not then delay the subsequent process of cure, but accelerate it by preventing extensive ulceration, sloughing, or the formation of sinuses. (*Princ. of Surgery*, p. 274.)

Should sinuses form, resort may be had to the plan recommended by Dr. Foster, which consists simply in the application of compressed sponge, confined by means of an appropriate bandage, aided by a suitable diet, and attention to the bowels. The sponge, freed of dirt, perfectly soft, elastic, and large enough to cover the entire breast, is thoroughly dried, and then effectually compressed by keeping it for twenty-four hours under a heavy weight, as, for example, a common letter-copying press. Thus prepared, it is bound upon the affected organ over a piece of patent lint to prevent irritation of the skin, by means of a roller passed several times round the chest above and below the sound breast. It is then saturated with tepid water, which has the effect of expand-

ing it towards the diseased structures, pressing the walls of the sinuses together, and at the same time forcing out their contents and absorbing them. The sponge is changed once in the twenty-four hours. A little pain generally attends the first application, but this usually disappears in fifteen or twenty minutes, and does not recur afterwards. The improvement under this treatment is most rapid, the worst cases generally recovering in a few weeks. The organ after recovery may be allowed to remain inactive, or suckling may be resumed, if it should be deemed necessary. (*Gross, System of Surgery*, vol. ii. p. 1056.)

When the cavity of the abscess begins to be filled up with granulations, the poultice may be left off, and superficial dressings applied, followed by stimulant lotions.

For dispersing the considerable induration, which sometimes continues a long while after the abscess has been cured, the most effectual plans are moderate compression, friction with camphorated mercurial ointment, the iodine ointment, or the soap liniment, with 3j of the tinct. iodine to each ounce of it, and the occasional exhibition of purgative medicines, with tonics, or the compound calomel pill, according to the state of the constitution.]

If the abscess be small, Sir Astley Cooper allowed the child to suck the affected breast as well as the other; but if much of the mamma be involved in the disease, he lets the infant suck the other breast, and directs the mother to draw the other herself by means of the glass tube constructed for the purpose. As a general rule, it is advisable not to let the infant suck the suppurating breast, on account of the possibility of the abscess communicating with one or more lactiferous ducts. Indeed, if the abscess be large, it will generally be necessary to remove the child from the breast, and, as Mr. Earle remarks, in some cases from both breasts, "as the flow of milk, induced by the suckling at the sound breast, induces a sympathetic determination to the other." When the abscess is less extensive, however, he approves of the trial of other means, as those of keeping a free outlet for the matter, and brisk purging, in order to lessen the secretion of pus. When the child is prevented from sucking by excoriations, or ulcers of the nipple, the milk accumulates in large quantity, and inflammation is excited. Here Sir Astley also recommended the breast to be drawn, but considered that the sooner the child can be restored to it, the better. A simple mode of drawing the breasts is to procure a wide-mouthed gooseberry bottle, and expel the air from it by immersing it in hot water. When applied to the breast, a vacuum is formed, and the milk flows abundantly; or an exhausting bottle of caoutchouc may be used. (*Earle, in Lond. Med. Gaz.* vol. x. p. 153.)

[An interesting example of a deep narrow sinus in a virgin breast, which apparently had been caused by the egress of pus from an abscess placed below the gland, came under the writer's observation in St. Mary's Hospital. The patient was a maid-servant, aged 17. The right breast was swollen and tender; there was a small opening midway between the nipple and border of the gland, which gave exit to a small quantity of purulent discharge. about five weeks previously she had a swelling of the face; after the lapse of a month, the face recovered its natural appearance, but shoulder and arm were attacked in the same manner. The swelling



gradually spread to the breast, accompanied with darting pains, sickness, and shivering. The patient mentioned that she had been to another hospital, where her breast was bandaged; after which she was discharged. However, the pain and swelling went on increasing until the day preceding her admission into St. Mary's Hospital, when the abscess burst. She had missed her two last catamenial periods; her bowels were irregular, and she had been badly fed, and overworked—was, in short, out of health. On examining the opening with the probe, a deep sinus was found extending apparently under the breast to a considerable distance up, and towards the arm. This was dilated by means of a long narrow probe-pointed bistoury and poultices applied. In the course of a fortnight it was injected with a dilute solution of sulphate of zinc; but not after the lapse of ten days showing any disposition to heal, it was laid freely open, and got well presently.]

Mr. Hey's practice was to trace the course of all the numerous sinuses, and lay them open, and he asserts that unless this be done with respect to every one of them, the cure cannot be accomplished. If he found any two sinuses running in such directions, that when fully opened they left a small part of the mamma in a pendulous state, he removed such part entirely. As the sinuses are filled with fungus, their continuations present no visible cavity, and can only be detected by the greater softness of parts of the wound, where, on breaking down the fungus, the orifice of the collateral sinus may be found. Mr. Hey has found that, even in the most unfavourable subjects, the wounds heal quickly, and the natural shape of the breast is preserved.

The foregoing treatment, it must be confessed, is severe; and if milder measures will answer, they should be preferred. Instead of laying all the sinuses open, Sir Astley Cooper injected them with a lotion composed of rosewater and two or three drops of strong sulphuric acid to each ounce of it, folded linen, wet with the same application, being also laid over the breast.

[Dr. Byford, of Chicago, extols injection of iodine. This is done by inserting a soft flexible catheter to the bottom of the tortuous canal, and throwing the injection through it so as to apply it without dilution to the bottom of the fistula. This favours the shallowing instead of the narrowing of the cavity. (*Chicago Med. Exam.*, Sept. 1860.)

Benefit will, occasionally, be derived from covering the surface where the fistulous openings are with a layer of compound mercurial cerate spread on lint, and applying over this a bandage, in order to maintain a moderate amount of pressure. This determines redness and smarting of the integument, followed by shedding of the cuticle.

A case of deep purulent sinuses in the mamma of five months' standing was cured in thirteen days, by simply preventing the play of the pectoral muscle. The patient was a delicate-looking young woman from the country, who came under the writer's care in St. Mary's Hospital (*Lancet*, March 14, 1863, p. 296.)]

When a deep-seated abscess forms between the ribs and the posterior surface of the breast, and bursts, so as to be attended with a sinus, and a tedious exfoliation of the ribs, Sir Astley Cooper considered the injection of diluted acids the best practice; for, unless the dead bone be loose, no

advantage can result from the division of the sinus. (*Illustrations of Dis. of the Breast*, p. 11.)

[The breast is liable to chronic abscesses, the formation of which is sometimes so slow and free from pain that the cases are mistaken for solid fleshy tumours. The treatment consists in letting out the matter, and giving such medicines as shall regulate the secretions, and improve the general health. To the tumour itself the counter-stimulant embrocation recommended by Sir B. C. Brodie may be applied (*R. Sp. Camphoræ, Sp. Vini Tenuior āā* ʒiijss., *Lq. Plumbi Diac.* ʒj. *M. Fiat embrocatio*); a piece of flannel once folded is to be soaked in this, laid on the part, and renewed six or eight times day and night until the skin is inflamed, left off for three days and resumed.]

Sometimes, when the swelling is opened, a considerable quantity of milk is discharged: in this case, Sir A. Cooper recommends a sponge tent to be introduced into the puncture, by which means the adhesive inflammation and obliteration of the cavity will be produced.

Mr. Hey describes a very deep-seated abscess of the breast, not of frequent occurrence, and not confined to pregnant or suckling women. Its situation renders all superficial applications ineffectual. The inflammatory stage is tedious; and when the matter has made its way outwards, the discharge continues, and there is no tendency to healing. Sometimes the matter lodges behind the mamma, as well as in the substance of the gland, and breaks out in different places, the intermediate parts of the breast feeling as if affected with a scirrhus hardness. Numerous sinuses run in different directions, and, when opened, a soft purple fungus appears within them. The disease goes on in this state for a long while, keeping up hectic symptoms.

The curative means for sore nipples are various. Abrasions may be covered with starch, and mucilage of quince-seed. When the cracks are deep, they ought to be closed by pressing their edges together, and covering with collodion in a thick and wide coat. When ulceration exists it will be acute or chronic. Sir Astley Cooper recommended a solution of a drachm of borax in three ounces and a half of water and half an ounce of spirit of wine. [A beneficial application is pencilling the chapped surface with a solution of hydrate of potash. A scruple of hydrate of potash is to be dissolved in four ounces of water; and a piece of lint moistened with this is to be placed on the part twice a day; when it gets dry, the surface may be cleansed with a sponge dipped in water, frequently renewed. Glycerine, with tannin, tincture of catechu, and alum, will all be found useful applications. Should the ulcer become indolent, strong astringents and stimulants are required. A skilful use of the sulphate of copper and nitrate of silver will shorten the course of these ulcers. The latter applied solid to the surface, once in eight days, is excellent. In the interval the sore may be dressed with tannin or alum. See *Paper by Dr. Byford, of Chicago, Med. Exam.*, 1860.) See NIPPLE.]

*Galactocoele, the lacteal or lactiferous tumor of Sir Astley Cooper.* [This implies a swelling of the breast depending on the accumulation of a large quantity of milk, and occurs, according to Scanzoni, under two forms. In the first form the milk is found in a more or less capacious encysted cavity,

caused by distension of an obstructed lactiferous duct or sinus, and this cavity is either completely closed, or is in communication with some of the lactiferous tubes more or less dilated. If the complaint is of short standing, the contents are usually milk; otherwise it may contain a quantity of epithelial cells. The adjacent glandular structure is either somewhat condensed or wasted.

The second form of this kind of swelling depends on rupture of one or more lactiferous tubes, whereby the milk effused into the cellular tissue accumulates in larger or smaller cavities, becomes gradually inspissated, and in general induces suppurative inflammation of the adjoining glandular structure.

The first form is usually painless, comes on during or soon after lactation, may attain the size of the fist, is attended with fluctuation, but is very different from an abscess, and should never be confounded with it. To avoid error in diagnosis a fine trocar may be introduced, through the tube of which a liquid will be evacuated possessing the characters of milk.

The second form supervenes after sudden interruption to the flow of milk, accompanied with violent pain and fever. There speedily forms in some part of the breast a circumscribed, uneven, nodulated swelling; the overlying integument becomes tense, and of a dark red colour, and in a few days shows several fluctuating points, which when opened emit milky fluid. There presently follows suppuration of the glandular texture, ulceration frequently takes place, and milk and pus are discharged together through one or more apertures. The result is, when the infant sucks, the nutritious food is either lost, or else deteriorated in quantity by admixture with pus.]

The following treatment was advised by Sir A. Cooper:—If the child can be weaned, a simple puncture will suffice; but if suckling be continued a larger opening must be made, and the milk suffered to escape through it whilst the infant is sucking. Relief may thus be obtained, until the child is weaned, and the secretion of milk has been stopped by means of laxatives, such as the combination of sulphate and carbonate of magnesia. (*Illustrations of Dis. of the Breast*, p. 16.) It will sometimes be expedient, after the incision has been made, to apply a suitable compressive bandage, and to inject the cavity daily, first with tepid water, and subsequently with solutions of nitrate of silver, or of alum, or with diluted tincture of iodine. Otherwise the suppuration, if allowed to persist, will necessarily weaken the patient.

[Scarpa has recorded a curious example of lacteal tumor, where not less than ten pounds of pure milk were at once evacuated. A countrywoman, 20 years of age, of small stature, of robust constitution, and in whom the breasts were naturally large, observed, ten days after a second confinement, a swelling in the left axillary region. This gradually spread to the breast, which, in less than two months, enlarged till it had acquired a circumference of thirty-four inches; and when the woman was seated, the mamma was so elongated that it rested upon the left thigh. By puncturing the axilla with a trocar, vent was given to the above-mentioned quantity of milk. The patient eventually recovered. (*Bérard, Diag. Diff. des Tumeurs du Sein*, p. 43.)]

The morbid dilatation of a lactiferous tube is observed by Dr. Cumin to approach somewhat

to the natural structure of the mamma of one species of goat, of which there is a preparation in Dr. William Hunter's Museum. In this animal the nipple forms but one large tube about the size of the finger, and an inch and a half in length. This tube enlarges into a bag, capable of containing an orange; and on the sides of the bag a great many short thick tubes open. (*See Edinb. Med. and Surgical Journ.*, vol. xxvii. p. 226.)

[*Cysts of the Breast* occur independently, or are associated with tumors both benign and malignant. The cysts are developed—1, in the cellular tissue which surrounds the mamma; 2, between the lobules; 3, in the parenchyma of the gland; 4, in the acini obliterated at their orifice; 5, in the dilatation of a lactiferous duct; 6, lastly, between the mamma and thorax (*Velpeau*).

The cysts are unilocular or multilocular; the liquid which they contain is sometimes serous and limpid (serous cysts), sometimes reddish or brown (sero-sanguinolent cysts), sometimes glairy or mucous (sero-mucous cysts). Occasionally fat, sebaceous matter, or even hair, has been found within mammary cysts.

The cysts form vacuities in the connective stroma of the glandular tissue. The serous cysts are lined with a fibrinous layer; the sero-sanguinolent have smooth walls. In a case of the latter description, a hæmatic cyst, occurring in a patient in St. Mary's Hospital, the cyst-wall was thin, of a brownish-red hue, like the inner lining of the heart, seemingly about the size of a walnut. The cyst membrane was smooth, and consisted of two parts; an inner thin lining of an amorphous and granular character, showing no appearance of cell-formation, and closely resembling the membrane of a hydatid cyst. It did not, however, present a series of laminae as that does. The bulk of the cyst-wall consisted of fusiform fibre-cells, the whole interspersed with oily matter. In a case observed by M. Velpeau, the walls of the cyst were converted into a very flexible calcareous lamina, intimately adherent to the tissues.

The multilocular cysts are constituted by pouches, which do not communicate one with another, and are separated by partitions of variable thickness. They arise from different parts of the breast; when of rapid growth, and of considerable size, they induce interstitial absorption of the glandular substance, so that scarcely a trace remains. The tissues which surround the cysts are dense, as if compressed by the progressive development. The skin is seldom discoloured till the growth has attained some size.

Their origin has been sometimes traced to external violence, and extravasation of blood. It has also been referred to catamenial disorder, but in nine cases observed by Scanzoni (*op. cit.* p. 556), the women menstruated regularly, and were unable to assign any cause for the adventitious formation. They occur, though rarely, in the male breast. For example, a case of cystic tumor of the right breast of a man aged 61 years, as large as an orange, is reported in the *Lancet* for 1861. The skin over it was slightly discoloured. The growth was of nine years' standing. It was removed by Mr. Gowland, at the London Hospital, and the patient recovered.

The patients, in general, perceive at the outset a small, hard, movable, painless swelling. This



gradually enlarges, and if not deeply seated, and containing merely thin fluid, becomes fluctuant. If the cyst is multilocular, the tumour presents an irregular nodulated aspect, somewhat resembling encephaloid. The surrounding tissues become indurated; the patient experiences now and then slight dragging and darting pain in the part, which disappears for a while, and recurs when the growth has increased in size, but she is chiefly incommoded by the weight. It is true that single cysts seldom grow larger than an apricot. Marini, however, witnessed an instance in which the cyst contained nine pounds of liquid (*Virchow Handbuch, von Veit*, p. 389). Multilocular cysts often attain a considerable volume, and may eventually ulcerate on the surface, from interstitial absorption of the tegumentary covering.

Tumors of this kind may be distinguished from carcinomatous, by their being little disposed to adhere to the skin, by the nipple and adjacent glands remaining unaltered, and by the general health continuing undisturbed. In order to discover fluctuation, a ready method is to seize the tumor by one of its diameters between the thumb and middle finger of the left hand, pressure is then to be made upon the two extremities of this diameter, so as to render the tumor more prominent, and by applying the pulp of the forefinger of the right hand on the culminating part of the tumor, the presence of fluid may be perceived. For more exact diagnosis, resort may be had to exploratory puncture; again, where the tumor is prominent and filled with limpid serous fluid, it will possibly appear translucent when placed between the eye and a candle in a dark chamber, like a hydrocele. M. Velpeau had recourse to this means of diagnosis in the case of a young man, 15 years of age, in whom a tumor of large size occupied the whole mammary region, and extended towards the axilla.

The treatment of simple cysts resolves itself into puncturing with a trocar, withdrawing the fluid through the canula, and injecting a solution of iodine (tincture of iodine one part, water two parts), or else applying a blister over the part, so as to set up adhesive inflammation. Compression of the breast is advantageous after using the injection. If the walls are unusually thick, a free incision may be made, and oiled lint introduced into the cavity, which may be subsequently pencilled over with nitrate of silver, in order to destroy the secreting surface. Ponderous multilocular cysts are to be got rid of only by complete extirpation, the operation being performed to relieve the patient from its inconvenience, and to satisfy her mind. Indeed, the extirpation of tumors of this description is not really called for, except when they are bulky and progressively increasing, the seat of constant uneasiness, or when, as Sir B. Brodie observes, they have reached that stage in which it is evident that spreading ulceration, sloughing, and hæmorrhage—the usual results of an ulcer occurring in a diseased structure—must ensue, and that no remedy is likely to be of any service to the patient except the removal of the affected parts.]

*The Hydatid Tumor of the Breast, of Sir A. Cooper.* [The objective symptoms are the presence of a sacculated swelling, which is elastic to the touch, and of a peculiar consistency and form, and which contains *echinococci*. One of the most impor-

tant signs for the diagnosis is furnished in certain cases by percussion. M. Piorry was the first to call attention to a sensation which is felt by the finger employed in percussion, or the hand, when pressing the swelling, a sort of vibration or trembling (*frémissement*), which resembles the clang of a repeater, or a spring-sofa, in the finger that taps it. According to Küchenmeister (*Parasites of the Human Body*, vol. i., p. 225, Syd. Ed.), the hydatid trembling can only occur when several gelatinous tremulous cysts are in any way set in motion. The affection originates in the introduction and development of the parasitic ova. (See *Hydatids*.) The affection is comparatively rare. Mr. Birkett records, in his work on *Diseases of the Breast*, an instance of a woman, aged fifty-one, the subject of an hydatid cyst in the left breast for six years, and which on removal gave all the true characters by which a hydatid is known. A case is detailed in the *Lancet* (Nov. 23, 1861), which had been under the care of Mr. Mitchell Henry in Middlesex Hospital, of true hydatid cysts, developed in the left breast of a woman twenty-eight years of age, who when a child had been subject to tapeworm. She had been troubled with the affection for five years. The tumor had progressively increased in size, and gave a good deal of pain of a lancinating character. It was about as large as a medium-sized orange, had an indistinct feeling of fluctuation, and was freely movable. There were two enlarged and slightly indurated glands in the axilla. On incising the tumor, after extirpation, about half an ounce of slightly opalescent transparent fluid escaped, together with a hydatid the size of a walnut, as from a sac, to the inner surface of which a large number of smaller ones were attached. The walls of the cyst were much thickened. Numerous and well-developed *echinococci* were revealed on microscopic examination. The patient recovered.

In the instances recorded by De Haen and Lassus, the cyst contained both serosity, and several hydatids. Graefe has published the particulars of a case in which the tumor was deeply seated under the *pectoralis major* muscle; it was the size of a hen's egg, and the seat of intolerable pain. The patient was an unmarried female, twenty-five years of age. A complete cure followed two months after the operation (*Journ. des Progrès*, t. viii., p. 255). Spontaneous cure has been known to result from the tumor bursting, and when once got rid of, relapses are rare. By way of treatment, it has been proposed to employ the galvanic acupuncture, and also incision followed by the use of irritant injections; but, on the whole, the most satisfactory course is extirpation, especially when the affection is a source of distress and uneasiness to the patient.]

*Simple Chronic Tumor of the Breast.* [Under this head may be included tumors which form in different parts of the breast, and which show no signs of malignancy. An ordinary form is that termed 'adenoid' by M. Velpeau, and by M. Lebert 'partial hypertrophy of the glandular structure.' This kind of tumor is principally met with at the circumference of the gland, in persons of healthy appearance. Its usual size is from that of a filbert to that of a billiard-ball. When examined with a light hand, it presents a peculiar and irregular surface, not so indurated as that attendant upon scirrhus, nor yet possessing the

elasticity which characterizes the encephaloid tumor. In some cases both breasts are similarly affected. It is generally met with, as Sir A. Cooper states, in persons from 17 to 30 years of age, but may be developed at any period of life. A section of the tumor appears lobulated, lustrous, more or less granular, and of a whitish-yellow or amber colour, from the presence of fat, exuding a serous or ropy-limpid fluid, but never the lactescent juice characteristic of cancer.

Tumors of this kind are but little vascular. M. Lebert has twice traced nervous filaments into their structure; in one instance the nerves were hypertrophied. They may implicate either the proper glandular structure, or the fibro-cellular structure of the mamma, or both together, to a variable extent, are incased in a cellular envelope; and in about a third of the cases, cysts are developed. They are of slow growth, and seldom the seat of uneasiness or pain, unless at the menstrual period. The shape of the breasts remains unaltered, except where cysts are rapidly developed. These sometimes contract adhesions with the nipple, but never with the pectoral muscle.

There is another variety of chronic mammary tumor which seems to be isolated from the glandular texture, and which varies in consistence from that of a softish sarcoma to that of a dense fibrous growth, and has been described accordingly as sarcoma, or as fibrous tumour of the breast; a peculiarity connected with it is, that it occasionally recurs after extirpation.

In some instances the overlying skin becomes red and congested, and even ulcerates. In a case of lobular hypertrophy which the writer had the advantage of seeing in consultation with Dr. Alderson, and of which that gentleman has published an account (*Med. Chir. Trans.*, vol. xxxvii.), the superincumbent skin presented a remarkable appearance resembling parchment. The affected patch was situated above the nipple, and was four inches long by an inch and three quarters wide. It had much the feel of a portion of the integument in a dead body to which a blister had been applied during life. It was the seat of increased heat, and its margin showed a faint red blush. The patient was a young lady in her twentieth year, residing in the country, and enjoying good health: she eventually recovered.

Chronic mammary tumors are generally met with in unmarried and barren women, but have also been found in those who have become mothers and who have suckled their offspring. They may appear, as above stated, at any age, but usually during the persistence of the catamenial function, and but seldom in elderly females. Their development does not seem to depend on menstrual irregularity, but rather to proceed from traumatic causes. A case of the kind came under the writer's care in St. Mary's Hospital, of a young female, who ascribed its origin to a blow from a shutter. In another instance the tumor was believed to have arisen from the pressure of a stay-bone.

The diagnosis is often obscure. The mobility of the tumor, the absence of adherence to the integument, the slowness of its growth, and the fact of its frequently remaining stationary for years, the adjacent glands remaining almost always unaffected, and the general health undisturbed, are circumstances which will serve to distinguish it from cancer. It may be remarked that the diagnosis becomes obscure in the case of cysts being formed

internally, and determining a rapid evolution and painful condition of the growth.

In some rare instances these tumors have been known to disappear spontaneously. By way of treatment, recourse may be had to the different preparations of iodine and of bromine, employed both internally and topically. I have seen benefit follow the exhibition of alterative doses of bichloride of mercury, say the sixteenth or the eighth of a grain, and also of the tribasic phosphate of soda given in half-drachm doses. Intercurrent pain may be relieved by opium or belladonna, and, if of a congestive character, by the occasional application of a few leeches. Good has sometimes accrued from the use of flying blisters, and also from covering the part with lint spread with compound mercurial cerate, kept in its place by means of strips of soap-plaster laid on so as to maintain a gentle and equable pressure.

Should remedial means prove unavailing, as frequently happens, and the disease be very painful, and disposed to attain much size, recourse may be had to extirpation. The operation is simple, because the tumour is readily turned out, and the wound often heals by first intention. M. Velpeau, out of fifty operations, did not lose a single patient. M. Lebert, however, witnessed two cases fatal after operation—one from pneumonia and one from erysipelas. As stated above, there may be a recurrence of the growth.]

*Neuralgia of the Breast.—Mastodynia.*—This occurs under two different forms. The first consists in increased sensibility of the mamma, which is sometimes so great that exposure to cold, touching it even gently, or the weight of the bed-clothes causes excruciating pain. The breast presents no perceptible change whatever, the disease being purely neuralgic. Dr. Cumin, however, observed one of the lobes of the mamma become slightly swollen, and peculiarly tender when touched. (*Edin. Med. and Surg. Journal*, vol. xxvii. p. 226.) The affection may come on at the decline of life, but occurs chiefly in women from 20 to 30 years old; and the pain is most agonising just before the time of the menses, or during the flow, extending from the breast to the arm, down to the fingers' ends—nay, even sometimes affecting the sight. [It has been usually met with in chlorotic and hysterical women, and is occasionally associated with intercostal neuralgia, according to Scanzoni (o. c., p. 575). It is for the most part a tedious affection, proving highly refractory, but not endangering life. A variety of remedial means have been suggested. On the whole, most benefit has been obtained by the use of chalybeates, such as the solution of superacetate of iron, and embrocations compounded with chloroform, especially that prepared by allowing belladonna-root to digest in chloroform. Scanzoni states that he has known a cure follow the long-continued exhibition of Fowler's solution.] Sir A. Cooper recommended the employment of a hip-bath of sea or salt-water, heated to 100° or 105° Fahr.

[The other form, the *Irritable Tumor of the Breast* of Sir A. Cooper, has been fully described by M. Ruz. (*Arch. Gén. de Méd.*, 1843, 3<sup>e</sup> Série, t. iii., p. 73.) It is characterised by small tumors, which are possibly neuromata. They are usually scattered round the periphery of the gland



seated chiefly in the direction of the axilla, and on the border of the pectoral muscle. They are most common in the left breast, but may occur in both breasts. They consist of a faint yellow tissue, dotted with white, from which no liquid exudes, resembling in texture that of the mammary gland. At times they are isolated, or else adherent to the mammary tissue, and seem as if they were partial overgrowths of single lobules of the gland. They are freely movable, and never larger than a pigeon's egg. The patients complain of acute lancinating pain in the part, which radiates in every direction; comes on by fits, disappears spontaneously, and recurs without obvious cause, or from the slightest touch or pressure. These tubercles are generally met with in women who are hysterical or chlorotic and who menstruate irregularly. They are very slowly developed, and usually remain unaltered after the subsidence of the neuralgia, or diminish but little. The treatment consists in the employment of soothing means, and of small flying blisters, dusting over the blistered surface with about half a grain of finely-powdered hydrochlorate of morphia. Frictions with an ointment containing veratria, or with an alcoholic tincture of the root of aconite, occasionally afford relief. If the pain is very intense, resort may be had to extirpation, provided there is but a single tubercle, or a very limited number. Subcutaneous incisions are advocated by M. Ruz: he introduces a tenotome between the centre of the pain and the root of the nerve and vessels, and cuts the tissue of the mamma. He operates thus on several points at a time.]

A good deal of valuable information on the subject of mastodynia is to be found in the writings of Justamond, who appears to have been often successful in its treatment. (See *Tracts*, 4to. pp. 380 *et seq.*) By systematic writers on the diseases of females, it is usually considered with those of gestation. (See *Cumin, ib.*)

**Hypertrophy.**—[*General Hypertrophy* of the mamma consists in an extraordinary increase of the adipose tissue; the hypertrophy of the glandular substance exercises a very subordinate influence. On making a section, the texture appears either preternaturally vascular, interpenetrated by dilated blood-shot vessels, or else remarkably bloodless and dry. The former seems to be the case when the affection is rapidly developed in young persons, and where usually the lactiferous ducts and lobules of the gland are enlarged—the latter when the growth makes very slow progress. The affection may arise in both breasts simultaneously; or first in one, and then in the other sympathetically. Its course may be acute or chronic. In the former case the enlargement is very rapid; the patients complain of severe tensile or dragging pain, extending to the adjoining limb at times, and it is the case which Sir Astley Cooper terms the morbid growth of the breast, or large pendulous state of it.] In some instances, indeed, it acquires a uniform increase of size, so as to become at last altogether monstrous. Heat, uneasiness, and signs of increased flow of blood in the part may be noticed. The more chronic form is unattended with inflammation or pain, beyond a feeling of pricking in the part; the only inconvenience being from the weight and bulk. The disease most frequently commences soon after puberty, and in many cases the breast attains such magnitude that its extirpation becomes absolutely

necessary. (See *Hey's Surgery*; *Pearson on Cancer*; *Sir A. Cooper's Lectures*, by Tyrrell; *Cumin, in Edinb. Med. and Surg. Journ.*, vol. xxvii. p. 227.)

Hypertrophy of the breast is alleged to be always connected with a suppressed or disordered state of the menstrual function. Mr. Hey mentions the case of a girl who menstruated when only twelve years old, but shortly afterwards the menses disappeared, in consequence of damp clothes being worn during the period. The breasts increased in size, and her left breast attained the enormous weight of eleven pounds four ounces. After its removal the menses returned, and the right breast diminished.

[It is considered as a hindrance to conception, and should this take place, it generally results in abortion, or premature confinement. As regards treatment, attention ought to be directed to the state of the reproductive organs. The preparations of iodine may be exhibited both internally and topically; methodical compression may prove useful; as a last resource, amputation of the exuberant growth.]

**Atrophy of the mamma.** This usually takes place in advanced life, commencing after the catamenia have ceased. [The glandular substance, when minutely examined, shows a scanty amount of lactiferous tubes, which may be pervious, or partly obliterated, and of which the terminal vesicles are moreover considerably diminished both as regards number and size; sometimes individual lactiferous tubes appear calcified. Besides the senile atrophy of the breast, there is a second form which, according to Scanzoni, affects occasionally women at an earlier period of life, and is conjoined with maladies of the womb, ovaries, and the like, or ensues upon repeated and long-continued lactation. Partial atrophy of the mammary gland is not infrequent in breasts that are the seat of bulky adventitious growths, and which impede the circulation. The notion that mammary atrophy may proceed from the exhibition of preparations of iodine is now exploded.]

**Scrofula of the mamma** is described as appearing under different shapes, and as being in its earlier stages "not always easily distinguished from diseases of a much more formidable description. Sometimes a hard lump forms in the mamma, and remains nearly quiescent for several years; at other times, the whole gland is affected with scrofulous enlargement. But, in all cases of this disease, its tendency is to suppuration; and the purulent matter discharged is always more or less mingled with those curdy flakes which form the principal diagnostic of scrofula. Mr. Lloyd relates a remarkable instance, in which the whole of the tumor seemed to have been converted into this curdy deposit." In strumous diseases of the mamma, the part is always enlarged, not contracted, as in one form of carcinoma. The tumor is tender when grasped, never possesses the stony hardness observed in the latter disease, nor, so far as Dr. Cumin's experience goes, is it ever attended with retraction of the nipple. (*Op. et vol. cit.* p. 227.)

The treatment of scrofulous tumors of the breast is like that of the generality of other strumous swellings. It is considered in the writings of Pearson (*On Cancer*), Lloyd (*On Scrofula*), and Sir A. Cooper (*Illustrations of Diseases of the Breast*).

[Tumors of the character of tubercle have been

met with in the breast. M. Velpeau has seen them disseminated, to the number of eight or ten, of the size of a nut, formed by the lobules of the gland, softened in the centre, and infiltrated with tuberculous matter, and mixed here and there with serous flocculent pus. M. Nélaton saw Gerdy extirpate half a dozen tumors of this nature, similar to the tubercles found in the brain of young children.]

The breast is also liable to adipose tumours, and to cartilaginous and bony transformations, as well as to some other diseases described in the articles **CANCER, FUNGUS HÆMATODES, and TUMOR.**

[*Enchondromatous Tumors*, with or without partial ossification, have been described by various writers, including Bérard, Sir A. Cooper, and Müller. The ossified tumors are characterized by a hard uneven surface, often studded with sharp angular points; they make very slow progress, and after having attained a certain size remain stationary. In the case related by Sir A. Cooper, the tumor was the source of pain, increasing at the menstrual period. Extirpation affords the sole means of relief.] In the *Miscellanea Naturæ Curiosorum* (Dec. ii. An. vi.) is a case of complete ossification of both mammae. It occurred in a nun, who suffered much from distressing dyspnoea. The mammae were as hard as stone, and the skin stretched over them like hoops round a barrel. After death the mammae were found transformed into hemispheres of bone, so hard as completely to resist the scalpel.

#### MAMMA, AMPUTATION OF, OR EXTIRPATION OF.

Many swellings and indurations of the breast it would be highly injudicious and unnecessary to extirpate, because they generally admit of being dispersed. Such are many tumors, which are called *Scrofulous*, from their affecting patients of this peculiar constitution, cases in which the trial of iodine internally and externally may very properly be made. (See **IODINE**.) Such are nearly all those indurations which remain after a sudden and general inflammatory enlargement of the mamma; such are most other tumors, which acquire their full size in a few days, attended with pain, redness, &c.; and of this kind also are the hardnesses in the breast occasioned by mammary abscess.

In the removal of all malignant or cancerous tumors, their nature makes it necessary to observe one important caution in the operation—viz., not to rest satisfied with cutting away the tumors just at their circumference, but to take away also a considerable portion of the substance in which they lie, and with which they are surrounded. In cutting out a cancerous breast, if the operator were to be content with merely dissecting out the disease, just where his eyes and fingers might equally lead him to suppose its boundary to be situated, there would still be left behind white diseased bands, which radiate from the tumor into the surrounding fat, and which would inevitably occasion a relapse. In a vast proportion of the cases, also, in which cancer of the breast unfortunately recurs after the operation, it is found, that the skin is the part in which the disease makes its reappearance: hence the great prudence of taking away a good deal of it in every case suspected to be a truly scirrhus or cancerous disease. This may also be done so as not to prevent the important objects of uniting the wound by the first intention, and covering the whole of

its surface with sound integuments. So frequently does cancer recur in the nipple, whenever it does recur anywhere, that many experienced operators always make a point of removing this part in every instance in which it is judged expedient to take away any portion of the skin at all. The surgeon, indeed, would be inexcusable, were he to neglect to take away such portion of the integuments covering scirrhus tumors as is evidently affected, appearing to be discoloured, puckered, and closely attached to the diseased lump beneath. Nor should any fibres of the pectoral muscle at all diseased be ever left behind.

But, strongly as one would urge the prudence the necessity, of making a free removal of the skin covering, and of the parts surrounding, every cancerous or malignant tumor, the same plan may certainly be regarded as unnecessary, and, therefore, rashly severe in most operations for the removal of simple, fatty, fibrous, or encysted tumors, to which the breast, and almost every other part of the body, is liable. However, even in the latter cases, when the swelling is very large, it is better to take away an elliptical portion of skin; for otherwise, after the excision of the tumor, there would be a redundancy of integuments, the cavity of which would only serve for the lodgment of matter. The loose superfluous skin also would lie in folds, and not apply itself evenly to the parts beneath, so as to unite favorably by the first intention: nor could the line of the cicatrix itself be arranged with such nice evenness as it might have been, if a part of the redundant skin had been taken away at the time of operating.

The best method of removing a diseased breast is as follows: The patient, previously rendered insensible by an anæsthetic agent, is sometimes placed in a sitting posture, well supported by pillows and assistants; but the operator will find it equally convenient, if not more so, to remove the tumor while his patient is in a recumbent position; and this posture is best whenever the operation is likely to be long, or much blood to be lost, which circumstances are very apt to bring on fainting. The head is to be sufficiently elevated, and the patient placed in such a position, that the side of the tumor may be turned towards the operator, the corresponding arm being carried slightly upwards and backwards, and a large cloth passed across the chest so as to protect the bed or couch and the patient's clothes from any blood which may be spilt.

If the patient be in a sitting posture, an assistant should hold the arm back, by which means the fibres of the great pectoral muscle will be kept on the stretch, the most favourable state for the dissection of the tumor off its surface.

When the tumor is not large, and only a simple sarcoma, free from malignancy, it will be quite unnecessary to remove any of the skin; and of course this need only be divided by one incision, of a length proportionate to the tumor.

The direction of the incision is various with different practitioners; some making it perpendicular, some obliquely downwards and forwards, and others transverse. In general, the shape of the tumor must determine which is the best. It has been said, that when the incision follows the last direction, it heals more expeditiously, because the skin is more extensible from above downward than laterally, particularly towards the sternum, and consequently allows the sides of the wound



more readily to be placed in contact; and that the action of the pectoral muscle tends to separate the edges of the wound when it is perpendicular. On the other hand, it is allowed that the more the wound inclines downwards, the more favourable it is for the escape of the discharge, if suppuration occur. (See *Œuvres de Desault*, t. ii. p. 312.)

[The incision should be made, according to Mr. Birkett, in the direction of a line radiating from the nipple as from a centre, for, by so doing, a transverse division of several ducts may be avoided. (*Diseases of the Breast*, p. 239.)

When circumstances offer the choice, "as a general rule, the long axis of the wound should incline as much as possible downwards and outwards, when the patient is in a recumbent position." (*Birkett, Ib.*, p. 239.)

M. Velpeau advocates a curved or semilunar incision, taking care to direct the convexity of the incision towards the most dependent part. The surgeon is thus enabled without difficulty to expose the largest as well as the smallest tumors, and there is left a wound which readily gives exit to the secretions, the flap of which falls in some measure of itself over the solution of continuity, and the edges of which are easily kept in contact, so that the cicatrix almost always becomes reduced to a central line. (*Op. cit.* p. 518.)]

At all events, when the disease is of a scirrhus or malignant nature, the skin covering the tumor should be in part removed. As stated above, all that portion which is discoloured, puckered, tuberculated, or otherwise altered, should be taken away. Some must also be removed, in order to prevent redundancy, in all cases in which the tumor is large. In scirrhus, and cancer of the mammary gland itself, the nipple is a dangerous part to be left behind; but if the tumor be not of that gland, and away from the nipple, the excision of this part would not be called for. If a considerable portion of the mamma is affected, it is better to excise the whole gland than to preserve a few of its lobes. For the purpose of removing the necessary portion of skin, the surgeon must obviously pursue a different mode from that above described; and, instead of one straight incision, he is to make two semicircular cuts, one immediately after the other, and which are to meet at their extremities. The size of these incisions must be determined by that of the disease to be removed, and by the quantity of skin which it is deemed prudent to take away; for the part, which is included in the two semicircular cuts, is that which is not to be separated from the upper surface of the swelling, but taken away with it. The shape of the two cuts together may approach that either of a circle or an ellipse, as the figure of the tumor itself may indicate to be most convenient. The direction of the incision is to be regulated by the same consideration.

In the above ways, the first division of the integuments is to be made in removing tumors of every description covered with skin. The same principles and practice should prevail in all these operations; and whether the swelling be the mamma, or any other diseased mass, whether situate on the chest, the back, the head, or extremities, similar considerations should always guide the operator's hand.

The incision, or incisions, in the skin having been made, the next object is to detach every side of the tumor from its connexions, and the separa-

tion of its base will then be the last and only thing remaining to be done. In dissecting out a diseased breast, the best plan, after having detached it from its lateral connexions, is to begin separating its base at the side towards the axilla, and then carry the dissection downwards and forwards, till the swelling has been perfectly detached from all its subjacent connexions. When the tumor is of a malignant character, the operator must not dissect close to the swelling, but make his incisions on each side, at a prudent distance from it, so as to be sure to remove, with the diseased mass, every particle of morbid structure in its vicinity. But when the tumor is only a mere fatty or other mass, perfectly free from malignancy, the cellular bands and vessels forming its connexions may be divided close to its circumference. It is astonishing with what ease fatty tumors are removed, after the necessary division has been made of the skin; they may almost be turned out with the fingers, without any cutting at all. When they have been inflamed, however, they are considerably more adherent to the surrounding parts.

Thus the first stage of the operation of removing a tumor is the division of the skin; the second, the separation of the swelling from the surrounding parts on every side; the third and last, the division of the parts to which its under-surface or base is attached. The latter object should be accomplished by cutting regularly from below upwards, from above downwards, or from one angle to the other, as may seem most convenient and most safe, till every part is divided.

Having taken out the tumor, the operator is immediately to tie such large vessels as may be pouring out blood; indeed, when the removal of the swelling will necessarily occupy more than three or four minutes, it is sometimes better to tie the largest arteries as soon as they are divided, and then proceed with the dissection. This was Desault's plan, and it is often deserving of imitation, not only because many subjects cannot afford to lose much blood, but also because the profuse effusion of this fluid keeps the operator from seeing what parts he is dividing. For the same reasons Mr. Morgan's plan of compressing the subclavian artery from above the clavicle, during the operation, so as to prevent hæmorrhage, is entitled to praise, especially when the tumor is large, the patient already debilitated, and the operation likely to be tedious. However, if the tumor will admit of being promptly taken out, or if only two or three considerable vessels bleed, an assistant may put his fingers over their mouths until the operation is finished: in this way the completion of the dissection is not at all retarded. The other plan, of tying the vessels as the operation is proceeding, is chiefly applicable in cases in which the vessels are large, or the tumor is of considerable size.

The largest arteries being tied, the surgeon should not be immediately solicitous about tying every bleeding point which may be observed. Instead of this, let him employ a little while in examining every part of the surface of the wound, in order to ascertain that no portion of the swelling, no hardened lump or diseased fibres, remain behind. Even if any part of the surface of the pectoral muscle should present a morbid feel or appearance, it must, on every account, be cut away. Also, if any of the axillary glands should be

diseased, the operator ought now to proceed to remove them. After the time spent in such measures, many of the small vessels, which bled just after the incision of the swelling, will now have stopped, the necessity for several ligatures will be done away with, and, of course, the patient saved a great deal of pain, and more of the wound be likely to heal by the first intention.

Some information may be derived, respecting whether any of the tumor is left behind, by examining its surfaces, when taken out, and observing whether any part of them is cut off; for, if so, it may always be found in the corresponding part of the wound.

The axillary glands may invariably be taken out, without the least risk, if the plan pursued by Desault in France, and the late Sir Charles Blicke and other surgeons in this country, be adopted. The method alluded to is, after dividing the skin covering the gland, and freeing the indurated part from its lateral connexions, to tie its root, or base, by which it is connected with the parts on the side towards the cavity of the axilla. Then the indurated gland itself may be safely cut off, just beyond the ligature. Were the gland cut out in the first instance, the artery which supplies it with blood would be exceedingly difficult to tie, on account of its deep situation; and by reason of its shortness and vicinity to the heart, it would bleed almost like a wound of the thoracic artery itself. In this way there is also not the least hazard of injuring the axillary vein. M. Velpeau mentions an instance in which this vessel was wounded by M. Roux in the removal of some diseased glands; but the bleeding was readily stopped by compression. (See *Nouv. Elém. de Méd. Opér.* t. ii.) It is a great improvement in the mode of operating for the removal of diseased axillary glands, to make the patient lie down, with the arm placed in such a position as to let the light fall into the axilla.

[According to Mr. Birkett, however, the advantage said to result from the excision of the axillary glands, when morbidly enlarged, is as dubious as the operation is unscientific; for if one be dissected out another comes into view; this being removed, a third appears, and so on until the axillary vein is exposed, or perhaps incised. Very troublesome hæmorrhage is the result, and the patient is left in no better position than if the glands had been left alone. He considers, when the disease has so far advanced as to suggest to the operator the necessity for the removal of the infected axillary glands, that no operation is admissible, at least with the intention to prolong life. (*Op. cit.*, p. 242.)]

The above directions will enable a surgeon to remove tumors in general. They apply also in a great measure to *encysted tumors*; but a few additional rules will be found in the article *TUMORS*. One half of each ligature is always to be cut off before the wound is dressed. The edges of the incision are to be stitched together; and, before this can be done with ease, the arm must be brought forward, so as to relax the pectoral muscle and integuments of the breast. Some surgeons consider that there is a better chance of obtaining union by adhesion, when the wound is left open for some hours, than when it is closed immediately. The wound being closed, a compress of folded linen may be put over the integuments which have been

undermined in the operation. This is to be secured with a folded towel or a broad piece of linen, which is to encircle the chest, be fastened with pins, or stitches, and kept from slipping down by two tapes, one of which is to go from behind forward, over each shoulder, and be stitched to the upper part of the bandage, both in front and behind. The arm, on the same side as that on which the operation has been done, should be kept perfectly motionless in a sling; for every motion of the limb must evidently disturb the wound, by putting the great pectoral muscle into action, or rendering its fibres sometimes tense, sometimes relaxed.

The removal of a diseased breast rarely proves fatal of itself, unless the parts cut away extend to a considerable depth, and occupy a very large space, or the patient is much reduced before the operation. However, patients have been known to die, without any very apparent cause, soon after the operation. M. Velpeau cites two cases of the kind where the patients died on the third day (*op. cit.* p. 356) most mysteriously; Schmucker has recorded an instance in which the operation was followed by tetanus (*Wahrnehmungen*, b. ii. p. 80). [According to Dr. Lawrie's *Statistics of Tetanus*, one case out of fifty terminated fatally from this affection at Glasgow (*Glasgow Medical Journ.*, 1853). Among the casual sequelæ of the operation may be enumerated pleurisy, phlebitis, and purulent infection; and also diffuse phlegmon. M. Velpeau states, that in his hospital practice he had 32 deaths in 167 operations, or about 1 in 6. (*Op. cit.* p. 509.)]

With respect to the average success following the removal of cancerous diseases, this is a topic noticed in the article *CANCER*. [On the whole, those patients have the best chance of recovery, or, at all events, of a long respite from the malady, who present a tolerably healthful complexion, in whom the growth has made slow progress, feels circumscribed, and is unattended with enlargement of the glands.] The statement made by Boyer is exceedingly unfavourable; for, in 100 cases in which he removed the diseased parts, only four or five of the patients continued permanently cured. (*Mal. Chir.* t. vii. p. 237., 8vo. Paris, 1821.) [According to Dr. Alexander Monro, out of sixty cases in which he had known extirpation performed, there were only four patients in whom the disease had not returned in about two years. Dr. Macfarlane of Glasgow, after forty-five years of active and extensive practice, states to the writer in June 1861.—“I have never yet seen a case of cancer of the mamma in which extirpation proved successful, even when the operation was performed at an early stage of the disease, and before any glandular contamination had taken place, and, therefore, I have for a great many years past ceased to employ or recommend the use of the knife.”]

Alexander Ure.

*Pearson's Principles*, chap. 3., and on *Cancer*. *Hey's Practical Obs.* p. 504. *Kirkland's Inquiry into Medical Surgery*, vol. ii. p. 161. *Justamond's Tracts*, 4to. *Callisen, Systema Chirurgiæ Hodiernæ*, vol. i. p. 332. *Gibbon's De Mulierum Mammis et Morbis quibus obnoxie sunt*, 8vo. Edinb. 1775. *J. Clubbe, On the Inflammation of the Breasts peculiar to Lying-in Women*, &c. 8vo. Ipswich, 1799. *M. Underwood, on Ulcers, Mammary Abscess, &c.* 8vo. Lond. 1783. *J. H. James, on Inflammation*, p. 171. 8vo. Lond. 1821. *Boyer, Mal. Chir.* t. vii. p. 211, &c. 8vo. Paris, 1821. *Richter's Anfangsgr. der Wundarzn.* b. iv. c. 16. *Sir Astley Cooper's Illustrations of Diseases*



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MELANOSIS, derived from *μελας*, black, is a term employed to signify substances occasionally developed in or upon the textures of the animal body, and characterised by their black colour.

Although references to melanosis of the lungs and liver may be traced in the writings of Bonetus, Morgagni, and Haller, the first very careful descriptions of the disease were given by MM. Dupuytren, Bayle, and Laennec. The name of *melanosis*, which was first adopted by Laennec, who published the earliest particular account of the disease (see *Bulletin de la Soc. de l'Ecole de Méd.* 1860. No. 2.), is still generally retained. Professor Carswell uses the term *melanoma*. Our knowledge of the disease has been of late years much extended by the researches of Breschet, Trousseau, Leblanc, Carswell, and some eminent veterinary surgeons in France.

Under the title of *melanoma*, Dr. Carswell includes all melanotic formations, black discolorations, or products, described by Laennec and other authors; but, for the purpose of marking the difference in their nature, he arranges them in two groups, the first being distinguished by the appellation of *true melanosis*, the second by that of *spurious melanosis*. "Thus, (says he,) when these formations or products depend (as is the case with some of them) on a change taking place in that product of secretion whence the natural colour of certain parts of the body is derived, or, in other words, when they constitute what is called an idiopathic disease, I shall consider them as belonging to the first group; and when, as in the case with others they originate in the accumulation of a carbonaceous substance introduced into the body from without, the action of chemical agents on the blood, or the stagnation of this fluid, I shall include them in the second group. There are several black discolorations, which might also have been included in the present systematic arrangement, such as those observed in tissues affected with mortification, that have been subjected to the action of intense heat, or powerful escharotics of various kinds; but as they have never been confounded with any of the forms of melanosis, I shall not take any further notice of them in this place." Dr. Carswell then proceeds to describe, 1. *True melanosis*, of which there is only one kind. 2. *Spurious melanosis*, of which there are three kinds:—1. From the introduction of carbonaceous matter. 2. From the action of chemical agents on the blood; and 3. From stagnation of the blood. (See *Illustrations of the Elementary Forms of Disease, Fasc. on Melanoma*.) According to Dr. Carswell's definition, *true melanosis* consists in the formation of a morbid, unorganised product

of secretion of a deep brown or black colour, and the form and consistence of which present considerable variety, solely in consequence of the influence of external agents.

Melanosis is more frequently observed in the cellular tissue than any other, and perhaps it is in consequence of that tissue entering into all the common structures and organs of the body, that melanosis is sometimes noticed in most of them. Thus, Andral describes examples of melanotic formations in a great number of the elementary tissues, where it may either exist singly, or in union with other organic disease. (See *Précis d'Anat. Pathol.* t. i. p. 459.) Melanotic productions may also be met with simultaneously in various textures and organs. M. Martin Solon relates the case of a woman, in whose right inguinal glands, thighs, and breasts, melanotic tumors had formed. (See *Dict. de Méd. et de Chir. Pratiques*, t. xi.) M. Alibert gives another case, where the skin, different regions of the cellular tissue, the mediastinum, the mesentery, omentum, many lymphatic glands, the thyroid gland, and the lungs, all contained melanotic deposits.

In the cellular tissue, the most frequent seat of true melanosis, the melanotic matter is formed after the manner of secretion, accumulates in the cells of that structure, and gradually acquires the form of tumors of various sizes. A similar mode of formation is still more conspicuous in loose cellular tissue, and particularly on the surfaces of serous membranes, like those of the pleura and peritoneum.

The next variety, noticed by Professor Carswell in the seat and mode of formation of melanotic matter, is that of its deposit in the substance or molecular structure of organs, after the manner of nutrition. Lastly, he adverts to the detection of melanotic matter in the blood, chiefly that contained in the venous capillaries, and under circumstances which prove that it must have been formed in these vessels. See *Illustrations of the Elem. Forms of Dis. Fasc. on Melanoma*.)

There are four varieties of true melanosis. (See *Andral, Précis d'Anat. Pathol.* t. ii. p. 446.) The following names have been applied to them:—

1. The *punctiform* (*melanose infiltrée*) is that in which the melanotic matter presents itself in minute points or dots in the texture of an organ. It is principally noticed in the lungs and liver.

2. *Tuberiform melanosis* (*concretions melaniques, melanose en masse*) is the most common variety of it, and is occasionally met with in most of the organs of the body, and sometimes on the surfaces of serous membranes. "In the former situation (says Dr. Carswell) the tumors are generally globular, and in the latter not unfrequently pyriform. They are most frequently found single in organs, and aggregated in cellular and adipous tissues; and have, perhaps, never been found limited to one organ, the deposition of the melanotic matter taking place simultaneously or successively in a great many organs, or in the cellular tissues of the different regions of the body. The melanotic tumors are most numerous in the cellular and adipous tissues, and from their aggregation produce lobulated or irregularly shaped masses of great bulk." Melanotic tumors are sometimes bounded by cysts, but more frequently have no cysts (see *Andral, Anat. Pathol.* t. i. p. 451), but are in immediate contact with the texture in which they are produced. Laennec, indeed, divided melanosis into

the encysted, and non-encysted. According to the researches of Dr. Carswell, melanosis is perhaps never found encysted in compound tissues or organs, as the brain, lungs, liver, and kidneys; whereas it is always so in the cellular and adipous tissues, and sometimes on the surface of serous membranes.

3. *Stratiform melanosis* (mélanose membrani-forme) is represented by Dr. Carswell to be formed only on free surfaces, though M. Blandin states that it is occasionally produced on the adherent surfaces of serous membranes. As the name leads us to understand, the melanotic matter is deposited in the form of strata, or layers, or of a pseudo-membrane. Its consistence generally resembles that of jelly, and is inclosed either in a soft spongy cellular tissue, or fine transparent serous membrane of new formation, so that, when pressed, it feels pulpy, but is not removed by the finger, or a scalpel passed over it, unless some force is employed.

4. *Liquiform, or Fluid, Melanosis* was not described by Laennec, which, as Andral remarked, is not surprising, inasmuch as he regarded melanosis as a tissue or texture. M. Breschet has applied this name to certain liquids of a dark colour, which seemed to him to arise from morbid secretion. In some individuals, M. Andral found in the cavity of the abdomen, after chronic peritonitis, a black fluid which he regards as liquiform melanosis. Dr. Carswell remarks, that "the appearance of true melanosis in a liquid form has in general been confined to natural or accidental serous cavities. Among the former the cavities of the pleura and peritoneum furnish almost the only examples in which the liquid melanotic matter has been observed, and that too in very small quantity. I have never seen it in man as a product of secretion, but have met with it in consequence of the destruction of melanotic tumours, and the effusion of their contents into serous cavities, the walls of which they had perforated. The accidental serous cavities, in which it has been found, are those which constitute cysts, particularly in the ovaries." MM. Troussseau and Le Blanc met with a fibrous cyst, as large as the fist, situated above the kidneys of a horse, and containing about eight ounces of black liquid.

Breschet, Andral, and Cruvelhier, in describing liquiform melanosis on mucous surfaces, especially that of the stomach, have confounded it with the black discoloration of effused blood, produced by the action of the gastric juice upon it. (Carswell.)

[Modern pathologists consider melanosis as a variety of soft or medullary cancer, rendered black by the peculiar and characteristic colouring matter of the disease. Rokitsansky's views are sufficiently expressed in the following quotation from the Sydenham Society's edition of his "Manual of General Pathological Anatomy," vol. i. p. 279:

"Cancer melanodes, as an independent tumor, presents most of the physical aspects of medullary carcinoma. Its cut surface appears to the naked eye either homogeneous, or fibrous, or lobulated, and of a more or less firm and brain-like consistence. A closer inspection of it reveals elementary granules, nuclei, cells of spherical or oval, caudate, elongated, angular shape, and along with these the most varied intercellular substances and stromata. Melanotic cancer imitates most commonly the

encephaloid variety of medullary carcinoma with round and caudate cells, and a membranous—a villo-membranous—stroma.

"These alien-growths are chiefly marked by their black, or brown black, brown, bronze, green, or rust-brown coloration. The first glance at these often numerous tumors generally suffices to show that the colour is merely accessory. For, amongst thoroughly tinged, we meet also with perfectly colourless, white, heterologous growths; and again between the two extremes others pigmented in the most various forms, in dotted or stellate patches, or in ramifying anastomosing striæ. The white growths are recognised at once as genuine ordinary encephaloid cancer.

A minute examination detects, according to circumstances, a greater or lesser proportion of pigment, and even in the blackest, elements enough—cells and intercellular substance—free from pigment.

Pigment occurs free or inclosed in cells, in all the forms enumerated under that heading. Its basis is, as there taught, and especially as the examination of acutely produced or redundantly growing cancer melanodes incontestably proves, hæmatin in a free and dissolved state, or else blood-globules, with their pigment in substance. In the latter case, the alien-growth resembles an hæmorrhagic effusion, in which are found, along with the blastema, the elements of medullary cancer in various phases of coloration and of conversion into pigment.

Chemical analysis must needs detect the constituents of medullary carcinoma, and the pigment with its base. Barruel and Henry have discovered, in the melanosis in man, hæmatin, fibrin, three kinds of fat, a considerable amount of phosphate of lime, and iron.]

The largest melanotic masses are found in the loose cellular tissue behind the peritoneum, and these are always composed of many smaller ones. The largest single tumors are noticed in the liver. In the horse, masses of true melanosis have been found in the former situation, weighing from twenty to forty pounds. It is further explained by Dr. Carswell, that the consistence of true melanosis is determined by the texture and form of the part in which it is deposited. "Thus, it is never found solid in serous cavities, for the plain reason, that its diffusion is not limited by dense unyielding tissues. Even in tumors attached to the serous covering of these cavities, it is for the same reason either perfectly fluid, or not more dense than animal jelly. Loose cellular tissue is also occasionally filled with the black matter in a fluid state. In the dense texture of the cutis, on the contrary, even the smallest tumors may be as hard as cartilage, and are generally as firm as the pancreas. In the lymphatic glands, and in the brain, the melanotic tumor acquires only a medium degree of consistence, although it is generally firmer in the former than in the latter, in consequence of the capsule of the glands acting as a compressing cause.

Melanotic tumors are susceptible of a softening process, especially when situated near the surface. The skin becomes thin, ulcerates, and a fleshy blackish matter, characterising the disease, is discharged. This is what M. Blandin saw take place in an old woman, who was afterwards admitted into La Salpêtrière, and whose case is recorded



by M. Breschet. (See *Magendie, Journ. de Physiologie Experim.* t. i. p. 354.)

Melanotic tumors, attacked by ulceration, or the knife, pour out blood as well as a blackish fluid. They may also throw out granulations, suppurate and heal, as was exemplified in the horse operated upon by M. Damoiseau, the particulars of which were published by M. Trousseau. (*Archives*, Juin 1828, p. 180.) In ordinary cases, melanosis is not productive of much disorder in the economy. In the liver and the cellular tissue it may attain an enormous magnitude without giving rise, during life, to the slightest functional disturbance leading to the suspicion of its existence, provided it does not cause any mechanical oppression. When melanotic tumors exhibit any inflammatory action, or disposition to hæmorrhage, it is the cellular tissue in their structure that is the seat of those changes, just as it is the seat of cancer which sometimes invades melanotic tumors. (*Blandin, in Dict. de Méd. et de Chir.* t. xi. p. 392.)

Dr. Carswell and M. Andral differ from Laennec in believing the melanotic matter to be deposited first in a fluid state, and afterwards to acquire greater consistence from the cellular tissue in which it becomes developed. At an indefinite period of its formation, however, Dr. Carswell admits that the solid melanotic tumor loses its consistence, and softens; yet this change does not appear to him nor to M. Andral, as it does to Laennec (*Précis d'Anat. Pathol.* t. i. p. 450), to be a vital process, originating in the melanotic matter itself, but to depend upon the destruction of tissues which surround, or are contained in, the melanotic tumor, and upon the simultaneous effusion of serosity. Inflammation rarely accompanies the softening process, and, when ulceration and sloughing occur, they appear to be chiefly owing to the melanotic matter compressing or obliterating the blood-vessels of the tissues in which it is contained. (*Carswell, Op. cit.*)

The texture of the melanotic matter is homogeneous, void of smell, opaque, and a fluid exudes from it, which stains the fingers black; and it is not itself organised. In vain (says M. Andral) should we look for any trace of organisation. It is merely a homogeneous substance, sometimes divided into lobules, or layers, by cellular tissue, which pervades it, without belonging to it. There are neither cavities, areolæ, nor fibres in it: no vessel, no nerve, is distributed in it. No characters exist entitling it to be called a texture.

As Professor Carswell observes, "when a number of melanotic tumors are grouped together, they are included in a common capsule, and separated from one another by their respective coverings and portions of cellular tissue, contained in the angular spaces sometimes left between them. It is in these filamentous and cellular tissues alone, that blood-vessels or nerves are to be seen. Minute arteries and veins may be observed ramifying in both, but they never pass beyond the limits of these tissues. Large branches, and even trunks of arteries and veins are sometimes found passing over the surface, or included in the aggregated masses of melanotic tumors." (See *Carswell's Elem. Forms of Dis. Fasc. on Melanoma.*)

With respect to the chemical composition of melanosis, M. Thenard detected carbon in it; M. Clarion, albumen and a peculiar black colouring mat-

ter; and M. Barruel ascertained, that this last is analogous to the colouring matter of the blood. He also made out the presence of a particular modification of fibrine in it, and the existence of phosphate of iron in it; elementary ingredients also in the blood. M. Foy made a comparative analysis of medullary or encephaloid, scirrhus, and melanotic formations, and he detected in these different substances albumen, fibrine, and salts, the basis of which were soda, potassa, lime, and oxide of iron, in rather less proportion in the two first formations than in melanosis; and in this latter a highly carbonised principle, composing nearly one-third of it. These various researches thus all tend to prove a close analogy between the elements of melanosis and those of the blood.

Melanosis is not restricted to man. It is more frequently noticed in white and grey horses than in those of any other colour; M.M. Rodet and Breschet have met with it also in horses of a light bay colour; and dogs, cats, rabbits, mice, and rats, are all subject to it. In horses, melanotic swellings form especially under the tail, and thence extend to a greater or lesser distance within the pelvis. They may often be removed from this situation with success.

Though melanosis may occur at any period of life, and even in the fœtus, as a melanotic formation on the cerebellum exemplified in a preparation in University College Museum would tend to prove, yet it is more common in adults and aged persons than very young individuals.

[The following statistics are from Mr. Paget's *Lectures on Surgical Pathology*, vol. ii. p. 486 to 488:—

"In twenty-five cases of melanoid cancer, seventeen of the patients were females, eight were males. In fourteen cases, the primary seat of the disease was in the skin or subcutaneous tissue; in nine in the eye or orbit; in one in the testicle; in one in the vagina.

"The ages of the patients at the access of the cancer were as follows:—

Under 10 years	2
Between 10 and 20	1
" 20 and 30	7
" 30 and 40	4
" 40 and 50	5
" 50 and 60	4
Above 60	2

"In eighteen cases, in all of which the primary disease was removed (but in two only partially) the durations of life from the first notice of the cancer were as follows:—

Between 6 and 12 months	3 cases
" 12 and 18	4 "
" 24 and 36	5 "
" 36 and 48	1 "
Above 48	5 "

"Among eighteen cases whose history is known for some time after the removal of the primary disease, one has survived for three years, another for ten months, without recurrence of the disease. In the rest the disease recurred at the following periods:—

Between 1 and 3 months	7 cases
" 3 and 6	4 "
" 6 and 12	2 "
" 12 and 24	2 "
" 24 and 36	2 "

"Seeing this close correspondence in their general pathology, the rules respecting operations for

melanoid cancers must be the same as for the medullary."

Melanosis was regarded by Laennec as a species of cancer. (*Auscult. t. ii. p. 33.*) The *carcine mélanée* of Alibert, and the *cancer anthracine* of Jurine, like other cancerous affections, are reproduced in other parts after extirpation, are disposed to soften and be accompanied by ulceration, and all the evils peculiar to cancerous diseases. At all events, then, it would seem as if there are modifications of melanosis, which are of malignant character, whether we adopt the doctrine or not, that they are combinations of cancer and melanosis together.

The fact of melanosis taking place chiefly in white, grey, or light bay horses, is a curious one, seeming to prove that the black matter of this accidental production is deposited in internal organs, as it were, in consequence of such colouring matter not being secreted by the skin. Perhaps, however, as M. Andral observes, there has been too much disposition to generalise on this point; for M. Rodet has published instances of melanosis in horses of all colours. (See *Anat. Pathol. t. i. p. 475*; and *Rodet. in Journ. de Méd. Vétérinaire, par M. Dupuy, t. ii. p. 273.*)

As in other cancerous affections, surgery possesses no means of dispersing a melanotic tumour, the only plan of cure being that of removing the new production with a knife. The practicableness and propriety of this will depend upon the situation and extent of the disease, and the inconveniences experienced from it. (See CANCER.)

See Laennec, *Bulletins de la Soc. de l'École de Méd.*, 1806, No. 2, et *Traité de l'Auscultation, t. i. Gilbert Breschet, Sur une Altération Organique, appelée Dégénérescence Noire Mélanose, &c.* 8vo. Paris, 1821. *Cullen and Carswell, in Edinb. Med. Chir. Trans. vol. i. 8vo. 1821. MM. Trousseau et Le Blanc, Archives de Méd., Juin 1828. London Med. Repository, 1823. M. Chomel, Nouv. Journ. de Méd. t. iii. M. Andral, Précis d'Anat. Pathol. t. i. p. 446. 8vo. Paris, 1829. Robert Carswell, Illustrations of the Elementary Forms of Disease; Fasc. on Melanoma. David Williams, in Trans. of Med. and Surg. Assoc. i. p. 244. 8vo. 1836. Sydenham Society's Edition of Rokitsansky, vol. i. p. 279, 1851. Paget's Lectures on Surgical Pathology, vol. ii. p. 483, 1853.*

**MELICERIS** (from *μελι*, honey, and *κηρος*, wax). A tumour of the encysted kind, filled with a substance resembling wax or honey in consistence. (See TUMORS, ENCYSTED.)

**MENINGOPHYLAX** (from *μηνιγξ*, a membrane, and *φυλασσω*, to guard). An instrument used by the ancients for guarding the dura mater and brain from injury, in their mode of trepanning.

**MERCURY**. (*Quicksilver, Mercurius, Hydrargyrum.*) The medicinal virtues of this mineral were almost totally unknown to the ancients, who considered it as a poison. It was first employed for purposes of medicine by the Arabians, who made use of it in the form of ointments for the cure of certain diseases of the skin. From the writings of Theodoric, it appears that mercury was employed in the practice of medicine and surgery as early as the thirteenth century. But its use in venereal cases was first mentioned in a tract by Almenar, published in 1516. (See *Thomson's Dispensatory, p. 205. ed. 2.*) In modern times it is one of the most important articles of the *materia medica*; and though recent investigations will not strictly allow it to be regarded

as a specific for the venereal disease, still mercury retains the character of being generally the most expeditious and permanent means of relief. The alleged possibility of curing the venereal disease without mercury by no means establishes the propriety of abandoning this remedy, any more than its unfitness for certain states of the same disease ought to be a reason for not availing ourselves of its superior utility in others.

Mercury, taken into the stomach in its metallic state, has no action on the body, except what arises from its weight or bulk. It is not poisonous, as was vulgarly supposed, but perfectly inert. But, in certain states of combination with iodine, chlorine, cyanogen, oxygen, and acids, it produces potent effects on the human frame. [The effect of mercury is to produce rapid transformation of tissue, to check effusion, and promote molecular absorption. Mr. Lawrence ascribes to it "the power of arresting that disturbed condition of the capillaries which is the essence of inflammation." (*Lectures, p. 100.*)] According to circumstances, the habit of the patient, the temperature in which he is kept, the nature of the preparation, and the quantity in which it is exhibited, its action varies. Sometimes it more particularly increases one secretion, sometimes another; but its most characteristic effect is the increased flow of saliva, which it generally excites, if given in sufficient quantity.

It has been said, that the efficacy of mercury in curing the venereal disease was an accidental discovery; but it seems more probable, that the good effects which it produced in cutaneous diseases first led to the trial of it in venereal cases, which, being frequently attended with eruptions, ulcers, &c., seemed to present an analogy to the affections in which mercury had already been found successful.

In the times immediately following the supposed origin of the venereal disease, practitioners only ventured to employ this remedy with timorous caution, so that, of several of their formulæ, mercury scarcely composed a fourteenth part; and either on this account, or some difference in the disease itself at that period from what is now remarked, few cures were effected. On the other hand, the empirics, who noticed the little efficacy of these small doses, ran into the opposite extreme, and exhibited mercury in quantities so large, and with so little care, that most of their patients were suddenly attacked with violent salivations, frequently attended with very dangerous and even fatal symptoms; or such as, after making them lose their teeth, left them pale, emaciated, exhausted, and subject, for the rest of their lives, to tremblings, or other more or less dangerous affections. From these two very opposite modes of practice, there originated such uncertainty, respecting what could be expected from mercury, and such fears of the consequences which might result from its employment, that every plan was eagerly adopted which offered the least chance of cure without having recourse to this mineral.

A medicine, however, so powerful, and whose salutary effects had been watched by attentive practitioners amidst all its inconveniences, could not sink into oblivion. After efforts had been made in vain to discover an equally efficacious substitute for it, a medium was pursued between the timid methods of those practitioners who had first ad-



ministered it, and the inconsiderate boldness of empirics. Thus the causes, from which both parties failed, were avoided; the character of the medicine was revived in a more durable way, and from this period its reputation has always been maintained.

The renowned Paracelsus first taught practitioners that mercury might be given internally with safety, for, before he set the example, it had only been employed externally in different ways.

#### GENERAL REMARKS ON THE ADMINISTRATION OF MERCURY, ITS OCCASIONAL CONSEQUENCES, ETC.

With regard to the preparations of the medicine, and the modes of applying it, we are to consider two things—first, the preparation and mode attended with the least trouble or inconvenience to the patient; and secondly, the preparation, and mode of administering it, calculated most readily to convey the necessary quantity into the constitution. Mercury is carried into the constitution either by being absorbed from the surface of the body, or that of the alimentary canal. It cannot, however, in all cases be taken into the constitution in both ways; for sometimes the absorbents of the skin will not readily receive it, at least no material effect is produced, either on the disease or constitution, from this mode of application. In this circumstance mercury must be given by the mouth, although the plan may be very improper in other respects, and often inconvenient. On the other hand, the internal absorbents sometimes will not take up the medicine, or, at least, no effect is produced on the disease, or the constitution.

In such cases, different preparations of the medicine should be tried, for sometimes one succeeds when another will not. In some rare instances mercury seems to have no effect, either applied outwardly or taken into the stomach. Again, many surfaces seem to absorb mercury better than others: such are probably all internal surfaces and sores. Dressing small ulcers with red precipitate sometimes causes a salivation. (See *Hunter on the Venereal Disease*, pp. 335, 336.)

Besides the practicability of getting the medicine into the constitution in either way, it is proper to consider the easiest for the patient, each mode having its convenience and inconvenience, depending on the nature of the parts to which it is applied, or on certain situations of life at the time. Hence it should be given in the way most suitable to such circumstances.

In many the bowels can hardly bear mercury at all, and it should then be given in the mildest form possible, conjoined with such medicines as will lessen or correct its violent local effects, although not its specific ones on the constitution.

When mercury can be introduced into the constitution with propriety by the external method, Mr. Hunter deemed it preferable to the internal plan, because the skin is not nearly so essential to life as the stomach, and, therefore, is capable in itself of bearing much more than the stomach. The constitution seemed to him also to be thus less injured. Many courses of mercury (he thought) would kill the patient, if the medicine were only given internally, because it proves hurtful to the stomach and intestines, when given in any form or joined with the greatest correctors. (*Hunter*, p. 338.)

[Sir B. Brodie regarded inunction with mercurial

ointment as the only certain way of effecting a cure in syphilis. (*Lectures, Lancet*, 1864.)]

Whenever mercury is given in venereal cases, the first attention should be to the quantity, and its visible effects in a given time, which, when brought to a proper pitch are only to be kept up, and the decline of the disease to be watched; for by this we judge of the invisible or specific effects of the medicine, and know what variation in the quantity may be necessary. The visible effects of mercury affect either the whole constitution, or some parts capable of secretion. In the first, it produces universal irritability, making it more susceptible of all impressions. It quickens the pulse, increases its hardness, and occasions a kind of temporary fever. In some constitutions it operates like a poison, while in others it produces a kind of hectic fever—that is, a small quick pulse, loss of appetite, restlessness, want of sleep, and a sallow complexion, with a number of consequent symptoms; but such effects commonly diminish on the patient becoming a little accustomed to the medicine. (*Hunter*, pp. 339, 340.)

The quantity of mercury to be thrown into the constitution, for the cure of any venereal complaint, used to be proportioned to the violence of the disease. However, surgeons were guided by two circumstances, namely, the time in which any given quantity was to be thrown in, and the effects it had on some parts of the body, as the salivary glands, skin, or intestines.

These circumstances being known, mercury becomes a much more efficacious, manageable, and safe medicine than it was formerly thought to be; but, unluckily, its visible effects upon the mouth and the intestines are sometimes much more violent than its general effect upon the constitution at large. These parts must therefore not be stimulated so quickly, as to hinder the necessary quantity of mercury from being used.

The constitution, or parts, are more susceptible of mercury at first, than afterwards. If the mouth is made sore, and allowed to recover, a much greater quantity may be thrown in, a second time, before the same soreness is produced. However, anomalous cases occur, in which, from unknown causes, mercury cannot at one time be made to produce any visible effects; but, afterwards, the mouth and intestines are all at once affected. (*Hunter*, p. 342.)

Mercury occasionally attacks the bowels, and causes violent purging, and even discharge of blood. This effect is remedied by discontinuing the use of the medicine, and exhibiting opium. At other times it is suddenly determined to the mouth, and produces inflammation, ulceration, and an excessive flow of saliva. To obtain relief in this circumstance, besides the discontinuance of the mercury, the patient is to be freely exposed to dry cool air, with the occasional use of cathartics, and the assiduous application of astringent gargles, containing sulphate of copper, and the like. "The sole objection against this method of treatment is the hazard to which the patient will be exposed of having the saliva suddenly checked, and of suffering possibly some other disease in consequence of it.

"That the hasty suppression of a ptyalism may be followed by serious inconveniences, has been proved by Dr. Silvester (*Med. Obs. and Inq.* vol. iii.), who published the cases of three persons,

who had been under his own care, two of whom were afflicted with violent pains, and the third scarcely retained any food in her stomach for the space of three months. I have seen not only pains, but even general convulsions, produced from the same cause. But this singular kind of metastasis of the mercurial irritation does not appear to me to owe its appearance to simple exposure to cold and dry air; because I have known it occur in different forms, where patients continued to breathe a warm atmosphere, but used a bath the water of which was not sufficiently heated. Cold liquids taken in a large quantity into the stomach, or exposure of the body to cold and moisture, will also prove injurious to those who are fully under the influence of mercury; whereas breathing a cool air, while the body is properly covered with apparel, has certainly no tendency to produce any distressing or dangerous consequences. (*Pearson on the Effect of Various Articles in the Cure of Lues Venerea*, edit. 2. pp. 163, 164.)

Mercury, when it affects the mouth, produces, in many constitutions, violent inflammation, which sometimes terminates in mortification. In these habits great caution is necessary. The ordinary operation of mercury does not permanently injure the constitution.

From mercury occasionally acting on the system as a poison, quite unconnected with its agency as a remedy, and neither proportionate to the inflammation of the mouth, or the actual quantity of the mineral absorbed, Mr. Pearson noticed that one or two patients in general died suddenly every year in the Lock Hospital. The morbid state of the system, which tends to the fatal event, during a mercurial course, is named by Mr. Pearson *erethismus*, and is characterised by great depression of strength, a sense of anxiety about the præcordia, irregular action of the heart, frequent sighing, trembling, a small, quick, and sometimes an intermitting pulse, occasional vomiting, a pale contracted countenance, a sense of coldness; but the tongue is seldom furred, and neither the vital nor natural functions are much disordered; a statement, however, according to my notions, not very consistent with the alleged irregular action of the heart. They who die suddenly of the mercurial erethismus have frequently been making some little exertion just before. To prevent the dangerous consequences of this state of the system, the use of mercury must be discontinued, whatever may be the stage, extent, or violence of the venereal symptoms. The patient should be directed to expose himself freely to dry and cool air, in such a manner as shall be attended with the least fatigue, and he should have a generous diet. In this manner patients often recover sufficiently in ten or fourteen days to resume the use of mercury with safety. In the early stage the mercurial erethism may often be averted by leaving off the mercury, and giving the *mistura camphorata* with large doses of ammonia. When the stomach is unaffected, *sarsaparilla* sometimes does good. (*Pearson*, p. 164, &c.)

Occasionally the use or rather misuse of mercury brings on a peculiar eruption, which has received the several names of *hydrargyria*, *mercurial rash*, *eczema mercuriale*, *eczema rubrum*, *lepra mercurialis*, *mercurial disease*, and *erythema mercuriale*.

"Eruptions of various kinds are very common symptoms of syphilis, but a very unusual effect of

mercury. Therefore, until the real nature of this erythema was lately discovered, whenever it occurred in patients undergoing a mercurial course for syphilitic complaints, it was naturally enough considered as an anomalous form of *lues venerea*. The mercury was consequently pushed to a greater extent in proportion to the violence of the symptoms, and from the cause of the disease being thus unconsciously applied for its removal, it could not fail to be aggravated, and hurried on to a fatal termination. The observation of this fact, conjoined with another of less frequent occurrence—namely, that a similar eruption did sometimes appear in patients using mercury for other complaints, and in whom no suspicion of syphilis could be entertained—at last led some judicious practitioners in Dublin to the important discovery, that the eruption was entirely an effect of mercury, and not at all connected with the original disease. This discovery was not published till 1804." (*M'Mullin in Edinb. Med. and Surgical Journal*, No. 5.) Mr. Pearson states, however, that he had been acquainted with the disease ever since 1781, and had always described its history and treatment in his lectures since 1783.

The eruption is attended with more or less indisposition, is not confined to either sex or any particular constitution, and seems to be equally produced by mercury applied externally, and by any of its preparations taken inwardly. Mr. Pearson has never seen it in subjects above 50; and he says its occurrence is more common about eight or ten days after the beginning of a mercurial course. (P. 166.)

Dr. M'Mullin has described three distinct stages of the *erythema mercuriale*. "The first stage commences with languor, lassitude, and cold shiverings; these symptoms are succeeded by increased temperature of the body, quick pulse, nausea, headache, and thirst. The patient is troubled with a dry cough, and complains of difficult respiration, anxiety, and sense of stricture about the præcordia. The tongue is usually moist, and covered with a white glutinous slime; it sometimes appears clean, and brightly red in the centre, whilst the margins remain foul. The skin feels unusually hot and itchy, with a sense of prickling, not unlike the sensation experienced from the application of nettles. The bowels are generally confined, but a diarrhoea is often produced by very slight causes.

"On the first or second day, an eruption most commonly shows itself, the colour of which is either dark or bright red; the papulæ are at first distinct and elevated, resembling very much those in *rubeola*. Sometimes, but rarely, the eruption appears like *urticaria*, and in such instances the disease is observed to be very mild. The papulæ very speedily run together in such a manner as to form a suffused redness, which disappears on pressure. In most cases it begins first on the scrotum, inside of the thighs, forearm, or where mercurial friction has been applied, and the integuments of the parts affected become much swollen. There have also been observed instances where an eruption of a purplish colour, and unaccompanied by papulæ, has diffused itself suddenly over the entire body. This, however, may be considered as uncommon. In every instance which came under my observation, it was confined at first to a few places, and from thence gradually extended, until the different



portions of the eruption had united, and the papulæ were also rough. But in those cases, which resemble urticaria, a number of minute vesicles, which contain a serous fluid, appear, from the commencement, interspersed among the papulæ. Contrary to what happens in most diseases accompanied with cutaneous affections, the febrile symptoms are much aggravated, and continue to increase after the eruption has been completed. The pulse in general beats from 120 to 130 in a minute, the thirst continues urgent, and the patient, extremely restless, seldom enjoys quiet sleep. When the eruption has continued in this manner for a certain period, the cuticle begins to peel off in thin, whitish, scurfy exfoliations, not unlike those observed in rubeola. This desquamation has not been attended to by Dr. Moriarty or Mr. Alley, if they have not, by giving the same name to the decrustation which occurs in the last stage, confounded both together. It commences in those places where the eruption first made its appearance, and in this order spreads to other parts. About this period the fauces become sore, the tongue swells, and the eyes appear somewhat inflamed.

"The duration of this stage is very various; sometimes it continues from ten to fourteen days, and in other cases it terminates in half that time. When the disease has appeared in its mildest form, the patient recovers immediately after the desquamation, a new cuticle having formed underneath; but if severe, he has only experienced the smallest part of his sufferings, and the skin now assumes a new appearance, which I have considered as the second stage.

"The skin at this period appears as if studded with innumerable minute vesicles, which are filled with a pellucid fluid. These vesicles may be expected, if the patient, at the close of the first stage, complains of increased itching and sense of burning heat in those parts from which the cuticular exfoliations have fallen. They remain sometimes for a day or two, but are most commonly burst, immediately after their formation, by the patient rubbing them, in order to relieve the troublesome itchiness with which these parts are affected. They discharge a serous acrimonious fluid, which possesses such a very disagreeable odour as to induce nausea in the patient himself, and those who approach near his bedside. The odour is so peculiar, that it can easily be recognised by any person who has once experienced it.

"This fluid is poured out most copiously from the scrotum, groin, inside of the thighs, or wherever the skin forms folds, and the sebaceous glands are most numerous. The serous discharge from these minute vesicles forms, with the cuticle, an incrustation, which may be considered as the third or last state.

"These crusts are generally very large, and, when detached, retain the figure of the parts from which they have fallen. Their colour is yellowish, but sometimes appears dark and dirty. This period of the disease might be termed, I think, with much propriety, the stage of *decrustation*, in order to distinguish it more fully from the *desquamation*, which has been already noticed. From the use of the two last terms indiscriminately, those who have described the disease have introduced into their descriptions a degree of confusion which has caused its progress not to be well understood. When this stage appears, the fauces become more

affected, the eyes intolerant of light, and the tarsi tender, inflamed, and sometimes inverted. The crusts formed on the face, as in other parts of the body, before falling off, divide asunder, so as to leave cracks and fissures, which produce a hideous expression of countenance; and the eyelids are also, from the general swelling of the face, completely closed. The back and hairy scalp are last affected, and even in very severe cases, these parts are sometimes observed to escape entirely. The patient whilst in this state is compelled to desist from every kind of motion, on account of the pain which he experiences on the slightest exertion, and which he describes as if his flesh were cracking. The crusts also fall off in such abundance, that the bed appears as if strewn with the cones of hops. Whilst the eruption is only making its appearance in one place, another part may have arrived at its most advanced form; so that all the different stages of the disease may be present at one time in the same individual. It is attended with typhus through its entire course; but it is very curious to observe that the appetite for food in most cases remains unimpaired, and sometimes is even voracious. This circumstance was particularly remarked in a patient who laboured under the disease, in its worst form, for the space of three months, in the Royal Infirmary of Edinburgh, for double the usual hospital allowance of food was scarcely sufficient to satisfy his hunger. When the catarrhal symptoms have continued during the progress of the complaint, they are at this advanced period particularly aggravated: the anxiety and pain of the chest are also very severe, attended with cough and bloody expectoration, and the patient always feels languid and dejected. The pulse becomes frequent, feeble, and irregular, the tongue black and parched, and at length diarrhoea, delirium, convulsions, gangrene of the surface of the body, and death supervene. In its mild form it only goes through the first stage, and terminates, as we have already stated, in a few days, by a slight desquamation. But when severe, it is often protracted more than two months, every stage of the eruption continuing proportionably longer; and when, in this manner it has run its course, it repeatedly breaks out on the new surface, and passes through the same stages." (*M'Mullin, in Edinb. Med. and Surg. Journal, No. 5.*)

The remote cause is the employment of mercury. Dr. M'Mullin is inclined to believe, with Dr. Gregory, that the application of cold to the body while under the action of mercury is absolutely necessary for its production, an opinion strengthened by the constant prevalence of catarrhal symptoms. However, Mr. Pearson thinks that cold has no concern in bringing on the complaint in patients under the influence of mercury. At the same time it merits particular attention, that the disease is not exclusively occasioned by mercury, either in its general or more partial attacks; it has been observed to follow exposure to cold, and to recur in the same individual, at irregular intervals, without any obvious or adequate cause. (*Bateman's Synopsis, p. 256. ed. 3.; Rutter, in Edin. Med. and Surg. Journ. vol. v. p. 143.; Marcell, in Med. Chir. Trans. vol. ii. art. 9.*)

In the early stage, Mr. Pearson recommends small doses of antimonial powder, with saline draughts, or the acetate of ammonia. A gentle purgative should be given every three or four days,

and opium to procure sleep. The latter medicine sometimes does most good when joined with camphor, or Hoffman's anodyne liquor. Sarsaparilla and bark may be given when the discharge is no longer ichorous, and the tumefaction has subsided. Diluted sulphuric acid has seemed to give relief. The diet may be light and nutritive, without fermented liquors, however, till the desquamation has somewhat advanced. Frequent use of the warm bath, and often changing the patient's linen and sheets, which soon become stiff and rough with the discharge, afford much benefit. If the warm bath cannot be had, Mr. Pearson advises washing the body very tenderly with warm-water gruel; he also covers parts, from which the cuticle is detached, with a mild cerate, and renews the application twice a day. (P. 176.)

Dr. M'Mullin advises the immediate discontinuance of mercury, the removal of the patient from wards where this mineral is in use, emetics and diaphoretics; but on account of the very irritable state of the bowels, he says antimonials are hardly admissible, and that when purgatives are indicated, only the mildest ones, such as castor-oil, sulphate of magnesia, &c. ought to be given. He advises mucilaginous draughts with opium for relieving the soreness of the fauces; in the second stage, the cold infusion of bark, with aromatics and opium, or (what is more to the purpose) wine, porter, &c.; to relieve the ophthalmia tarsi, the unguentum oxidi zinci, and to appease the painful sensation of the skin cracking, the linimentum calcis, which should be liberally applied as soon as crusts appear.

Consult Essay on a Peculiar Eruptive Disease arising from the Exhibition of Mercury, by G. Alley, 8vo. Dublin, 1804; also Obs. on the Hydrargyria, or that Vesicular Disease arising from the Exhibition of Mercury, 4to. Lond. 1810. A Description of the Mercurial Lepa, by Dr. Moriarty, 12mo. Dublin, 1804. *Spens* and *M'Mullin* in *Edinburgh Med. and Surgical Journal*, Nos. 1. and 5. *Pearson* on *Lues Venerea*, ed. 2. *Bateman's Synopsis*, p. 256, &c. ed. 3.

#### *Frictions with Mercurial Ointment.*

[Fresh mercurial ointment is composed of finely-divided mercury, lard, and suet; when kept for some time, it contains a larger or smaller proportion of protoxide of the metal combined with sebatic acid. The metallic mercury penetrates the organic textures when rubbed in as ointment. It can always readily be discovered in the epidermis, corium, and subcutaneous areolar tissue, at the site of inunction. In animals thus treated the evidence of metallic globules in internal organs, particularly in the intestines, liver, and kidneys, can moreover be easily established. In man, the mercury has been detected in the saliva, urine, and the cutaneous exhalation. It has also been found in the brain, lungs, liver, and in the blood. The metal in mercurial ointment is in the most simple and least combined form of all its preparations, and hence it is believed not only generally to operate with more mildness on the system, but with more specific effect on the disease.

Dr. Sigmund of Vienna, a strenuous advocate of this plan of treatment (*Anweisung zur Einreibungs-kur*), advises, by way of preparation, that the patient should remain within doors for some six or ten days before commencing inunction, should observe a light unirritant diet, and by repeated bathing render the skin more susceptible for the absorption of the mercury. The ointment is to be rubbed in

the last thing in the evening, upon the inner and hinder surface of the limbs, by the patient's own hand, for not less than ten minutes at each sitting. The part is then to be covered with a linen or woollen cloth, cleansed the following morning by washing, carefully dried, and kept warm. Dr. Sigmund advises suitable change of body and bed-linen; the apartment to be duly aired, and kept at a temperature of from 68° to 72° Fahr. The quantity of ointment to be employed each time is from 20 to 40 grains, which must be distributed over two different surfaces of skin. The average duration of the course of treatment is from twenty to thirty days, or until all trace of the disease has disappeared. The patient is to observe a light nutritious diet. The most favourable seasons of the year for following out the practice are spring and summer.

In the cases of children born with syphilis, Sir B. Brodie recommends the following method of employing inunction as eminently successful (*Lectures illustrative of Various Subjects in Pathology and Surgery*, p. 245):—He directs a flannel roller to be procured, on one end of which some mercurial ointment, say a drachm or more, is to be spread. The roller, thus prepared, is to be applied, not very tight, round the knee, repeating the application daily. The motions of the child produce the necessary friction; and the cuticle being thin, the mercury easily enters the system.

The objections to the plan of treatment, by frictions with mercurial ointment, are its uncleanness and other inconveniences.]

#### *Mercurial Fumigations.*

This method is one of the most ancient plans of affecting the constitution with mercury, and Abernethy has stated circumstances in its favour, which seemed to make it occasionally an eligible mode. He was of opinion, that if the peculiar advantages of mercurial fumigations were generally known to practitioners, they would be much more frequently employed. The advantages of the method consist in its affecting the constitution, when other means fail, and in producing its effects in a much shorter time than any other mode. This celerity of operation, when venereal ulceration was making great ravages in the palate and throat, was particularly insisted upon as a most desirable circumstance. For patients who had not strength to rub in ointment, and whose bowels would not bear the internal exhibition of mercury, fumigation was also deemed highly advantageous.

"In the year 1776 the Chevalier Lalouette, a physician at Paris, laid before the public an account of a new mode of mercurial fumigation, free from the inconveniences of former ones, and which, in the space of thirty-five years, he had successfully employed in more than four hundred cases that had resisted all the ordinary methods of cure. His method consisted in inclosing the patient, previously undressed, in a kind of box resembling a sedan-chair, with an opening at the top to let out the head, and another at the bottom, to which was fitted a small grate or furnace, having in it a heated iron for converting the mercurial remedy into fume. The preparation he made use of was obtained from calomel, which by repeated sublimation from iron filings, was so far deprived of its chlorine, as to be in part reduced into running quicksilver, and, while it possessed considerable



volatility, was perfectly unirritating. Some of this powder being strewed upon the hot iron placed below, was immediately converted into smoke, which surrounded the patient's body, and after some time settled on his skin in the form of an oxide of the metal: a complete dress, having its inner surface fumigated with the same powder, was then put on. The remedy being thus generally applied to the mouths of the cutaneous absorbents, soon got admission into the circulating fluids, and the constitution became thereby more speedily affected than by any other process known before." (*Abernethy's Surgical and Physiological Essays*, part iii.)

As the fumigating powder used by M. Lalouette appeared to have no advantage over one made by simply decomposing calomel by means of ammonia, Abernethy employed the latter, which was prepared in the following manner: Two drachms of liquor ammoniæ are added to six ounces of distilled water, and four ounces of calomel are thrown into this liquor, and shaken up with it; the powder is afterwards separated by a filter, and dried.

In local disease of the joints, such, for instance, as a thickened state of the synovial membrane, and in sarcomatous enlargements of the breast in women, the late Mr. Sharp and Sir C. Blicke were accustomed to direct fumigated stockings, or under-waistcoats, to be worn; by which these complaints were relieved, and the constitutions of the patients affected, without the trouble and unpleasantness arising from the use of the common mercurial ointment. (See *Abernethy*, op. cit. part iii.)

Mr. Pearson procured Lalouette's machine, and made a considerable number of experiments to determine the comparative advantages of this method, and mercurial frictions. He found that the gums became turgid and tender very quickly, and that the local appearances were sooner removed, than by the other modes of introducing mercury into the system; but that it soon brought on debility, a rapid and premature salivation, and of course that the medicine could not be steadily continued. This gentleman concludes, that when checking the progress of the disease suddenly is an object of great moment, when the body is covered with venereal ulcers, or when the eruptions are large and numerous, so that there scarcely remains a surface large enough to absorb the ointment, the vapour of mercury will be advantageous. (*Pearson on Lues Venerea*, p. 145, &c.)

[In 1824 M. Rapou published two volumes on the employment of fumigation in various diseases, and recommends in certain cases mercurial fumigations to be used with steam, which, as he says, calms the system, softens the skin, and does not prevent the absorption of the mercury (vol. ii. p. 395). In this country the practice was revived, some twenty-five years back, by Mr. Langston Parker, whose experience, derived (as he tells us in the last edition of his work *Modern Treatment of Syphilitic Diseases*, London, 1860, p. 322) from the treatment of many thousand cases enables him to speak strongly in its commendation. Mr. Parker directs the patient to be placed on a chair, and covered with an oilcloth lined with flannel, which is supported by a proper framework; under the chair are placed a copper bath, containing from half a pint to a pint of water, and a tinned iron plate on which is put from one to three drachms of bisul-

phuret of mercury, or the same quantity of the grey oxide, or the biniodide, or other mercurial preparation; under each of these a spirit-lamp. The patient, as Mr. Parker observes, is thus exposed to the influence of three agents, heated air, common steam, and the vapour of mercury, which is thus applied to the whole surface of the body in a moist state. After the patient has remained in the bath from five to ten minutes, perspiration generally commences, and by the end of twenty or thirty minutes, beyond which he does not prolong the bath, it is generally very free. After the patient has become moderately cool, the coverings are removed, and the body rubbed dry. In particular cases the power of the bath may be modified, and not so great a heat or so much mercury employed. In skin diseases Mr. Parker prefers the employment of the bisulphuret; in diseases of the throat or nose, the grey oxide, or calomel, because the patient can bear the head immersed without sneezing or coughing, which he cannot do when the bisulphuret is used, no doubt from the irritant fumes of sulphurous acid evolved through decomposition of the bisulphuret. The iodide of mercury Mr. Parker also employs in fumigation, in the dose of from five grains to half a drachm, sometimes alone, sometimes combined with the other preparations. The bromide of mercury might in like manner be resorted to, as it is volatilized, unchanged at a dull red-heat. Mr. Henry Lee published a paper in the *Medico-Chirurgical Transactions* for 1856 (p. 340) on mercurial fumigation in the treatment of syphilis, where he advocates the use of calomel; he says that, in ordinary cases five or ten grains of calomel is quite sufficient. He considers it can be used with comparative certainty both as regards its composition as volatilized, and its physiological effects, because, as he asserts, it is "not acted upon either by heat or the vapour of water" (p. 244). This is not so. According to Turner (*Elements of Chemistry*, 5th ed., p. 630), when calomel, at a heat short of redness, is volatilized, a portion is always resolved into mercury, and into bichloride of mercury.

Mr. Parker states that, in a great majority of cases, the moist mercurial vapour, employed as he directs, is capable of curing the disease without the assistance of internal medicine; but the cure is generally expedited, and rendered more certain, by the administration of the latter in small quantities. Thus it may be conjoined with mercurial inunction, and warm draughts of decoction of guaiacum taken immediately after the bath. He also exhibits the biniodide, or bichloride of mercury, given in solution in small quantities not exceeding the twentieth of a grain for a dose. The baths, it appears, very rarely produce salivation; the gums, when affected, are simply red, elevated, and tender.

For further particulars, the reader is referred to the above-cited work of Mr. Parker.]

#### PREPARATIONS FOR INTERNAL EXHIBITION.

[Mercury with chalk is frequently prescribed for the cure of the venereal disease in children, in the dose of from one to five grains twice a day. It is, however, rather an unstable preparation, inasmuch as the mercury, reduced by trituration with chalk to a state of minute division, is prone to pass into a state of peroxide, and thus prove irritant and deleterious to the system. It is ascertained

that saccharine substances have the power of preventing metallic oxydation in certain cases. Hence it is probable, that if sugar of milk or manna were substituted for the chalk, a safe, unchangeable, and efficient preparation would be obtained. A more eligible medicine for children than mercury with chalk is a minute quantity of mercurial pill, say one or two grains, blended with any viscid substance, such as mucilage of tragacanth.]

The bichloride of mercury (corrosive sublimate) was a medicine highly praised for its antisymphilitic virtues by Van Swieten; and, indeed, there is no doubt that, like other preparations of mercury, it possesses such qualities. It still retains great reputation, and, probably, will always do so.

[It acts not merely as an alterative, but also somewhat as a tonic. It is a valuable remedy in those varieties of constitutional syphilis which are complicated with ulcerations of the mucous surfaces. I had a man under my care, in St. Mary's Hospital, with a mushroom-like growth at the extremity of the penis, the size of half a chestnut, of syphilitic origin, which completely disappeared after a short course of the bichloride of mercury.]

The following case, mentioned by Boyer, and quoted by Vidal (*Pathologie Externe*, 1861, tom. iii. p. 491), shows the remedial efficacy of corrosive sublimate in constitutional syphilis:—

A postilion, respectably connected, had been troubled for two years with an outgrowth of the left maxillary sinus. The eye of that side was watery, and pushed forwards; the nose was turned to the right, and the nostril closed; the arch of the palate was somewhat bulging. The swelling was prominent upwards and outwards, and the superincumbent skin red and shining. It appeared soon after infection, accompanied with other symptoms. It had at first increased slowly, but for a long period made no progress. It was at the outset painful, but the pain ceased as it grew. On account of the deformity thus produced, the patient, of his own accord, took large and repeated doses of the solution of Van Swieten, prepared by dissolving eight grains of sublimate in one ounce and a half of spirits of wine and fourteen-and-a-half ounces of distilled water, so that one ounce of the liquid contained half a grain of sublimate. Within three months he had swallowed no less than 128 grains of corrosive sublimate. The tumour completely disappeared, the eye resumed its natural position within the orbit, the lachrymation ceased, and the nostrils became pervious; the only vestige was a depression at the upper part of the cheek, caused by adhesion of the skin.]

"Corrosive sublimate," says Mr. Pearson, "will often check the progress of secondary symptoms very conveniently, and I think it is peculiarly efficacious in relieving venereal pains, in healing ulcers of the throat, and in promoting the desquamation of eruptions. Yet, even in these cases, it never confers permanent benefit; for new symptoms will appear during the use of it, and on many occasions it will fail of affording the least advantage to the patient, from first to last. I do sometimes, indeed, employ this preparation in venereal cases; but it is either at the beginning of a mercurial course, to bring the constitution under the influence of mercury at an early period, or during a course of inunction, with the intention of increasing the action of simple mercury. I sometimes also prescribe it, after the

conclusion of a course of frictions, to support the mercurial influence in the habit, in order to guard against the danger of a relapse. But on no occasion whatever do I think it safe to confide in this preparation, singly and uncombined, for the cure of any truly venereal symptom." (*Pearson on Lues Venerea*.)

[This salt is best given in solution in water, amply diluted, in the dose from  $\frac{1}{16}$  to  $\frac{1}{8}$  grain twice or thrice daily.]

Corrosive sublimate has been employed externally as a bath, in syphilitic affections of the skin, in the proportion of half a grain to a pint of water. A solution in distilled water to the amount of one grain to the eight or twelve ounces forms a valuable collyrium.

Calomel is extensively employed for the purpose of bringing the system quickly under the influence of mercury, as in iritis, laryngitis, synovitis, and especially in peritonitis. One grain and a half, or two grains, joined with a quarter of a grain of opium, which will prevent disturbance of the bowels, may be exhibited every two, four, or six hours, according to circumstances. It is frequently prescribed as an alterative in the dose of half a grain or a grain once or twice a day, and likewise as a purgative in doses varying from five to twenty grains. The addition of half a grain of calomel to four or five grains of mercurial pill is said to render the latter more prompt in its action on the system.

Calomel combined, as above stated, with opium, or in the form of the compound calomel pill, is occasionally administered for the cure of constitutional syphilis. M. Bielt treated certain syphilitic affections of the skin by applying daily one-eighth of a grain of calomel to the pituitary membrane; mixed with from thirty-two to sixty-four times its weight of lime-water it forms the *black-wash*, a useful application to promote the healing of sores generally. According to MM. Mérat and De Lens it has been resorted to for fumigation, like cinabar, to the extent of one or two drachms at a time, united with sugar or incense. (*Dictionnaire de Mal. Méd.*, 1832, tom. iv. p. 352.) In the case of scrofulous sores of the schneiderian membrane, M. Jobert advises a powder composed of one drachm of calomel, mixed with half an ounce of gum arabic, to be snuffed up from time to time within the nostril. Protiodide, or green iodide of mercury, is extensively prescribed on the Continent, in the treatment of constitutional syphilis. It may be exhibited in the form of pill, in the dose of half a grain, night and morning, progressively increased to three grains, conjoined with two or three grains of extract of conium or hyoscyamus, or half a grain of extract of Indian hemp, in order to prevent griping. Red iodide, or biniodide, of mercury is also used in syphilitic complaints, usually dissolved by the aid of iodide of potassium. Mr. Langston Parker recommends the subjoined formula:—Take of red iodide of mercury, three grains; iodide of potassium, from one to three drachms; spirits of wine, one drachm; syrup of ginger, three drachms; distilled water, one ounce and a half; mix together; twenty or thirty drops are to be swallowed three times a day, in half a tumbler of some decoction of the woods. (*Op. cit.*, p. 330.) He finds this preparation agree well with the gastric condition of the patient, and considers it more manageable than the green iodide. In the



instance of syphilitic pompholyx, a somewhat analogous compound, procured by dissolving one-eighth of a grain of corrosive sublimate in a solution of three grains of iodide of potassium, taken thrice a day, has proved most beneficial. An ointment composed of ten grains of red iodide of mercury, to an ounce of lard, has been found of advantage in bronchocoele.

The mercurial pill (*pilula hydrargyri*) is an eligible preparation for internal administration. It consists of mercury in a state of minute division, blended with some saccharine substance or confection, which preserves it from oxidation. From three to five grains is the usual dose, repeated twice or thrice in the day. When it purges, opium will generally prevent this effect, or, according to Mr. B. Phillips, a minute quantity of rhubarb. The common mode of exhibition, in the instance of syphilis, is to give five grains of mercurial pill at night, combined with a quarter of a grain of opium, and five grains in the morning without opium; or three grains of the pill may be given thrice daily, conjoined with one-third of a grain of opium and half a grain of ipecacuan, until the patient is fully under the mercurial influence. In protracted cases of constitutional syphilis, Dr. Graves has seen a perfect cure follow the exhibition of one grain of blue pill daily for about three months. (*Clinical Lectures*, p. 545.)

The red oxide of mercury is seldom or ever prescribed to be taken internally. The average dose is stated to be one grain, and this is generally exhibited with opium in order to prevent griping and purging. It is occasionally used for fumigation in venereal diseases of the throat and nostrils.

For the purpose of fumigating sores, either the grey oxide, the bisulphuret, or mercury with chalk, may be used. Ulcers and excrescences about the pudendum and anus in women are benefited in this way; and, in these cases, the fumes are most conveniently applied by placing a red-hot heater at the bottom of a night-stool pan, and after sprinkling on it a few grains of red sulphuret of mercury, placing the patient on the stool. On other occasions, a small apparatus, sold at the shops, is used, which enables the surgeon to direct the fumes through a funnel against the ulcer in any situation.]

Alexander Ure.

**MEROCELE** (from *μερος*, the thigh, and *κηλη*, a tumour.) A femoral or crural hernia. (See **HERNIA**.)

**MEZEREON** was recommended by Dr. A. Russell for a particular class of venereal symptoms, in the following terms: "The disease, for which I principally recommend the decoction of the mezereon root as a cure, is the venereal node that proceeds from a thickening of the membrane of the bones. In a thickening of the periosteum, from other causes, I have seen very good effects from it; and it is frequently of service in the removal of those nocturnal pains with which venereal patients are afflicted; though, in this last case, excepting with regard to the pain that is occasioned by the node, I own I have not found its effects so certain as I at first thought I had reason to believe. I do not find it of service in the cure of any other symptom of the venereal disease." (*Med. Obs. and Inq.* vol. iii. pp. 194, 195.) Mr. Pearson, however, asserts unequivocally, that

mezereon has not the power of curing the venereal disease in any one stage, or under any one form; and if the decoction should ever reduce the venereal node, yet there will be a necessity for taking mercury in as large quantity, and for as long a time, as if no mezereon had been exhibited. Cullen found this medicine of use in some cutaneous affections; but excepting an instance or two of lepra, Mr. Pearson very seldom found it possessed of medicinal virtue, either in syphilis, or the sequelæ of that disease, scrofula or cutaneous affections. (*Pearson on Lues Venerea*, pp. 55—59.)

As the possibility of curing most forms of the venereal disease, not only without mercury but without any internal medicines whatever, is now well established, it is difficult to know what degree of importance to attach to observations, declaring certain articles of the materia medica efficient or inefficient in the cure of that disease; because if it admit of a spontaneous cure, but will not get well when mezereon, or any other particular medicine, is exhibited, we are necessarily obliged to suppose that such medicine is worse than useless.

**MOLLITIES OSSIUM.** (*Osteo-malacia. Malacosteon.*) A morbid softness of the bones, which become preternaturally flexible, in consequence either of the inordinate absorption of the phosphate of lime, from which their natural solidity is derived, or else of this matter not being duly secreted into their texture. The bones affected become specifically lighter. (*Saillant, Hist. de la Soc. Royale de Méd.* t. viii.) Dr. Bowstock made some experiments, with the view of ascertaining the proportion of earthy matter in bones affected with mollities: he examined a dorsal vertebra of a woman, whose bones were found soft and flexible after her decease. In one part of the diseased bone, he found, that the quantity of earthy matter only amounted to one-fifth of its weight, and in another only to one-eighth, while the proportion in healthy bones amounted to more than one-half of their whole weight. (See *Med. Chir. Trans.* vol. iv. and *Wilson on the Bones and Joints*, p. 253.) [A portion of femur from another case which he examined yielded only eleven parts of earthy salts in one hundred (*Med. Chir. Trans.* vol. xx. *Stanley on Diseases of Bones*, p. 237). And even a smaller proportion than this has been found (*Path. Soc. Trans.* vol. xiii. p. 211).]

In rickets, the bones yield and become distorted only by slow degrees, and retain their natural inflexibility; but, in the present disease, they may be at once bent in any direction, and frequently admit of being readily divided with a knife. Preternatural brittleness and flexibility of the bones appear to Mr. Mayo, as they did to Boyer, to be the results of different degrees of the same cause. "One degree of atrophy produces brittleness; a greater degree flexibility, with greater brittleness. The disease, in which these features are shown in the highest aggravation is one which attacks adults, but is of very rare occurrence. It is named mollities ossium." (See *Outlines of Human Pathology*, p. 19.) [This opinion is shared by most English authors, who consider that the fragility, met with in some cases of this disease, is the commencement of the degenerative change in the bone, and is due to the absorption of its cancellous texture; but in the more advanced stage, when the compact tissue is also involved, and uniform softening of the whole thickness of

the bone has taken place, fragility no longer exists, having gradually given way to the extreme flexibility which is the characteristic feature of this affection.] The causes of this extraordinary disease are buried in obscurity. It is supposed, however, to depend upon some peculiar state of the constitution, and the individuals, attacked by it, have been remarked to be mostly about, or rather beyond, the middle period of life (*J. Wilson*, vol. cit. p. 252), and generally women. (*Neumann*, in *Abhandl. der K. K. Josephs-Acad.* b. ii. p. 173. *Portal*, *Cours d'Anatomie*, t. i. p. 15.) One instance, however, is reported, in which the patient was a young man, seventeen years of age (*Thomassin*, in *Journ. de Méd.* t. xliii. p. 222); and other cases where men have been the subjects of this disease are on record. [Several patients have referred the commencement of the disorder to a previous injury or illness (*Med. Chir. Trans.* vols. xxvii., xxxiii., xlv.; *Lancet*, 1852, vol. i.). Pregnancy would seem to be an exciting cause, and especially in those who have borne many children. Occasionally the disease has appeared to be hereditary (*Brit. Med. Journ. Sept.* 1859). Severe continuous pain in the affected parts is usually the earliest symptom, with wasting of the muscles, and great general debility; the urine is often highly charged with phosphates (*Med. Chir. Trans.* vols. xxvii., xxxvii.; *Lancet*, 1852, vol. i.; *ibid.* 1862, vol. ii.), or more rarely with a peculiar animal matter, closely resembling albumen (*Philos. Trans.* vol. lxvi.; *Med. Chir. Trans.* vol. xxxiii.). Gradual softening and yielding of the bones then follow, or, in some few cases, these have been the first manifestations of the disease. In some instances, the bones become so soft that they may be bent in any direction, and the most fearful distortion takes place; in others, they are more brittle, and even will break spontaneously, so that several fractures have occurred at once in the same patient. Death generally results from exhaustion, or from the effects of pressure upon the viscera through deformity. After death the bones are found softened to such an extent that they may be easily divided by a knife; the cells are expanded and filled with a red pulpy material, which is largely mixed with a soft fat or oil; in this oily semifluid matter, blood corpuscles and nucleated cells are seen under the microscope, whilst the minute osseous structure is very indistinct. In more advanced cases the bony tissue has almost disappeared, a mere shell remaining attached here and there to the periosteum; this membrane is generally much thickened, so as to retain the shape of the bone and to form a dense envelope to the fatty gelatinous substance above mentioned. In a few specimens of the disease, this fatty matter has been replaced by a more highly organised structure, which contained a large quantity of oil, and was not dissimilar in colour or consistency to a piece of liver. (*Gooch's Surgery*, vol. ii. p. 402; *Trans. Med. Chir. Soc. Edin.* vol. ii.)] As a detailed description of a case will give a fuller idea of the disease, I shall quote that of Madame Supiot. In the year 1747 she had a fall, which occasioned her to keep her bed for some time, and left great pain and weakness in her loins and lower extremities. In about a year and a half afterwards, she began to perceive her left leg particularly affected. Along with this weakness, she had violent pains over her whole body,

which increased after a miscarriage, and still more after a natural delivery, in the year 1751. She was now seized with startings, great inquietude, and such violent heats that she was almost continually in a sweat, and could not bear the least covering even in the coldest weather, and while her pains continually increased, she noticed that her urine precipitated a white sediment. Her pains abated on the appearance of the sediment, but she now observed that her limbs began to bend, and from this time the softness of them gradually increased till her death. In the month of April, 1752, the trunk of the body did not exceed 23 inches in length, the thorax was exceedingly ill formed, and the bones of the upper part were very much distorted; those of the lower part were considerably bent. At length, the thigh-bones became so pliable that her feet could easily be laid on each side of her head. The right side did not, till after some time, become so deformed as the left; but it was surprising to observe the alterations which daily took place, and the different figures assumed by the limbs, in consequence of the increased softness of the bones; so that, when the sediment in the urine was considerable, the disease of the bones seemed to be at a stand, increasing considerably when it was suppressed. Besides this, she had violent pains, startings, difficulty of breathing, spitting of blood, and lastly, a fever, with convulsions. She died in Nov. 1752, and on dissecting her body, the following appearances were observed: 1. The muscles in general were of a very soft and pale consistence; the vastus externus, sartorius, quadriceps, biceps, and external parts of the gracilis, were much shorter than in their natural state, and more firm and tense; while those on the opposite side were much elongated, thin, and very tender; in short, the whole muscular system had suffered more or less, according to the action of the muscles in her lifetime. 2. The bones had entirely disappeared, whilst the periosteum was thickened but otherwise unchanged, so as to present the form of a cylinder. 3. The heart and principal blood-vessels, both veins and arteries, contained large black masses, of a viscid consistence, and very unlike the clots usually found in dead bodies.

A case of softness of the bones is related by Mr. Gooch, but considerably different from the above, as it was attended with a remarkable fragility of them before they became soft. It likewise began with pains through the whole body, attended with feverish symptoms; but, after some weeks, these pains were confined chiefly to the legs and thighs, and they were not increased by pressure. This fragility of the bones does not appear to have been the case with Madame Supiot. In the month of June, 1749, Mr. Gooch's patient broke her leg in walking from her bed to a chair, and heard the bone snap. No callus was formed, though the fracture was instantly reduced, and treated by one of the best surgeons in her part of the country: but, instead of this, the bones began to grow flexible, and, in a few months, were so from the knee to the ankle. The disease still continued to increase, so that, in a short time, the other leg and thigh were affected in the same manner, after which both legs and thighs became œdematous, liable to excoriations, and discharged a thin yellow ichor. Scorbutic symptoms began to appear in the winter after the leg was broken,



and her gums began to bleed. Tonic medicines were exhibited without any success except that her menstruation was more regular, and her appetite and digestion were improved; but, towards the end of her life, her breathing became difficult, the spine distorted, and a pain in the loins took place upon every motion of the vertebræ; and as her limbs were now quite useless, she was obliged to sit upright in bed. At last, the ends of the bones, on which she sat, having become also very soft, spread much, and the ends of her fingers and thumbs, by frequent endeavours to raise herself, became also very broad and the phalanges crooked. The flexibility of the bones gradually increased, and became more general, attended with a wasting of the flesh, and excessive difficulty of breathing. The menstrual flux totally ceased four months before her death; her legs, which were very anasarcaous, and excoriated almost all over, became erysipelatous; but she retained her senses to the last. She expired suddenly, having talked in a composed manner, concerning her miserable situation and approaching end, only a few moments before her death.

On examining the body, she was found to have lost two feet two inches of her natural stature. The heart and lungs appeared sound, but had been much compressed, principally by the liver, which was enlarged in an extraordinary degree; it was not, however, scirrhus, nor in any other way diseased. The spleen was very small, and the mesentery had one large scirrhus gland. All the bones, except the teeth, were softened, so that scarcely any of them could resist the knife; but those of the lower extremities were the most dissolved, being changed into a kind of parenchymous substance, like soft dark-coloured liver, without any offensive smell. So completely, indeed, were they decomposed, that the knife met with less resistance in cutting through them than sound muscular flesh, though some bony lamellæ were here and there to be met with, but as thin as an egg-shell. The most compact bones, and those which contained the greatest quantity of marrow, were the most dissolved; and it was observable, that the dissolution began internally, for the bony laminæ remained here and there on the outside, and nowhere else. The periosteum was rather thicker than ordinary, and the cartilages thinner; but not in a state of dissolution. The bones were found to contain a great quantity of oily matter and little earth. No cause could be assigned for the disease; and in the case of Madame Supiot, the one assigned, viz., that of her eating too much salt, seems totally inadequate to explain the origin of the disorder.

[Mollities ossium is a most intractable affection, and nearly always proves fatal; but a few cases are recorded where the disease has been arrested, and recovery has taken place (*Med. Chir. Trans.* vol. xlv.); in these the patients seem to have derived benefit from full doses of cod liver oil with generous diet; but no means of cure are yet known.] In the Museum of the College of Surgeons in London, there is a humerus, the cortex of which is as thin as a wafer, and the interior filled with a substance that looks like tallow. Towards the lower part, the bone is occupied by a vascular membranous sac. In the Museum of the London Hospital are specimens of bones similarly affected, taken from the body of a woman, who died at the age of

72, after having been confined four years to her bed by paralysis of the lower extremities (see *Mayo's Human Pathology*, p. 19); and the Museums of the several Metropolitan Hospitals contain preparations illustrative of this formidable disorder. [In that of St. Mary's Hospital is a specimen which shows beautifully the complete dissolution of the bony tissue and the substitution of a soft yielding material, which can be bent in any direction. The osseous structure has entirely disappeared, except where a few bony scales still adhere to the periosteum. This membrane is thickened and presents accurately the shape of the bone; it thus forms a tube, which contains a substance very much resembling a piece of muscle after long maceration, both in appearance and consistence; it has somewhat of a fibrillated arrangement, and from between its meshes an oily fluid exudes. The cartilages covering the condyles are unaltered.]

For additional observations, connected with this subject, refer to *Fragilitas Ossium* and *Rickets*. Boyer and Richerand treat of mollities ossium, and rickets, as one and the same disease. [Gerdy describes this affection as rickets in the adult (*Maladies des Organes du Mouvement*, p. 324), and most of the modern French pathologists consider these two diseases to be identical.] But, as Mr. Wilson observes, it differs from rickets, in attacking people of middle age, or rather older, and not particularly children; it differs also in the changes, produced in the bones themselves, for, when dried, they do not appear as if they had been long steeped in weak acid, by which the animal constituent is unaltered; but both the phosphate of lime and the animal matter appear to have been absorbed, so as to leave mere shells of bone, which are also softer than natural bone of the same thickness. Large cavities are met with in the substance of the bones, and sometimes communicate with the soft parts surrounding them. In some of these cavities is contained oily matter, like boiled marrow; and in others, masses of coagulated blood, and a soft inorganic animal substance. (*J. Wilson on the Bones*, &c. p. 253.)

[Again, rickets is an affection of frequent occurrence, painless, and very amenable to treatment, whilst mollities is the reverse of these; in the former the bones bend in the direction of their natural curves, and are shorter than usual from an arrest of growth; in the latter they have attained their full development, and yield in any direction from the action of the muscles or the superincumbent weight. Rokitsky states that bone in this disease "undergoes a striking change in its chemical composition, the extract produced by boiling being not only different from chondrin, but also from the animal matter of bone;" and he considers that this constitutes an essential difference between mollities and rickets (*Syd. Soc. Path. Anat.* vol. iii. p. 178).]

(G. G. Gussowen.)

*Acrel*, Diss. Descriptionem et Casus aliquot Osteomalaciæ sistens; Upsal. 1788. *Morand*, in Journ. des Savans, 1792, et Mém. de l'Acad. des Sciences, 1752. *Morand*, junr., in Mém. del'Acad. des Sciences, 1764, p. 206. See also *T. Lambert*, Relation de la Maladie de Bernard d'Armagnac, sur un Ramollissement des Os; Toulouse, 1700. *Fernclius*, in lib. de dabitibus rerum causis. *Th. Bartholinus*, Hist. Anat. cent. 4. *Petit*, Hist. de l'Acad. des Sciences, 1722. *Hoin*, ibid. 1764. *Gagliardi*, Anatomie Ossium, Romæ, 1789. *C. G. Ludwig*, Programma, quo observata in sectione Cadaveris Fœminæ cujus Ossa

emollita erant proponit; Lips. 1757. *Fries*, Dissert. de Emolitione Ossium; Argentor. 1775. *Thomson*, in Med. Obs. and Inquiries, vol. v. p. 259. *Chr. Obs* and Cases, by *Wm. Bromfield*, vol. ii. p. 50, &c.; *Boyer*, Traité des Maladies Chir. t. iii. p. 607, &c.; Paris, 1814. [*Stanley*, On Diseases of the Bones 1849. *Rokitsky*, Manual of Pathological Anatomy, v. 1. iii. Syd. Soc. 1851. *Beylard*, Thèse sur le Rachitisme, 1852. *Gerdy*, Maladies des Organes du Mouvement, 1855. *Med Chir. Trans.* vols. xx, xxvii., xxxiii., xxxvii. We meet with cases of Mollities Ossium in the Philosophical Transactions; Act. Hafniens; Ephem. Nat. Cur.; *Saviard's Obs. Chir.*; the writings of *Forestus*; *Goach's Chir. Works*, vol. ii. pp. 393–399, ed. 1792. &c. *J. Wilson*, on the Structure and Physiology of the Skeleton; and on the Diseases of the Bones and Joints, p. 252, &c. 8vo Lond. 1820. *Good's Study of Med.* vol. v. p. 334, ed. 4. *J. Howship*, in Edin. Med Chir. Trans. vol. ii. p. 137. *Herbert Mayo*, Outlines of Human Pathology, sect. 3. 8vo; Lond. 1835. *Med. Chir. Trans. Lancet. Med. Times and Gazette. Brit. Med. Journal. London Medical Journal.*]

### MORTIFICATION or GANGRENE.

[This term signifies the death of any part of the body in consequence of injury or disease. The diversity of circumstances under which it may occur has caused it to be classified in various manners. Thus, if the mortified part has been previously inflamed, swelled, and loaded with liquid effusion, the terms humid, acute, and inflammatory mortification are used; whereas, if the mortified part has died without previous inflammation, swelling, and effusion, the gangrene is said to be *dry*. Many classifications are founded on the nature of the exciting causes. These were arranged thus by Professor Carswell:—1. Cessation of circulation; 2. Violent operation of mechanical, chemical and physical agents; 3. Influence of certain poisons.

The degree of completeness of the process is also indicated by corresponding terms: thus the term *sphacelus* is used when the affected part has lost all motion, sensibility, and warmth, and has become entirely dead. So long as any remains of vitality linger, the state is said to be one of *gangrene*; hence a gangrenous state may exist without ending in complete sphacelus (*Richter, Anfangsgr. der Wundarzn.*, b. i. kap. 3). Some writers make the distinguishing feature of sphacelus to be death of the bones as well as of the soft parts (*Lassus, Pathologie Chir.* t. i. p. 30, ed. 1809), a distinction pronounced by Pearson to be useless (*Principles of Surgery*, p. 115, ed. 2.) The definition of Dr. J. Thomson has become almost classical. "I shall employ the term gangrene," he says, "to express that state of mortification in inflamed parts which precedes the death of the part; a stage in which there is a diminution, but not a total destruction, of the powers of life; in which the blood appears to circulate through the larger vessels; in which the nerves retain a portion of their sensibility; and in which, perhaps, the part affected, may still be supposed to be capable of recovery. The word *sphacelus*, I shall use to denote the complete death, or mortification of a part; that state, in which the powers of life have become extinct; in which the blood ceases to circulate; and in which the sensibility of the nerves is lost, whether the dead or mortified part has, or has not, become actually putrid, or shown any tendency to separate and fall away from the living and sound parts. Putrefaction, or the spontaneous process, by which animal bodies are decomposed, is an accidental, and not a necessary, effect of the state of mortification. It takes place at very different periods, after the death of particular parts;

and these periods, it may be remarked, are always regulated, not only by external circumstances, such as the humidity and temperature of the atmosphere, but, also, by the peculiar structure, and morbid conditions of the animal texture, or organ, in which the putrefaction occurs. The term sphacelus has, I know, been employed to express, that a part is not only completely dead, or mortified; but, also, that that part has become putrid, and is in a state of separation from the surrounding and living parts. But, as putrefaction is not a necessary, or immediate, consequence of mortification, or partial death in animal bodies, this use of the term sphacelus is obviously improper." (*On Inflammation*, p. 504.)

Dr. Carswell pointed out the essential identity with mortification of certain minute changes going on in the interior of tissues; and protested against the restriction of the term to parts outward and visible. "It may," he says, "be fairly questioned whether the application of the term mortification has not been too restricted; and whether parts, deprived of their vitality, and separated from the living tissues, should not be designated by the same appellation as those which, similarly circumstanced, differ from them only in point of colour, and perhaps smell. Softening of the cerebral substance, of the mucous, and frequently of the serous, membranes constitutes a state of positive death; but, the softened substance, in those instances, presenting neither the peculiar colour nor odour of external parts, when mortified, it has been considered proper to distinguish softening from mortification by a term expressive of its principal character—that of softness." (*See Carswell's Illustrations of the Elementary Forms of Disease*, Fasc. 7.)

[Here modern pathology displays a very wide field. In the first place, we must remember, that, as every individual unit of the body lives but a limited time, so there must be a time for the natural and physiological death or mortification of every such living unit: a process which is familiar enough to us, in the shedding of all epithelial structures: hair, cuticle, nails, gland epithelium, &c. Dr. Lionel Beale has, moreover, rendered it probable, that but a small portion of our tissues is actually *living* in the proper sense of the word, *i.e.*, endowed with *germinal* power—power of growth and assimilation. The bulk consists of *formed* matter, which is useful by its mechanical qualities, or through undergoing oxydation and conversion into various secretions. Amongst real mortifications there must be reckoned the daily death of effete structures; and we may see how a failure of *germinal* force, or an excessive and premature decay of formed matter, accompanied with some of these slow processes of decomposition which pass under the name of "fatty degeneration," constitute many of these internal *softenings* of which Dr. Carswell spoke. *Ulcerations and caries*, also, are true varieties of mortification on a minute scale.]

The causes of mortification are either *internal* or *external*. It was commonly taught in the medical schools on the Continent, that the internal causes probably operate after the manner of a deleterious substance, which, being introduced into the circulation, occasions a *putrefaction of the fluids*—necræmia, death of blood. (*Lassus*, op. et loc. cit.) —Boyer professes a similar notion (see *Maladies*



*Chir. t. i. p. 140*), as well as Larrey in his account of *traumatic gangrene*.

Under the head of *mortification from the deleterious influence of certain poisons*, Dr. Carswell notices one form arising from the bite of the *cobra di capello*, the rattle-snake, and viper; another produced by a deleterious agent, generated during the decomposition of animal substances; a third, known by the term *hospital gangrene*; a fourth, exemplified in the *malignant pustule*; a fifth, in the carbuncle of plague; and a sixth, in the mortification caused by eating various grain in a state of disease.

*Mortification from eating bread made of bad black wheat or from spurred rye* (this used to be reckoned amongst the species of *dry gangrene*, a classification not correct, and now obsolete) has been rarely observed in England; but it has been frequently seen on the Continent, in districts where rye forms a principal article of food. It occurs, however, in such districts only after wet seasons, in which that grain is affected with the disease known by the name of the *Ergot*, or cockspur rye. In this disease, the grains of rye grow to a large size, acquire a black colour, and have a compact horny consistence. The species of mortification, produced by eating this substance, was first particularly described by Dodard. (See *Journ. des Savans*, an. 1676.) The part affected became at first insensible and cold, and, in the progress of the disorder, dry, hard, and withered. In very malignant cases, there was delirium. Dodard says that fowls, fed with cockspur rye, are killed by it. Saviard informs us, that he saw this disease in the year 1694, at the Hôtel Dieu of Orleans. It attacked the upper and lower extremities, which were rendered, in the course of the disorder, as dry as touchwood, and as emaciated as the limbs of Egyptian mummies. In 1710, Noel, surgeon to the Hôtel-Dieu at Orleans, transmitted to the Royal Academy of Sciences at Paris an account of this peculiar mortification. About fifty people, men and children, had come that season into the hospital with the affection. According to Noel, the disorder always began in the toes, and extended itself gradually along the foot and leg, till it sometimes rose to the upper part of the thigh. He had never seen any of the female sex affected with it, and had observed only one instance of it in the upper extremities. The Academy received the history of one case, in which the lower extremities were separated from the body in the articulations of the thigh-bones with the acetabula; the first example (Dr. Thomson believes) of this separation upon record; and it was the occurrence of this, and of similar cases, that probably first suggested the operation of amputation at the hip-joint. (See *Thomson on Inflammation*, p. 541.) As Noel's patients did not come under his care till after the disease had existed some time, he could not describe from his own observation the early symptoms; but the patients had often told him, that the disease generally began in one, or both feet, with pain, redness, and a sensation of heat, as burning as the fire; and that, at the end of some days, these symptoms ceased, as quickly as they had come on, when the extreme sensation of heat, which they had formerly felt, was changed into cold. The part affected (adds Noel) was black, like a piece of charcoal, and as dry as if it

had passed through the fire. After some time, a line of separation was formed between the dead and living parts, like that which appears in the separation of a slough produced by the cautery; and the complete separation of the limb was, in many cases, effected by nature alone. In others, Noel was obliged to have recourse to amputation. The blood seems to undergo a change, hæmorrhages ensue. The chief post-mortem appearances are, congestion of brain, liver, and lungs. (*Taylor on Poisons*, p. 538.)

This disease appeared in Switzerland in 1709 and 1716, and its symptoms and progress in that country have been accurately described by Langius in a dissertation, entitled, "*Descriptio Morborum ex Esu Clavorum Secalinorum*."

Gassaud, physician in Dauphiny, where this disease appeared also in 1709, states, that many of the patients were affected with swellings of the feet and legs, and of the hands and arms, which degenerated into a gangrene that penetrated to the bone, and produced a separation of the affected limb. The disorder was attended with different symptoms in different individuals. Some suffered very violent pain, accompanied by an insufferable sensation of heat, although the part affected often felt cold to the touch. In other patients, redness, with much swelling, supervened, attended with fever and delirium. Other patients were without any fever, or delirium, though they seemed to suffer equal pain. In some patients, the parts affected become withered, dry, and black, like charcoal. The separation of the dead parts from the living took place with the most excruciating pain, and a sensation resembling that produced by the direct application of fire. This sensation was sometimes intermittent; and, in other instances, it was succeeded by an equally harassing sensation of cold.

According to Bassau, surgeon to the hospital of St. Antoine, in Dauphiny, the cases which he saw were not all of the dry kind, the limb sometimes becoming putrid, and maggots being generated. He says, that the disease was not infectious, and it attacked indiscriminately men, women, and children.

The degree of fatality, caused by this species of mortification, seems to have been extremely various. In the *Memoirs of the Royal Academy of Sciences* for 1748, M. Duhamel mentions, that of 120 persons afflicted, scarcely four or five recovered with their lives. According to Langius, it was equally fatal in Switzerland.

Dr. Thomson believes that the preceding sort of gangrene has never occurred in this country, excepting, perhaps, the cases recorded by Dr. Charlton Woolaston, in the *Phil. Trans.* for 1762; and which proceeded from eating unsound wheat, not rye. (See *On Inflammation*, p. 548.)

Dr. Carswell said, that "all the local changes appear to be produced as direct consequences of the spurred rye, acting through the medium of the blood, or nervous system, or both at the same time; for, we have seen, that the dead parts are separated without hemorrhage, and it is stated, that the blood, when taken from a vein, is dark, and so very thick that it only oozes out from the orifice of the wound." (See *Illustrations of the Elem. Forms of Disease*, Fasc. 7.)

The external causes of mortification, which are manifest, and act mechanically, or chemically, are burns; excessive cold; the application of caustics;

the presence of any ichorous, urinary, or fecal matter effused in the cellular substance; violent contusions, such as are produced by gunshot wounds, or bad fractures; the strangulation of a part, as in cases of hernia, or when polypi, or other tumours are tied; a high degree of inflammation; and lastly, everything that has the power of stopping the circulation and nervous energy in parts. (*Lassus, Pathologie Chir. t. i. pp. 34, 35.*)

[To these must be added long continued pressure, as of the child's head in protracted labour on the meatus urinarius; or of a comatose or fever patient on the skin of the buttocks or hips. But few traumatic causes are equal in importance to interference with the main artery or vein of a limb; such as wounds or ruptures of arteries, ligature, aneurism, and every idiopathic mode of obstruction, such, for example, as embolism. (See *infra.*) Circumstances which hinder the return of venous blood are of equal force. The effect of injuries, and of irritation of the nerves, in producing mortification has been discussed in the article INFLAMMATION.]

*Inflammation is one of the most frequent causes of mortification.* But, as I have already remarked, the death of a part may take place without previous inflammatory disorder; and the latter, even when present, is, in reality, only an effect of the very same cause which produces the sphacelus itself. It is often a matter of doubt whether actual inflammation precedes the occurrence or not; for a part, before it mortifies, is in certain instances only affected with pain, and with no degree of preternatural redness. [The most correct way of putting the matter, is to drop the use of abstract Latinized terms, and use concrete English ones; and to say that a part injured, but not killed outright, often inflames before it mortifies; and that the inflammatory swelling and exudation tend to interrupt the circulation, and to destroy the remains of vitality.]

Mr. James enumerates the following circumstances, as capable of influencing, in a very great degree, the disposition of inflammation to terminate in mortification: 1. The powers of the part, in which the inflammation occurs, being naturally weak, as in fibrous membranes, the scrotum, &c. 2. The remote supply of blood, or nervous energy, as in the lower extremities. 3. Obstruction to the return of blood. 4. To the supply of blood. 5. Disease in the heart, or vessels. 6. Debility from age, habits of life, disorder of the digestive organs, or fever. 7. Poor living, foul air, improper food, scurvy, &c. 8. Impairment of organization from external injury. 9. Of the nervous power by poisons. 10. Undue excitement of weakened parts. 11. Depressing remedies. 12. Pressure and tension. 13. Excessive violence of inflammatory action. 14. Peculiar disposition in the constitution. (*James on Inflammation, p. 102.*)

With the exception of carbuncles and boils, which are essentially gangrenous diseases, phlegmonous erysipelas is, of all inflammatory complaints, that which most frequently terminates in gangrene. It demands early free incisions, when the cellular tissue is threatened with gangrene, or is actually gangrenous.

The symptoms of mortification from inflammation take place variously, yet generally as follows:—The pain and sympathetic fever suddenly diminish, the part affected generally becomes soft, and of a livid colour, losing, at the

same time, more or less of its natural warmth and sensibility. In some places, the cuticle is detached; while, in other situations, vesicles arise, filled with a clear or turbid fluid. Such is the state to which we apply the term *gangrene*, and which state of the disorder too often rapidly advances to *sphacelus*, when the part becomes a cold, black, fibrous, senseless substance, called in technical language a *slough*.

It merits notice, that, "in cases, in which gangrene immediately succeeds inflammation, these two morbid states may, in some measure, be regarded as stages, or periods, of the same disease. They pass insensibly into one another; nor is it possible to say precisely where the one state ends, and the other commences. The symptoms of inflammation, in these cases, do not disappear before those of gangrene come on; but seem rather to undergo a gradual and almost imperceptible change, or conversion, into one another. *The redness acquires a deeper tinge, and spreads farther, than formerly; the swelling increases and becomes more doughy; and, in this incipient stage, the gangrene, particularly when it attacks the cutaneous texture, often bears a considerable resemblance to erysipelas.*" It is to be observed, also, that "the part of the body, which becomes affected with gangrene, *does not immediately lose its sensibility*, for the pain, on the contrary, is often very much aggravated by the approach of this state. *The blood also still continues to circulate, at least, in the larger vessels of the part, but perhaps, with less force; and from the resistance which it meets with in passing through the capillaries, in less quantity than formerly.* The serous effusion into the cellular membrane continuing to increase, and the action of the absorbent and sanguiferous vessels to diminish, the part becomes at length incapable of being restored to its former office in the animal economy. It is, therefore, in its earlier stages only, that gangrene is to be considered as an affection admitting of cure; for there are limits, beyond which, if it pass, recovery becomes impossible. These limits it may not, in every instance, be easy to define; but they form the boundaries between incipient gangrene and the ultimate termination of that state in sphacelus." (*Thomson on Inflammation, pp. 506, 507.*)

Dr. Carswell observes, that when the "modifications of colour, consistence, temperature, and sensibility continue to increase, and terminate in sphacelus; the part affected assumes a still deeper tint, or becomes of a dirty brown, or black, colour, sometimes grey, greyish, yellow, or greenish. The vesicles, or phlyctenæ, become more numerous and larger, or the whole of the epidermis, covering the sphacelated part, may be completely separated, raised in the form of a large blister filled with bloody serum, or ruptured and lying in wrinkles on the denuded and discoloured cutis. The skin and cellular tissue, beneath the epidermis, are swollen and puffy, and crepitate when pressed; or they are soft, flaccid, and cold; and may be cut, pinched, or otherwise stimulated without pain, or feeling of any kind being induced; and lastly, the sphacelated part emits a strong cadaverous odour. When these latter appearances present themselves, but more particularly when the peculiar odour of gangrene is perceived, they may be regarded as positive signs, not only of complete death of the part to a certain depth, but also that putrefaction has already taken place. The local emphysema, and



fetor of putrefaction, produced during life, constitute, therefore, signs of great value in mortification. Their absence, however, furnishes no proof, that local death may not have taken place; for putrefaction, or chemical decomposition, of an organ may not follow as the consequence of the cessation of those powers, by means of which it was enabled to resist the injurious influence of external agents, until some time have elapsed, the length of which will depend on various circumstances, but more especially on the quantity of fluids contained in the affected organ, and the degree of temperature to which it is exposed." (See *Carswell, in Elem. Forms of Disease, Fasc. 7.*) The state of the blood and vascular system in mortification from inflammation has been elsewhere described. (See **INFLAMMATION.**)

*Mortification often arises from a mechanical obstacle to the circulation of the blood.* Thus the blood may be hindered from arriving at, or returning from, the part. "In both cases, mortification is the consequence of the cessation of the function of nutrition, either from a deficiency of the arterial or the stagnation of the venous blood. A deficiency of the arterial blood may be occasioned by ligature of the principal artery of a limb; by coagulated blood; organized, or unorganized fibrine, occupying the entire calibre of such an artery, or its larger branches; by ossification of the walls of these vessels: or their conversion into a solid fibrous, or ligamentous, tissue." (*Carswell, op. cit.*)

*The causes which produce mortification by impeding the return of blood from the part affected* for the most part operate by making pressure on the trunk, or principal branches of a vein. In these instances there is always an accumulation of blood in the part, which first swells, becomes of a dark livid colour, tense, and very painful. Soon afterwards, vesicles arise, and the part becomes soft, œdematous, cold, insensible, emphysematous, black, and fetid. Such are the circumstances which happen in strangulated hernia, in tied polypi, and in a limb in which the veins have been so compressed by any hard swelling, such as the head of a dislocated bone, as to excite mortification. In hernia the bowel assumes a dark brown, and sometimes nearly a black, colour, from stagnation of the venous blood.

Mortification from a mechanical obstacle to the return of the venous blood is not only well exemplified in strangulated hernia, but also in intussusception of the intestines. "When the superior portion of the intestine passes into the inferior, it carries along with it that part of the mesentery to which it is attached. If it does not suffer much compression, the invaginating process may go on to a great extent; but, if it is compressed to such a degree that the return of the venous blood is obstructed, this stage of the disease is arrested on account of the congestion of all the tunics of the invaginated portion. The congestion is not the consequence of inflammation; it is produced by compression, and in the following manner: when the mesentery is put on the stretch, by the descent of the superior into the inferior portion of the intestine, the veins belonging to it are compressed between the walls of both portions, just at the point where the invagination terminates superiorly. If adhesive inflammation take place at this point, the peritoneal surface of both portions becomes united, and the veins obliterated. As the arteries

are much less affected by pressure than the veins, they continue to pour their blood into the invaginated portion. This fluid accumulates, and produces an extreme degree of congestion of the mucous and submucous coats, giving to them a deep red, or almost black colour." From gangrene, the disease may advance to sphacelus of the whole of the invaginated portion, which may be discharged in the form of irregular shreds, of a dirty ash-grey, brown, or black colour. (See *Carswell's Elem. Form of Disease, Fasc. 7.*) In the same invaluable work will be found perhaps the best description yet extant, of another variety of mortification from impediment to the venous circulation, depending upon disease of the heart, and manifested in the lower extremities. It begins with slight œdema round the ankles, and afterwards the serosity becomes more widely and deeply diffused; the feet, legs, and thighs becoming swollen, and the skin smooth and pale. When discoloration of the skin takes place, it depends on the presence of subcutaneous veins, which increase in bulk and number, coalesce at several points, and communicate a slightly mottled aspect to the limb, of a dull red or purple colour. On one or more of these points, where the congestion is greatest, phlyctenæ or large bullæ are formed, and when these burst, the subjacent cutis presents a dark red or brown colour, and is soon converted into a dirty yellow, or ash-grey slough. The separation of the slough is sometimes preceded by an increase of redness in the surrounding cutis, which is obviously of an inflammatory nature. In other instances this redness is very slight, and plainly owing to venous congestion. The quantity of serosity effused causes by its pressure further obstruction to the venous circulation, and in the early stage conceals the venous congestion itself. (See *Carswell, op. cit. Fasc. 7.*)

*Other causes operate by preventing the entrance of arterial blood.* The application of a ligature to an artery, as practised in various surgical cases, and all external pressure that closes the artery, or arteries, on which a part entirely depends for its supply of blood, have this effect. Mortification does not, however, always take place when the trunk of an artery is rendered impervious, because nature furnishes the necessary supply of blood through collateral ramifications. But, when the disorder does happen, the part commonly first affected becomes pale, flaccid, and cold, and soon afterward shrinks, loses its sensibility, grows black, and perishes.

It has sometimes been observed, that the pulse has been suddenly and permanently lost in one part of the body, while it has continued to be distinct in other parts; and, in some cases of this kind, on examination after death, it has been found that an obliteration had taken place of a portion of the tube of the artery, in which the pulse could not be felt during life. The late professor John W. Turner first drew attention to this subject by the publication of a series of interesting examples of it. In one of these cases, after the brachial artery had become suddenly obstructed, followed by loss of the pulse, a similar change occurred in one of the popliteal arteries, and mortification of the leg, terminating fatally, was the consequence. After death, the brachial artery at the elbow was found embedded in a hardened mass, composed of the surrounding cellular tissue, veins, and nerves.

which adhered firmly to one another and to the artery. When the last was slit open, it was found to be impervious, immediately before dividing into the radial and ulnar branches. At this part, it was much contracted and filled with a cylindrical clot of firm lymph, which adhered firmly to its inner surface. The orifice of a large branch was situated immediately above this clot. The radial and ulnar arteries were also obstructed at their commencement. The coats of the arteries in the obstructed places were hard, thickened, and of a whiter colour than natural. In the popliteal artery, an ovoid sac was formed, filled with solid lymph, and directly above it the artery was obliterated to the extent of half an inch. For some way below it, the vessel was also blocked up with lymph. The inner layers of the sac consisted of the coats of the artery, with the exception of the internal one, which had disappeared. After detailing several other interesting particulars, Professor Turner adds, "The obstruction to the supply of blood to the leg produced important effects on the functions of the nerves of the foot; for it was ascertained very soon after that the skin of the foot was insensible, and apparently the muscles had lost their power of contracting. At the same time a burning pain, and feeling as if crushed, were induced in the foot. The progress and appearances of mortification, from sudden deficient circulation, were well exhibited. They seem to confirm the opinion, that even in mortification from deficient circulation, a certain degree of re-action, or inflammation, precedes the complete death of the part, as was shown by the vascular congestion, the swelling, the increase of heat, and the tense vesications, which took place on foot and leg." (See *Edinb. Med. Chir. Trans.* vol. iii. p. 105.) This paper is remarkably valuable, as containing a true explanation of the circumstances which prevent lacerated arteries from bleeding; a subject, according to Dr. J. Thomson (*On Inflammation*, p. 512), first noticed by Dr. Jones, and, as Professor Turner proves, still more completely described by Hodgson and Beclard. (See *Additions à l'Anatomie Gén. de X. Bichat*, p. 95.)

It would appear that, in the case recorded by Professor Turner, the arteries became permanently and suddenly obstructed from laceration of their inner coats. In most of these instances, he observes, it seems necessary to suppose some predisposition in the coats of the arteries to laceration, as this took place in the ordinary motions of the limbs, and affected different arteries of the same individual. In some cases, marks of disease in the arteries were conspicuous; but, in others, no evidence of this kind was apparent. In several a considerable degree of constitutional affection and fever preceded and accompanied the obstruction of the arteries. When the obstruction takes place, the lower part of the limb may yet receive sufficient blood by the anastomoses, as happened in several of the cases published by Turner; but, in five others, mortification was the result. In one, the patient was greatly debilitated by previous illness.

In some cases of fracture, mortification proceeds not simply from the interruption of the course of the blood through the principal artery or arteries, but is promoted by great violence done to the limb, and in particular by the injection and distension of the cellular tissue with effused blood. No doubt

all these causes operated in the fatal example of mortification which followed a fracture of the thigh, attended with laceration of the femoral artery, as related by Sir A. Cooper in his *Lectures* as well as in the example, recorded by me, of gangrene of the leg, from the rupture of an aneurism in the deeper part of the ham. (See *Med. Chir. Trans.* vol. xvii.)

Among the causes of the present species of mortification, may also be mentioned: great debility, extreme old age, a thickening and ossification of the coats of the arteries, and a consequent diminution of their capacity, and of their muscular and elastic power.

Cowper, the anatomist, was one of the earliest writers who took notice of this ossification of the arteries of the leg, in persons who had died of mortification of the feet and toes. (See *Phil. Trans.* vol. xxiii. p. 1195, and vol. xxiv. p. 1970.) A similar case was remarked by Mr. Becket, of which he has given an account in his *Chirurgical Observations*. The occurrence was also mentioned by Naish. (See *Phil. Trans.* vol. xxxi. p. 226.) Dr. J. Thomson has seen one example of a very complete ossification of the arteries of the leg, accompanying a mortification of the feet and toes. (*On Inflammation*, p. 537.) Speaking of the same subject, Mr. Hodgson remarks: "Experience has proved this condition of the arteries to be at least a constant attendant upon one species of gangrene, to which the extremities of old subjects are liable; and I have found the three principal arteries of the leg nearly obliterated by calcareous matter in two fatal cases of this disease. But our knowledge of the power of collateral circulation in every part of the body will not allow us to admit the obliteration of the trunks as a sufficient cause of mortification, from a deficient supply of blood. It is therefore necessary for us to remember, that the same disease may probably exist in the collateral branches, upon which it has produced similar effects. But if an extent of vessel be converted into a calcareous cylinder, it loses its elasticity and organic powers, so as to be unable to afford any assistance to the propulsion of the blood; and the existence of parts, supplied by vessels in this state, constitutes a strong argument against the agency of the arteries in the circulation of the blood. The above observations, on the cause of this species of gangrene, at once expose its incurable nature; and this state of the blood vessels renders the danger of amputation very considerable, unless fortunately the disease in the arteries does not extend to the part, at which the ligature is applied." (See *Hodgson on Disease of the Arteries and Veins*, p. 41.) However, although the ossified state of an artery must certainly be unfavourable to its healing, it does not constantly prevent this desirable event. (See case in *Medico-Chir. Trans.* vol. vi. p. 193.)

True, mere ossification of arteries will not cause mortification. There must either be at the same time obstruction of them with fibrine or other matter; or great constitutional debility, and a languid circulation; or some organic changes, interrupting the free passage of the blood through the heart, or at a point near the source of the circulation, or through the trunk of the artery leading to the mortified parts. As Cruveilhier remarks, the obliteration of the arteries in a degree adequate to interrupt the supply of arterial blood to the part, is



the essential condition; and hence, instead of calling the disorder *gangræna senilis*, or *spontaneous gangrene*, he thinks it would be better to call it *gangrene from obliteration of the arteries*. Several years ago he adopted the doctrine, that ossification of the small arteries is a cause of *gangræna senilis*. (*Essai sur l'Anat. Pathol.* t. ii. p. 57, 8vo. Paris, 1816.) He joins Dupuytren, however, in regarding arteritis as the most usual cause of this species of mortification; but adds, that neither arteritis, nor ossification of the arteries, will bring on the disorder, unless the course of the blood be completely intercepted by it. In two interesting cases reported by him, some of the arteries of the leg were blocked up with lymph, and calcareous deposits found extending even to the small ramifications of them. (*See Anat. Pathol.* livr. xxvii. fol. Paris, 1816.)

"Nothing (remarks M. Cruveilhier) is more subject to variety, than the extent of obliteration in gangrene from arteritis. Thus, in a case communicated to the Anatomical Society by M. Maisonneuve, the lower part of the aorta, the common iliac arteries, and the external and internal iliac, the popliteal, tibial, and fibular, were completely obliterated, and yet the mortification was exceedingly limited. In another instance recorded in this work (*Anat. Pathol.* livr. xxxii.), the obliteration was restricted to the posterior tibial and fibular arteries, the anterior tibial being quite pervious. How does it happen, that though the anterior tibial was free, the circulation in the posterior tibial and fibular arteries was not re-established? For this plain reason: the means of communication between these different orders of vessels were intercepted. Had the posterior tibial and fibular arteries themselves been pervious, gangrene would have taken place not the less from the obliteration of the small arterial divisions. Obliteration of the small arteries is inherent in spontaneous gangrene: the obliteration of the larger ones is only an accessory circumstance. If the published cases of *gangræna senilis* or spontaneous mortification be read, not two of them will correspond in respect to the extent of the obliteration of the large arteries. Thus, in the case above cited, the end of the aorta, and the two common iliac arteries, were obstructed with clots, and yet the mortification was confined to some of the toes of one limb. In other examples, the great and middle-sized arteries are perfectly free; but as numerous lesser ones are obliterated, the mortification is very extensive. Sometimes the clots are very dense, and their loss of colour, and intimate adhesion to the sides of the artery, prove their long standing; while in other instances, clots so recent are met with in the great arteries, that they cannot be looked upon as the cause of the disease, but as produced in the final stage of it, and perhaps in the last moments of life." Cruveilhier considers the acute pain experienced in the artery some time previously to the appearance of spontaneous gangrene, and the hardness of the vessel, which feels to the finger like a tense cord, as proofs that the clot precedes the mortification. He takes this same pain as an argument, that the obliteration of the vessels is the result of inflammation. (*Anat. Pathol.* livr. xxvii. fol. Paris, 1836.)

[Acute pain is felt in the arteries when suddenly obstructed, or when irritating substances are injected into them.]

In every case of *gangræna senilis*, which Professor Carswell has examined after death, the arteries of the limb were obliterated to such an extent as to interrupt the circulation of the blood. The obstructing cause consisted, in five or six cases, of a fibrous tissue, found either in the walls, or cavities of the arteries, and which had converted these vessels into nearly solid cords of ligamentous consistence. This state was traced from the toes more than half way up the leg: it was always connected with ossification of the larger branches and trunks of the thigh, and other parts of the body. In two other cases, the obstruction depended on extensive ossification of the principal arteries of the limb; and, in several others, it was produced by solid fibrine formed around spicula of bone, projecting from the internal surface of the arteries. Connecting these states of the arteries with the external appearances of the mortification, there cannot, as Dr. Carswell conceives, remain a doubt, that this form of the disease is the immediate consequence of a deficient supply of arterial blood, from a mere mechanical obstacle to the circulation of this fluid.

Professor Carswell does not adopt, however, the view advanced by Dupuytren (see *Clin. Chir.* t. iv.), and espoused by Cruveilhier, that the mortification originates from arteritis. "For the presence of fibrous, fibro-cartilaginous, and osseous tissue in the arteries is no proof that inflammation had ever existed in these vessels." (*See Carswell's Illustrations of the Elem. Forms of Disease*, Fasc. 7.)

[Degeneration and embolism take the place in modern nomenclature of what used to be called arteritis.]

Fabricius Hildanus mentions a fatal case of mortification of the feet and legs, where the patient was in the vigour of life, and apparently of good constitution. After death, a scirrhous tumor was found surrounding and compressing the inferior vena cava and aorta, near their bifurcation, so as to prevent the free circulation of the blood in the lower extremities. Mortification of the extremities also sometimes occurs from deficient circulation, in the progress of diseases of the heart. In a case of dropsy of the chest, Sir A. Cooper has seen a small spot on the leg become all at once black, without any appearance of inflammation.

[The theory of embolism may be very briefly stated. When the blood coagulates in any of the veins (thrombosis), a portion of such clot may be displaced, and carried around in the venous circulation, to the right side of the heart. It depends on its size whether it stops in the right side of the heart, or in the pulmonary artery, or one of its large branches, or whether it passes on and is arrested in some smaller vessel in the lungs. The effect will vary from sudden death, to pulmonary gangrene, or inflammation of one or more portions of lung. (*See Inflammation, Causes of.*) If the clot were in one of the mesenteric systems of veins, it will be arrested in some branch of the *vena portæ*, and produce disease of the liver. Small portions of clot, or fibrine, detached from the walls of the left side of the heart, may be carried to and lodge in the arteries of any organ or member; producing softening and paralysis if in the brain; amaurosis, or destructive suppurate of the eye; fibrinous deposit in

the kidney; and, more especially, gangrene of the extremities, if the clot happen to lodge in one of their arteries. Gangrene will be infinitely more liable to happen if the arterial obstruction occur to a patient whose arteries are already diseased, or whose vital forces are weakened by any cause. *Intense pain* in the course of the obstructed vessel is a frequent symptom of embolism.

Cohn, *Klinik der embolischen Gefässkrankheiten*, Berlin, 1860; Dr. Kirkes on *Detachment of Fibrinous Deposits from Heart*, &c., *Med. Chir. Trans.* vol. xxxv. Edward Crisp on the *Arteries*, London, 1847; *Pathological Catalogue of R. College of Surgeons*, vol. iii.]

*Senile gangrene* was first described by Pott. It is very unlike the mortification from inflammation, that from external cold, from ligature, or bandage, or from any ordinary cause, and this as well in its attack as in its progress. In some few instances, it makes its appearance with little or no pain; but, in the majority of the cases, the patients feel great uneasiness through the whole foot and joint of the ankle, particularly in the night, even before these parts show any mark of distemper, or before there is any other than a small discolored spot on the end of one of the little toes. It generally makes its first appearance on the inside, or at the extremity, of one of the smaller toes, by a small black or bluish spot; from this spot the cuticle is always found to be detached, and the skin under it to be of a dark red colour. If the patient has lately cut his nails or corns, it is most frequently, though very unjustly, ascribed to such operation. In some patients, it is slow and long in passing from toe to toe, and from thence to the foot and ankle; in others, its progress is rapid, and horribly painful: it generally begins on the inside of the small toe, before it is visible either on its under or upper part; and when it makes its attack on the foot, the upper part of it first shows its distempered state by tumefaction, change of colour, and sometimes by vesication; but wherever it is, one of the first marks of it is a separation or detachment of the cuticle.

The progress of this variety of mortification is denoted beforehand by uneasiness, numbness, and a remarkable coldness and paleness of the part. Phlyctenæ often form, and underneath them is a slough; but on other occasions there are none, and then black spots suddenly appear, and are converted into sloughs; the sensibility of the parts is lost, and a shrivelling, drying, and mummification of them ensues, in proportion as the disorder invades the toes or fingers. (See *Dupuytren, Chir.* t. iv. p. 493.) The mention of the fingers reminds me that, though this species of mortification is only described by Pott as seated in the lower extremities, I have seen it attack the upper; and one remarkable example of this occurred about three years ago, in an old woman under Mr. Liston, in University College Hospital. A line of demarcation was formed a little below the axilla, and the living soft parts having separated from the dead down to the bone, the latter was sawn through, the stump healed up, and the patient recovered. Other examples of spontaneous gangrene of the upper limbs, are given by Dupuytren and Cruveilhier.

It is very certain, that, in many of these cases, the pulse becomes imperceptible, or ceases entirely, while, in the course of the artery, a hard round cord is felt; and, by the cessation in the

pulsations, and the ascent of the cord up the limb, the progress and limits of the mischief may be calculated. Dupuytren declares, that this chronic form of mortification is not essentially connected either with old age, or ossification of the arteries. In its commencement, it appears to him to be sometimes quite a local affection; the respiration, circulation, intellectual and digestive functions, being all carried on at first with regularity. He admits, however, that hard drinking and disease of the valves of the heart are generally concerned as exciting causes of arteritis; and that such arteritis may take place, producing coagulation of the blood, and obstruction in the diseased arteries of old subjects, as well as in the sound ones of young persons. (See *Dupuytren, Op. et vol. cit.* p. 492.)

Even when the whole of the foot has mortified, and all below the upper third of the leg is intensely cold, the motions of the ankle are performed, which, as Dupuytren observes, is explicable by the fact, that most of the muscles of the foot ascend to the neighbourhood of the knee, a point to which the disorder has not yet reached.

For one female, in whom Pott had met with this form of mortification, he had seen it in at least twenty males. He had much more often found it in the rich and voluptuous, than in the labouring poor; more often in great eaters, than free drinkers. It frequently happens to persons advanced in life, but it is by no means peculiar to old age.

Many instances of this species of gangrene in females are now upon record. Dupuytren adverts to its occurrence in children only ten years old, and in women of twenty and forty. The particulars of some of these cases are also given by him. (See *Leçons Orales*, &c. t. iv. p. 485.) Other instances of it in females are described by Cruveilhier. (*Anat. Pathol.* t. ii. livr. xxvii.) I attended the late Mrs. W., of Guildford-street, for this species of mortification, which proved fatal to her. In this instance, it began on the heel, and extended so slowly, that it had not reached further than the ankle at the end of nine months, when the lady died. Sir B. Brodie saw this patient, with me, about a fortnight previous to her death. There is great variety, then, in the rate at which this gangrene advances. Cruveilhier relates one case in which the patient lived nearly a year with it. Mrs. W., whom I attended, lived nine months; a gentleman whom I attended in Gray's Inn, with Mr. Hughes, of Holborn, lived about six weeks; and another patient whom I attended, with Mr. Baker, of Staines, was destroyed by it in ten days; the disorder, in this short time, having reached from the toes some way up the leg.

[*Gouty Degeneration of Arteries*.—Sir Benjamin Brodie, like Pott, denies that gangrene from degeneration of arteries is, as might have been supposed *a priori*, the especial malady of persons in the lower ranks of life, subsisting by their daily labour, and undergoing all kinds of privations. On the contrary, he affirms it to be one of the many penalties paid by persons who enjoy ease and affluence, and who live luxuriously; and more especially by those who neglect exercise, and take too much animal food and fermented liquors. (*Brodie's Works*, by C. Hawkins, vol. iii. p. 377.) This accords with what is known of the tendency of the gouty to imperfect metamorphosis of the fibrous tissues, to atheromatous degeneration of the



arteries, aneurism, &c. See *Professor Laycock's Lectures, Med. Times, & Gaz.* 1861, vol. i. p. 153.]

*Mortification arising from long continuance in the same posture*, is chiefly attributable to debility and the unremitted pressure which parts sustain, and which obstructs the circulation. Surgeons have frequent occasion to see melancholy examples of this kind of mortification, particularly in cases of fractures, paralysis from disease of the vertebræ, injuries of the spine or pelvis, &c. The mischief most readily occurs where the bones have the least flesh upon them, and, consequently, where all external pressure has the greatest effect; as, for instance, about the os sacrum, os ilium, spines of the scapulæ, &c. The disordered part first becomes soft, livid, red at the circumference, and œdematous, afterwards losing its sensibility, and acquiring a black appearance; at length, it is converted into a foul sloughing ulcer.

Dr. Carswell describes a local accumulation of blood as constituting in general the first perceptible change. "The blood accumulates partly from the influence of gravitation, and partly from compression of the veins; as, for example, in mortification of the soft parts covering the sacrum, heels, elbows, &c. of persons recovering from typhoid fevers and who are left in that state of prostration which precludes the possibility of changing the position of the body. It is, perhaps, still more conspicuous in some patients similarly confined with paraplegia from injury of the spinal cord." (See *Carswell's Illustrations, &c., Fasc. 7.*)

Though long continuance in the same posture is the grand cause of this kind of mortification, yet incidental circumstances are frequently combined with it, and have great influence over the disorder. These are, great debility, fever, impure air, unclean bedding, &c. According to Sir A. Cooper, some fevers have a greater tendency than others to produce gangrene, as is the case with scarlatina. In slight cases of this disorder, he says, the most horrible effects will sometimes arise from gangrene. The tonsils will slough to a great extent; parts of the Eustachian tube, and even the tympanum, will separate, and large portions of bone exfoliate. He also adverts to the dangerous sloughing frequently brought on in the measles by the application of large blisters to the chests of children, and points out the disposition to sloughing occasioned by the immoderate use of mercury, or by whatever tends to weaken the constitution.

There are some causes which produce death in a part at once, by the violence of their operation. A very powerful blow on any portion of the body may destroy its vitality in this sudden manner. Lightning, strong concentrated acids, alkalies, arsenic, and other mineral poisons, and gunshot violence, sometimes act in a similar way.

Cold is often another cause of mortification, and, when parts which have been frozen, or frost-bitten, are suddenly warmed, they are particularly apt to slough.

I find in Baron Larrey's valuable publication, some interesting observations on the gangrene from cold. He acquaints us, that after the battle of Eylau, one of the most grievous events to which the French soldiers were exposed was the freezing of their feet, toes, noses, and ears: few of the vanguard escaped the affliction. In some, the mortification was confined to the surface of

the integuments of the toes or heels; in some, the skin mortified more deeply, and to a greater or lesser extent; while, in others, the whole of the toes, or foot, was destroyed. (See *Programma quo frigoris acrioris in corpore humano effectus expendit.—Haller, Disp. ad Morb. Leips.* 1775.)

"All the writers on this species of mortification (says Larrey) have considered cold as the determining cause; but, if we attend to the period when the complaint begins, and the phenomena which accompany it, we shall be convinced that cold is merely the predisposing cause. In fact, during the three or four exceedingly cold days which preceded the battle of Eylau (the mercury having then fallen to 10, 11, 12, 13, 14, and 15 degrees below zero of Reaumur's thermometer), and until the second day after the battle, not a soldier complained of any symptom depending upon the freezing of parts. Nevertheless, they had passed these days, and a great portion of the nights of the 5th, 6th, 7th, 8th, and 9th of February, in the snow and the most severe frost. The imperial guard especially had remained upon watch in the snow, hardly moving at all for more than four-and-twenty hours, yet no soldier presented himself at the ambulance, nor did any one complain of his feet being frozen. In the night of the 9th and 10th of February, the temperature suddenly rose, the mercury ascending to 3, 4, and 5 degrees above zero. A great quantity of sleet, that fell on the morning of the 10th, was the forerunner of the thaw which took place in the course of that day, and continued in the same degree for several days. From this moment, many soldiers of the guards and the line applied for succour, complaining of acute pain in the feet, and numbness, heaviness, and prickings in the extremities. The parts were scarcely swollen, and of an obscure red colour. In some cases, a slight redness was perceptible about the roots of the toes, and on the back of the foot. In others, the toes were destitute of motion, sensibility, and warmth, being already black, and, as it were, dried. All the patients assured me, that they had not experienced any painful sensation during the severe cold to which they had been exposed on the night watches of the 5th, 6th, 7th, 8th, and 9th of February, and that it was not till the night of the 10th, when the temperature had risen about 18 or 20 degrees, that they felt the first effects of the cold." It is further noticed by Larrey, that such patients as had opportunities of warming themselves in the town, or at the fires of the night watches, suffered in the greatest degree. (See *Mémoires de Chirurgie Militaire*, t. iii. pp. 60—62.)

There is little doubt but that dry cold applied continuously to the feet may induce gangrene; usually, however, it is the sudden rise of temperature and the damp, which is an accompaniment. Exposure to severe cold, especially with wind, produces frost-bite—a condition of local syncope—the part being cold, pallid, and pulseless, without circulation; but it may really be restored, if the process be accomplished gradually. There is no doubt but that a part may be really frozen and recover. An instance of this may be found in the process of congelation, as a mode of anæsthesia. The gums of persons who have been submitted to congelation for the purpose of painless tooth-drawing, though quite frozen, soon recover.

*Mortification from debility, loss of blood, &c.*—A generally ill-nourished state of body, whether from privation, exposure, or disease, is a most efficient predisposing cause of mortification, especially if, with deficient and unhealthy blood, there be super-added some injury of enfeebled parts. Sometimes some circumstance causing great general debility at once induces mortification of the extremities. Thus Sir B. Brodie narrates how a drunken man got a chemist more drunk than himself to bleed him to three pints; next day both feet were found mortified as high as the instep. The patient recovered with the help of wine and nourishment. (*Brodie's Lectures on Mortification, ib.*)

In the article HOSPITAL GANGRENE will be found the differences between that affection and true mortification.

*Mortification in different textures.*—The *Cutaneous Texture* is that in which we have the best opportunity of observing the phenomena and progress of gangrene. When it occurs as a consequence of inflammation, the colour of the skin changes from the florid red to a darker shade; and in the progress of the disease it acquires a livid hue. The cuticle often separates at certain points from the skin, and the vesications, termed *phlyctenæ*, are formed, which usually contain a bloody-coloured serum. As sphacelus comes on, the livid hue disappears, and a slough is formed which is sometimes ash-coloured, sometimes black. It is not always easy to judge of the extent of mortification from the appearance of the skin; for when the subjacent cellular tissue is affected, the disorder may occupy a greater extent internally, than upon the surface.

In a spreading gangrene, the red colour of the affected skin is insensibly lost in the surrounding integuments; but when gangrene, followed by sphacelus, stops, a red line, of a colour more lively than that of gangrene, is generally perceptible between the dead and living parts. It is at the inner edge of this inflamed line where we usually see the ulcerating process begin, by which the separation of the dead from the living parts is effected. (See *Thomson on Inflammation*, pp. 511, 512.)

The red line appears in the form of a narrow circle, indicating the boundary between the dead and living parts, and the commencement of the adhesive inflammation, which nature employs to stop the progress of the disorder. Ulceration then takes place along the internal border of the inflamed skin, and a separation is thereby effected between the living and dead tissues, the latter falling off in the form of what is termed a *slough*. A groove is first formed on the surface, and, advanced by degrees more and more deeply, at length accomplishes the perfect separation.

Mortification of the skin may be caused by all the external injuries which have been enumerated. It may be caused especially by such conditions as cause distention, or infiltration, of the areolar tissue, so as to stretch the superimposed skin, and hinder its circulation simply. [More especially will this be the case if the areolar tissue be itself gangrenous, whether through the injection of irritant fluids, as in a bungling operation for hydrocele, or through some of the causes to be presently detailed. The most frequent causes of gangrene of the skin, and the most important in civil practice, are the sloughing of small portions of ill-conditioned, dirty and

irritated skin on the small of the leg, especially of the lower orders, and of persons whose veins are varicosed. These lay the foundation of the well-known obstinate ulcers.]

Mortification frequently takes place in *cellular texture*. The skin, covering dead cellular tissue, generally has a dark red or livid appearance, and may afterwards either ulcerate or slough,—as is so often exemplified in phlegmonous erysipelas of the lower extremities. But, besides the *diffuse* form of gangrene and sphacelus of the subcutaneous tissue, there is a circumscribed form, which is observed in furunculus and carbuncle. "The great accumulation of blood, and the still greater and rapid effusion of serosity, which takes place in these circumscribed acute inflammatory affections, produce a state of extreme induration of the cellular tissue, a greater or lesser portion of which being thus, as it were, strangulated, dies from want of nutrition, becomes separated from the living parts, and is expelled in the form of a grey or straw-coloured spongy or pulpy mass, through an opening made in the skin by a similar process, or a surgical operation." (See *Curswell's Illustrations of the Elem. Forms of Disease, Fasc. 7.*) In erysipelas phlegmonoides, the cellular tissue connecting the muscles, tendons, nerves, blood-vessels, &c. often perishes to a great extent. Here large portions of skin are frequently destroyed by sloughing or ulceration, so that muscle, blood-vessel, tendon, nerve, &c. are exposed to view, quite denuded of their proper coverings, and in different states of disease. In truth, the cellular tissue is not only more frequently the seat of mortification, but it is also more extensively and more rapidly destroyed by it, than any other tissue of the body. This fact is important to be remembered in the operation of amputation, when called for by mortification, because it dictates the prudence of beginning the incision higher up than the mere appearance of the skin would indicate.

The cellular tissue may slough from idiopathic disease, as carbuncle and erysipelas—from distention, as by œdema: from injection of irritant fluids, as urinary and fœcal abscess.

*Artery* is the texture endowed with the greatest power of resisting its own destruction by mortification. "I have (says Dr. Thomson) in various instances of erysipelas phlegmonoides, seen several inches of the femoral artery laid completely bare by the gangrene, ulceration, and sphacelus of the parts covering it, without its giving way before death. The arteries in these, and other similar instances, in which I have seen them laid bare in the neck and arm, by abscess terminating in mortification, had the appearance of raw flesh, and were obviously thicker and more vascular than natural. The blood circulated through them, and assisted in supplying with nourishment the parts upon which they were distributed." (P. 523.) I have often seen the truth of the foregoing statement plainly illustrated in cases of sloughing buboes, by which several inches of the femoral artery were exposed. I have seen the throbbing brachial artery denuded for more than a month, nearly its whole extent along the inside of the arm, by the ravages of malignant and phagedenic ulceration, attended with repeated sloughing; and yet hæmorrhage had no share in carrying off the unfortunate patient.

The blood coagulates in the large arteries which



lead to a mortified part. This occurrence takes place for some distance from the slough, and is the reason why the separation of a mortified limb is seldom followed by hæmorrhage.

The same occurrence also affords an explanation why, on the amputation of a mortified limb, there is sometimes no hæmorrhage from the vessels, although the incisions are made in the living part. This fact was first particularly pointed out by Petit, the surgeon. (See *Mémoire de l'Acad. des Sciences*, 1732.) "When a gangrened limb (says this celebrated surgeon) is cut off in the dead part, no hæmorrhage occurs, because the blood is coagulated a great way in the vessels." He adds, "We have several examples of limbs amputated, on account of gangrene, in which no hæmorrhage occurred, although the amputation was made a considerable way in the living parts; because the clot was not confined in these cases to the dead part, but was continued forwards into the living, as far as the inflammatory disposition extended."

According to Dr. Thomson, cases in confirmation of the foregoing statement are recorded by other practical writers, especially Quesnay and Mr. O'Halloran. In one of the cases, mentioned by the latter gentleman, and in which no hæmorrhage followed the removal of the limb, the incisions were made four inches above the division of the dead from the living parts. Dr. Thomson has seen a still longer portion of femoral artery closed up with coagulated blood, after a mortification of the foot and leg; and, in one example, where the mortification began in the thigh, he saw the coagulation of the blood in the external iliac, extending up to the origin of this vessel from the aorta.

Hæmorrhage in separation of a mortified part is usually found in the class of cases which come under the definition of Hospital gangrene, sloughing phagedæna, &c., or in which there is a defect in the healthy power of coagulation of the blood.

If hæmorrhage occur in mortification, the vessels, of course, must be pervious, and Dr. Carswell has found them filled with fluid, or imperfectly coagulated blood; and the cellular and other tissues pervaded by serosity, bloody serum, or puriform fluid.

For other examples of mortification of tissues, see BONE, NECROSIS, CANCER, CARBUNCLE, ERYSIPELAS, NOMA.

*Constitutional Symptoms.*—If gangrene and sphacelus happen to any extent, the patient is usually troubled with an oppressive hiccough; a symptom well known to the surgeon of experience, and often an indication of the mischief, when external signs are less instructive. The truth of this remark is frequently seen in strangulated hernia.

As Dr. Thomson observes, the constitutional state "is often accompanied with great uneasiness and restlessness, dejection of spirits, wildness of the looks; and, in severe cases, with almost always more or less delirium. In the progress of the disease, cold sweats, palpitations, and convulsions sometimes occur; a hiccough, accompanied with nausea, often comes on, and proves a most distressing symptom to the patient. Frequently this hiccough is the forerunner of death. Some patients die comatose; others, after suffering severe pains, spasms, and delirium. But, in some, a slow, in others a sudden, abatement of the constitutional symptoms takes place, accompanied also with the

amelioration of the local affection. The gangrenous inflammation stops and a red line is formed by the adhesive inflammation in the extreme verge of the living parts; the dead part separates, and granulations form; and when the constitution has strength to sustain the injury it has received, recovery takes place." (*On Inflammation*, p. 509.)

Sphacelus from extreme debility, or from such a state of the system as attends the scurvy, typhoid fevers, &c., is constantly perilous, because these causes are very difficult to remove. It is also a fact that, when numerous causes are combined, it is an unfavourable occurrence, not merely because the surgeon is apt to overlook some of them, but because there are in reality more obstacles to the cure.

Humid gangrenes, which are frequently accompanied with emphysema of the cellular tissue usually spread with great rapidity. (See *James on Inflammation*, p. 96.)

Sometimes a mortification spreads so slowly, that it does not occupy much extent at the end of several months, or even a whole year. A case is recorded by M. Le Groux (*Thèse*, 1827), where a man, aged 66, was attacked with gangræna senilis, which made such very slow progress that the patient did not die till the expiration of nearly a twelvemonth from the first attack on one of the toes. (See *Cruveilhier, Anat. Pathol. livr. xxvii.*) The case, however, is often not the less fatal on this account. The danger is never altogether over until the dead part has completely separated. The entrance of putrid matter into the circulation (says Richter) is so injurious that patients sometimes perish from this cause long after the mortification has ceased to spread. (*Anfangsg. der Wundarzn. b. i. kap. 3, pp. 78, 79.*)

[The constitutional effects of mortification seem to be compounded of those of feebleness and of poison. The presence of putrid matter in the blood is now proved in cases in which putrid sloughs are pent up. During the earlier part of the present century, the action of anything like blood poisoning was ignored. Thus continues our author.]

English surgeons entertain little apprehension of the bad effects of the absorption of putrid matter in cases of mortification; and the opinion of Mr. Guthrie may be more correct, that nature receives the shock through the nervous system, and not through the absorbents. (*On Gunshot Wounds*, p. 123, ed. 2.)

But (as Sir B. Brodie observes) "whenever putrid matter is pent up round a slough of the cellular membrane, the system is poisoned by it. The sulphuretted and carburetted hydrogen seem to pass into the circulation, producing the most dangerous symptoms. The incisions which relieve the tension of the skin allow these noxious gases to escape, and the relief which this affords the patient is very remarkable." Patients, in fact, in whom a putrid urinary or fecal abscess is incised, seem sometimes to pass from the gates of death to comparative health. (*Brodie, Op. cit. vol. iii.*)

The danger of sphacelus materially depends upon the size and importance of the part affected, and upon the patient's age and constitution. The indications, already specified, of the stoppage of mortification, must also considerably influence the prognosis, especially the red line at the edge of the living parts, and the incipient separation of the dead from the living parts.

Sphacelus implies the total loss of life in the part affected, the destruction of its organisation, the abolition of all its functions, and an absolute inability to resume them again. However, even when we see the surface of a part manifestly sphacelated, we must not always conclude that the entire destruction of its whole substance or thickness is certain; for, in many cases the disorder only affects the skin and cellular substance. In this state, the integuments frequently slough away, leaving the tendons, muscles, and other organs perfectly sound.

## TREATMENT OF MORTIFICATION.

[The word mortification is far too vague and general to admit of being made the basis of practical precepts. It is not the *mortification* but the *patient* in whom some part tends to mortify, that the surgeon has to treat; and the conditions may be so widely diverse, that general precepts are almost impossible. Every variety arising from every cause requires to be separately dealt with. The senile gangrene, the traumatic, that arising from obstruction of veins, that arising from obstruction of arteries, from cold, from heat, from caustics, from animal poisons, all require special consideration.]

In the treatment, the surgeon must always have one thing under consideration; viz. whether the case before him is one of acute mortification, attended with inflammation and inflammatory fever; or whether it is a chronic mortification, beginning without fever, or attended with a fever of a typhoid nature and great prostration of strength? By making up his mind upon this point, the practitioner will establish a useful general principle for his guidance, especially in the commencement of the treatment.

1. When mortification is acute, and seems to depend on the violence of inflammation, the first indication is to moderate the inordinate action of the sanguiferous system, by the prudent employment of such means as are proper for counteracting inflammation. In short, relief is to be sought in the antiphlogistic regimen, which consists in the employment of blood-letting, purgatives, diaphoretics, and diluents, and in abstinence from all vegetable or animal substances which have a tendency to excite or to augment the febrile action. This regimen must be pursued so long as inflammatory fever continues; except only in cases in which the fever, from the first, assumes a typhoid character, or where the mortification takes place without the previous occurrence of fever.

Dr. Thomson, from whom I have borrowed the foregoing passage, also notices the present common aversion to bleeding in compound fractures, erysipelas, carbuncle, hospital gangrene, burns, and frost-bite: cases in which the patient, it is said, can seldom bear with impunity any considerable loss of blood. "In many instances of these injuries and affections (says he) blood-letting, I know, is not required; but I am doubtful, even if it were generally employed, whether it would produce all the mischiefs which have of late years been ascribed to it. I believe it to be the most efficacious of any of the remedies that can be employed, in all cases of inflammatory fever threatening to terminate in gangrene, and that its use in such cases ought never to be omitted in the young, strong, and plethoric." (See *Lectures on Inflammation*, p. 559.) Yet, it is to be employed with a

great deal of circumspection; for, should it be injudiciously resorted to, from the true state of the system not being understood, the error may be followed by the most fatal consequences. Owing to the constitution being generally broken by intemperance or enfeebled by an impure atmosphere, Sir A. Cooper considers it rarely safe in this metropolis to take blood from the arm, with the view of checking gangrene; though he acknowledges, that the removal of a few ounces of blood is a practice which sometimes answers in the country. It should also be well remembered that, however strongly bleeding may be indicated, the moment is not far off when it is totally inadmissible. If the mortification has already made progress, this evacuation is never justifiable.

In acute mortification, after as much blood has been taken away as may be deemed safe or proper, and this measure must be adopted with extreme circumspection, the other parts of the antiphlogistic regimen must be continued, so long as any increased action of the heart and arteries continues. A strict regimen, which may have been useful and even necessary, during the inflammatory stage, will have a very bad effect, if continued too long, by diminishing the patient's strength, which on the contrary should be supported by the most nourishing food.

Sir A. Cooper recommends two or three grains of the chloride of mercury at night, in order to restore the secretions of the intestinal canal and liver; and the liquor ammoniæ acetatis, with a few drops of the tinct. opii several times a day, with the view of lessening irritability, and tranquillizing the system.

[It seems curious to read now the ideas of surgeons two generations ago with regard to bleeding in mortification. It seems generally understood now that the only cases in which it is allowable are certain cases of acute inflammation in healthy persons, in which gangrene is threatened owing to some mechanical condition, i.e. when the cornea threatens to slough in gonorrheal ophthalmia; when the glans penis threatens to slough from inflamed chancre, or the tip of a finger from abscess in the sheath of the tendons. But in these cases, as in strangulated hernia, or in mortification from ligature, an *incision* or other mechanical mode of relieving constriction would occur to most surgeons in the place of bleeding. Suppose the case of a young and very plethoric person with an injury producing an inflammation threatening gangrene, it is quite conceivable that it might be expedient to take a little blood from the arm, or by leeches; yet, as Sir A. Cooper said, it will be "rarely safe." A raised position, iced applications, and incisions, would probably be better remedies for gangrene threatened by local turgescence.]

I next come to a second very essential and important indication to be fulfilled, as soon as the symptoms announcing the existence of the inflammatory state abate, and the patient begins to be debilitated. This indication is to prevent excessive weakness by the suitable employment of cordials, and particularly of tonics. These same means also contribute to bring the system into a proper state for freeing itself from the mortified parts, or, in other words, for detaching them.

In order to fulfil the above indication, it is necessary to prescribe a nourishing diet, with a certain quantity of good wine, proportioned to the patient's strength, and the symptoms of the com-



plaint. This diet is generally productive of more real benefit than the whole class of cordial and stimulating medicines. However, when the patient is much weakened, the mortification of the part affected is complete, and the disorder is spreading to others, some of the following remedies may be ordered: ammonia, aromatic confection, æther, &c. In general, however, wine is better, and especially sherry.

[Sir Benjamin Brodie is emphatic on this point; that the stomach must not be fatigued with tonic drugs, so as to interfere with the digestion of good food; and that the best stimulant is wine or brandy. Amongst drugs, Sir Benjamin speaks well of ammonia in senile gangrene, but gives a caution against giving it in too great quantities, or too often.]

Of all the medicines hitherto recommended for the stoppage of mortification, none ever acquired such a character for efficacy as the Peruvian bark. It is said, that this remedy often stops, in a very evident and expeditious manner, the course of the disorder. Being a very powerful tonic, it is thought to operate by strengthening the system, and thus maintaining in every part the necessary tone for resisting the progress of mortification. But, whatever may be its mode of acting, the advocates for this medicine contend that it ought to be employed in almost all cases of mortification, as soon as the violence of the inflammatory symptoms has been appeased.

It was Mr. Rushworth, a surgeon at Northampton, who first urged this doctrine in the year 1715. Amyand and Douglas, two surgeons in London, soon afterwards confirmed the virtue of the remedy. Mr. Shipton, another English surgeon, also described, in the *Philosophical Transactions*, the good effects which he saw produced by it. In the *Medical Essays of Edinburgh*, Drs. Monro and Paisley published several cases, illustrative of its efficacy. We are there informed, that when its exhibition was interrupted, the separation of the eschars was retarded, and that, on the medicine being resorted to again, the separation went on again more quickly. Since this period, all practitioners, in England and elsewhere, have employed bark very freely in the treatment of mortification; and the exaggerated statements of its effects led to its exhibition in all cases of this nature, without discrimination of the varying states of the general health and local disorder, in the different stages of the complaint, and without any reference to its causes and nature, which are subject to variety.

We cannot indeed doubt, that bark has frequently had the most salutary action, in cases of mortification, though sometimes it may probably have had imputed to it effects which were entirely produced by nature. The following observation, made by Dr. Thomson, is highly worthy of recollection: "In attending to the effects supposed to result from the operation of the external and internal remedies which are daily employed for the cure of mortification, there are two facts, well ascertained, which appear to me to be peculiarly deserving of your regard. The first of these is, that mortification often stops spontaneously, without any assistance whatever from medicine; the second, that it often begins, and continues to spread, or even, after it has stopped for a while, recommences and proceeds to a fatal ter-

mination, in spite of the best directed efforts of the healing art." (*On Inflammation*, p. 557.)

It is quite wrong to prescribe bark in every instance; for there are many cases in which it is unnecessary, some in which it does harm, and others in which it is totally inefficacious. It is a medicine obviously of no service, when mortification arises from an external cause, and is the only complaint in a healthy, strong constitution. It is equally unnecessary, when the sphacelus is of the dry sort, and has ceased to spread, at the same time, that the living margin appears to be in a state of inflammation, without any universal debility. But it deserves particular notice, that the circumstances of each individual case are liable to such variety, that though bark may be at first unnecessary, it may afterwards be indicated.

When mortification is complicated with serious disorder of the functions of the abdominal viscera, a frequent case, bark is manifestly pernicious. Here, the indication is to correct the state of the stomach and bowels with mild opening medicines, and especially calomel. When this has been done, if bark should be indicated by any of the circumstances already pointed out, it may be safely administered.

Sometimes mortification is accompanied with a low typhoid kind of fever, which, whether the cause or the consequence of the local mischief, may require the exhibition of bark.

However, mortification may be attended with common inflammatory fever, and then the living margin is generally inflamed and painful. This is particularly the case when mortification is the consequence of genuine acute inflammation, or of an external injury, in a healthy subject. Here, bark must obviously be injurious. Still it is wrong to regard this medicine as invariably hurtful whenever sphacelus is the effect of inflammation. It has already been observed, that the inflammation frequently has less share in the origin of the disorder, than some incidental cause, which may require the exhibition of bark. Even when mortification is the pure effect of inflammation, great prostration of strength may subsequently arise, and indeed does mostly take place at a certain period of the disorder. In this circumstance, the voice of experience loudly proclaims the utility of bark, though its exhibition would have been at first useless or hurtful. While genuine inflammatory fever, and local inflammation, are coexistent with mortification, mild antiphlogistic means are useful; but great caution is requisite, since, in humid gangrene, the inflammatory state soon changes into one in which the great feature is prostration of strength.

When there is mere prostration of strength without any symptom of gastric disorder, or of inflammation or typhoid fever, bark is evidently proper, though seldom effectual alone; diaphoretic and nervous medicines being also necessary, opium, wine, camphor, ammonia, brandy, &c.

We meet with one species of mortification, in which the patient experiences severe pain in the part, unpreceded by any appearance of inflammation. Here bark is never of use, and opium is the medicine in which we should principally confide.

Bark sometimes occasions purging, and then it must be immediately discontinued, unless that hurtful effect can be prevented by the addition of a few drops of laudanum to each dose, or by em-

ploying the sulphate of quinine, instead of the common preparations. Bark frequently disagrees with the stomach; in which case I should say, that it ought not to be continued at all; though, in this circumstance, the usual plan is to give, instead of the decoction, the infusion, or the powder finely divided, and mixed with wine, or what is yet better, the sulphate of quinine.

Several years ago I published a critique on the indiscriminate employment of bark in cases of mortification, and my remarks were inserted in the article *Gangrene* in *Dr. Rees's Cyclopaedia*. Many of them were introduced into the 2d edition of this surgical dictionary, printed in 1813. (See CINCHONA.) Since this period I am happy to find, that the blind enthusiasm with which bark was prescribed is beginning to subside, and that on this subject, some eminent surgeons have of late publicly avowed sentiments which entirely coincide with my former statements. "I think (says Dr. Thomson) I have frequently seen it prove hurtful, when administered in cases of mortification, by loading the stomach of the patient, creating a dislike to food, and sometimes by exciting an obstinate diarrhoea. *I believe it to be, in mortification, a medicine completely inert, and inefficacious.*" (See *Lect. on Inflammation*, p. 563.) By this expression, Professor Thomson does not mean, that bark can never be useful in cases of mortification, but only that it has no specific power in checking the disorder, as may have been erroneously inculcated.

"Bark (says Boyer) has been considered by several distinguished English practitioners as a true specific against gangrene in general, and especially against that which depends upon an internal cause; but subsequent observations to those published in England have proved that it has no power over the immediate cause of gangrene, and that it only acts as a powerful tonic in stopping the progress of the disorder, and promoting the separation of the mortified parts." (See *Maladies Chir.* t. i. p. 151. Paris, 1814.) Boyer also particularly objects to bark being given while inflammatory fever prevails; but whenever he prescribes bark in cases of mortification, he seems to entertain the old prejudice of expecting benefit in proportion to the quantity which can be got into the stomach. On the contrary, Mr. Guthrie declares, that he has not found bark useful, "further than as tonic, and given in such quantities as not to overload the stomach." (*On Gunshot Wounds*, p. 148, ed. 2.)

A third indication is, *to lessen the irritability and sufferings of the patient, by the use of opium.* In all cases of mortification, everything which heats, irritates, or adds to the patient's sufferings, appears, in general, to augment the disorder, and increase the rapidity of its progress. On the other hand, everything which tends to calm, assuage, and relax, frequently retards the progress of mortification, if it produce no greater good. The pain, also, which is a constant mark of too much irritation, contributes of itself to increase such irritation, and, in this double point of view, we cannot do better, in the majority of cases, than endeavour to appease it by the judicious and liberal use of opium. When the inflammatory stage evidently prevails, this medicine may be conjoined with antiphlogistic remedies, such as the nitrate of potash, antimonial, &c. In other instances, attended with

debility, it may be given with bark and cordials. [Mr. Cooper's remarks on bark, which were originally written more than fifty years ago, refer to the employment of powdered peruvian bark, as a specific against mortification *per se*. On which we must observe that modern pharmacy enables us to separate the active principles of bark from the inert sawdust, so that the patient's stomach need not now be loaded with the ounces of powder which were formerly "thrown in," as the phrase was. In cases of gangrene, the patient may take quinine in the small doses with acid, which excite appetite and promote digestion; it is not advisable in large sedative or antiperiodic doses. But if we want a preparation to stem spreading moist gangrene when there is deficient vital resistance of the neighbouring soft parts, none is equal to the liquor cinchonæ flavæ of Battley, of which the dose is twenty minims every three hours in water.]

*Treatment of Senile Gangrene.*—In this kind of mortification, Mr. Pott found bark, used internally or externally, by itself or joined with other medicines, completely ineffectual.

His plan was generally to give one grain of opium every three or four hours; but never less than three or four grains in the course of four-and-twenty hours. However, he did not propose opium as a universal infallible specific, but only as a medicine which would cure many cases, not to be saved by bark.

M. Dupuytren, who espouses the doctrine, that this species of mortification depends upon obstruction of the vessels by arteritis, advises it to be treated by means of venesection and opium. By this plan, he affirms that he has saved two-thirds, or even three-fourths of his patients. In this country, I should say, that not more than one patient in twenty is saved, who is attacked with this species of gangrene, and consequently, that if Dupuytren's practice were truly as successful as alleged, the means employed by him should be employed everywhere without hesitation. They have already been tried in this metropolis; but without any encouraging results. Nor does M. Cruveilhier, though a believer in arteritis being the cause of what is called *gangræna senilis*, give any confirmation of the efficacy of general bleeding, as practised by his distinguished friend, Baron Dupuytren. "The doctrine (says he) of arteritis being the cause of this mortification, has entirely changed the treatment of it; and for tonics, employed in every form, externally and internally, Dupuytren substituted venesection. But, though more rational, *I do not know that this method has had advantageous results.* The good effects of local bleeding in phlebitis has induced me to prefer it to general bleeding in the treatment of arteritis. The agonizing pain attendant on this disorder seems to me to render opium indispensable, which was first given by Pott in a case where he saved his patient." (*Anat. Pathol.* t. ii. livr. 27.)

The observations of Pott on the local treatment of these cases are of great practical importance. "I have found (says he) more advantage from frequently soaking the foot and ankle in warm milk, than from any spirituous or aromatic fomentations whatever; that is, I have found the one more capable of alleviating the pain which such patients almost always feel, than the other; which circumstance I regard as a very material one. Pain is



always an evil, but in this particular case I look upon it as being singularly so. Whatever heats, irritates, stimulates, or gives uneasiness, appears to me always to increase the disorder, and to add to the rapidity of its progress; and, on the contrary, I have always found, that whatever tended merely to calm, to appease, and to relax, at least retarded the mischief, if it did no more."

Indeed, the very nature of the disease, as already described, leaves little hope of essential good from topical applications. All that can be expected from the best of them is, some diminution of pain, and from the worst of them, an increase of it, with a more rapid extension of the gangrenous mischief.

In Greenwich Hospital, I understand that gangræna senilis is not unfrequent amongst the old pensioners, and that one of the surgeons of that establishment finds enveloping the foot and leg with lamb's wool, or other soft materials, calculated to maintain its temperature and circulation, better than the usual applications. The practice seems rational, with reference to the pathology of the disease. For this information I am indebted to Sir Benjamin Brodie.

[This surgeon was the late Mr. Vance, as we learn from Brodie's lectures. The whole limb was enveloped in loose flakes of carded cotton, and sewn up in a silk handkerchief, and allowed to remain undisturbed for some days; thus the exposure and irritation and fatigue of repeated dressings are avoided, the patient and his friends are saved from excitement, and the surgeon from importunate inquiries.]

If there be no offensive smell, the dressings may be left many days; if there be, they should be changed often. A lotion of chloride of soda, or an ointment of resin ointment mixed with creosote, may be used in such cases, or a light jacket filled with powdered peat charcoal. The patient should remain in bed, and the digestive organs be carefully attended to; the quantity of nutriment be sufficient, but anything like over-stimulation avoided.]

When the toes are, to all appearance, perfectly mortified, and seem so loose as to be capable of being easily taken away, some surgeons remove them. But, however loose they may seem, if they be violently twisted off, or the parts by which they hang be divided, a very considerable degree of pain will most commonly attend such operation, which therefore had much better be avoided; for Pott had seen the pain thus produced followed by fresh mischief of the gangrenous kind. If the patient does well, these parts will certainly drop off; if he does not, no good can arise from removing them. The slightest hæmorrhage is to be avoided.

Dr. Kirkland observes, that we must be careful not to force the doses of opium, especially at first; and that the medicine does more harm than good when its soporific effects go so far as to occasion delirium, take away the appetite, or cause affections of the heart. I may state, however, that the patient should in this, as well as in other examples of mortification, be kept continually under the influence of opium, by a proper repetition of the doses from time to time, as directed by Pott. [The object is to avoid pain. For this purpose small repeated doses of opium to begin with, increased by degrees, are enough. There is no foundation for the belief that opium checks the disease; and it is

of no use to keep a patient on his death-bed drunk and delirious with drugs.] In a case which I lately attended with Sir A. Cooper, the medicines which seemed to have most effect in prolonging the patient's existence were opium, the sulphate of quinine, and castor oil, with other mild aperients.

This species of mortification rarely attacks both feet. One example of mortification of both feet, supposed to have been mainly induced by want of the common necessities of life, presented itself a year or two ago in a woman in University College Hospital. The patient was a female about 30; the mortified parts of the feet separated, and she recovered. This case was not, perhaps, the kind of gangrene now under consideration. But one unequivocal instance of such disorder attacking both feet, I attended, in the summer of 1828, with Mr. Hughes, of Holborn; and the gentleman, who was the subject of the disease was also visited by Sir Astley Cooper. Both feet and legs were attacked, and gradually destroyed nearly up to the knees. The patient lived a month after the commencement of the disorder. During most of this time the pulse was from 100 to 130; and the stomach so little disturbed, that the patient used generally to eat a mutton chop for dinner, until the last two or three days preceding his death. Until the final stage, there was scarcely any delirium. Two circumstances were particularly noticed; first, that the disease never extended itself, without being preceded by violent pains in the parts about to be destroyed, so that a judgment can always be formed beforehand from the degree of suffering, whether the spreading of the disorder would be considerable, or not. Secondly, that the process of mortification, and its appearances in one leg, were totally different from those exhibited in the other. In the left, the disorder began on the inside of one of the toes, and followed the course described by Pott; in the right, a general diminution of the temperature of the foot and leg was the first thing noticed, without any discoloration of the skin, or any vesications, or spot on the toes. The coldness, after increasing very much, was followed by total loss of sensibility in the parts, and the cessation of the circulation and every other action in them; the flesh being little more changed in its appearance than that of the limb of a dead subject. The parts, as the French surgeons would say, were *mummified*.

2. With respect to the external or local treatment of mortification, the first indication consists in removing, if possible, such external causes as may have occasioned or kept up the disorder; as the compression of bandages, ligatures, tumours; all irritating substances, &c.

When mortification arises from inflammation, which still prevails in a considerable degree, it is evident that the dead part itself only claims secondary consideration, and that the principal desideratum is to prevent the mortification from spreading to the living circumference, by lessening the inflammation present.

However eligible the employment of cold applications may be in theory, in mortification attended with inflammation fomentations and emollient poultices are commonly preferred in practice. Besides bread and water and linseed meal poultices, there are several others, which have acquired celebrity. Of this kind are the cataplasma car-

bonis\*, cataplasma cerevisiæ†, and the cataplasma effervescens.‡

[The first object of local applications is to soothe and comfort the living tissues; or to give them some gentle stimulation, to excite them to form a healthy line of demarcation, and cast off the sloughs. Again, they may be used to mummify and disinfect the dead and decomposing sloughs, so that the air shall not be made unpleasant, nor the patient's blood be contaminated by the absorption of putrid matter. The first object is generally accomplished by warm linseed meal poultices. The second by the carbonic acid poultice; poultices of beer grounds, carrots, &c., ointments of Peruvian balsam, or creosote; weak lotions of mineral acids. The third indication is best carried out by the liquor sodæ chlorinatæ and creosote or carbolic acid. Here we speak of mortification in its usual sense. For sloughing ulcers, phagedæna, &c., many other applications are described elsewhere, as strong solution of opium; bromine is the best remedy in hospital gangrene, according to the evidence of the American military surgeons. The various cauterants, actual and potential, and their applications, are described under the head of HOSPITAL GANGRENE.]

In the gangrene produced by pressure and weakness in persons who are compelled by diseases and injuries to lie for weeks and months in one posture, the mode of treatment is a matter of extreme importance, and frequently makes the difference of life or death to the poor sufferers. This affection usually has its seat in parts which are but thinly covered with muscular flesh. It occurs towards the latter stages of long continued febrile diseases, as after typhus, or hectic fever, attended with tedious suppuration; or even without these fevers, as in paralysis, and in bad compound fractures. However, as Dr. Thomson observes, there are two forms of disease, arising from pressure, which have not always been accurately discriminated. One of these is the preceding sort of sloughing; the other is a chafed, excoriated, and ulcerated state of the parts.

Sometimes uncleanliness tends to cause this sort of mortification, that is, when the urine wets the patient's clothes. When this is the case, such irritation must be prevented by every possible means. If the skin be excoriated and broken, the powder of tutty, or lapis calaminaris [still better, bismuth], should be sprinkled over the part; or if an ointment be required, says Dr. Thomson, those which contain zinc or lead are the best. But when the ulceration threatens to extend, these remedies are to be laid aside, and an emollient hemlock, carrot, or fermenting poultice used. I have seen, in the irritable state of such ulceration, the solution of opium under a common linseed poultice do more good than any other application.

Sir A. Cooper recommends the application of turpentine. Sometimes he uses a mixture of vinegar and camphorated spirit.

But no topical remedies will in any of these

cases avail, unless the chief cause of the disorder be removed. This is to be effected by change of position, and laying pillows and cushions of the softest materials in convenient places under the patient; not directly under the disease itself, but in situations where they will tend to raise the parts affected from the contact of the bedding. A circular hollow pillow will often accomplish this important object; but, when possible, an entire change of posture is to be preferred. In these instances, I must not forget to recommend the water-bed, for which the public are indebted to Dr. Arnott, and which acts by nicely equalizing the pressure, on every point of the body on which the patient lies, so that he may experience no greater pressure on any one part than if he were floating on the surface of water.

When sphacelus succeeds to gangrene from pressure, I have often seen camphorated spirit applied, but not with decided advantage. A common emollient poultice, and in very bad cases, the topical use of the solution of opium along the living margin, are the means upon which I place most reliance, care being taken to improve the general health, without which grand indication, neither the removal of the pressure, nor the virtues of any dressings, will answer. Dr. Thomson speaks most highly of the fermenting poultice, which I believe to be in these cases an excellent application. He confesses, however, that he has sometimes found it too stimulating, and been obliged to substitute the simple emollient carrot or turnip poultice.

[Whenever this accident is reasonably to be expected, preventive measures should be adopted. The back, &c., should be daily washed with soap and water if possible, and be well dried with soft napkins; then dabbled with *eau de cologne* or other spirit. Brodie recommended a solution of two grains of corrosive sublimate to an ounce of spirit.]

When mortification arises from cold, every sort of warm emollient application must at first be avoided, and cold water, or even snow or ice, employed. (See CHILBLAINS.)

The gangrenous affection of the pudenda, to which female children are liable, was successfully treated by Mr. K. Wood by applying the liquor plumbi acet. dilutus in a tepid state, and bread poultices made with the same lotion. As soon as the ulcers became clean, they were dressed with the unguentum zinci. (See *Med. Chir. Trans.* vol. vii.) Other cases, which also ended well, have been dressed with lint dipped in camphorated spirit, and covered with a poultice; or, at first, poultices made with the opium lotion, and, after the separation of the sloughs, the ulcer was dressed with port wine and decoction of bark in equal proportions. In some cases, however, mild stimuli proved injurious. (*James on Inflammation*, p. 289.)

*Deep scarifications in the integuments.*—The majority of authors who treat of mortification recommend this plan in all cases. They even advise the incisions to be made down to the sound parts, in order to facilitate the application of topical stimulants, and to favour the operation of the supposed antiseptic qualities of these dressings. But, with the exception of cases in which the gangrenous parts lie under an aponeurosis, or others in which the integuments which have escaped destruction, cover a mixture of matter and sloughy cellular tissue, either in consequence of foregoing inflammation, or any other cause, such as extrava-

\* Prepared by mixing about 3j. of finely powdered wood charcoal with half a pound of the common linseed poultice.

† Prepared by stirring into the grounds of strong beer as much oatmeal as will make the mass of a suitable consistence.

‡ Prepared by stirring into an infusion of malt as much oatmeal as will render the substance of a proper thickness, and then adding a spoonful of yeast.



sation of urine in the scrotum, all scarifications, which penetrate to the living parts are often productive of the most serious mischief, instead of advantage. Such incisions cannot be practised without occasioning a great deal of pain, and producing inflammation, which often makes the mortification spread still further. But as parts which are in a complete state of sphacelus are absolutely extraneous substances in regard to those which still retain their vitality, all such portion of them as is already loose should be removed. By lessening the size of the putrid mass, the fetor is diminished. An outlet may sometimes be made for the escape of a great deal of putrid discharge, which, being confined, might have a bad effect on the neighbouring living parts; and the latter are enabled to free themselves more easily from the rest of the sloughs.

The too common practice of accelerating with a cutting instrument the separation of the mortified parts previously to the completion of the process by which nature breaks the connexion between them and the living flesh, in general ought to be strongly reprobated, as causing unnecessary pain, and irritation, and creating the risk of a renewal of the sloughing. So far as my experience goes, gangrenous phagedena is the only instance in which it seems useful to remove the sloughs before they are loose, so as to let the topical applications extend their actions without delay to the subjacent living surface. (See HOSPITAL GANGRENE.) Pott's sentiments, with respect to the danger and inutility of cutting the tendons and ligaments, in the mortification of the toes and feet, are well known.

If the surgeon prudently let nature work, without disturbing her, the separation of the mortified from the living parts will soon follow the establishment of inflammation and suppuration at the edges of the slough.

But when the whole thickness of a limb is affected with mortification, ought the surgeon to leave things to nature? or ought he to have recourse to amputation?

In general, the performance of amputation is indispensable; not that nature would not in many instances detach the sphacelated part; but because a great length of time would be required for the completion of the process, and a servicable stump would rarely be left.

Another important question then arises—should the surgeon amputate while the mortification is in a spreading state? Or, ought he to defer the operation until a line of separation begins to form between the dead and living parts?

In the mortification of the toes and feet, in old persons, Sir A. Cooper forbids amputation whether there be healthy granulations or not, and he declares that if the operation be done, mortification of the stump, and the patient's death, will certainly follow.

"Amputation (says a distinguished professor) was long regarded as one of the most effectual means which could be employed to prevent the extension of gangrene. This practice, however, has not received the sanction of experience; on the contrary, it has been generally found, wherever it has been practised, in either acute or chronic gangrene, to accelerate much the progress of the disease; and in this way to hasten the death of the patient. The parts, which were divided in amputation, though at a distance from a spreading

gangrene and from sphacelus, were found speedily to assume the appearance of the affection for which the operation had been performed. Till, therefore, the adhesive inflammation comes on, and a distinctly marked separation of the dead from the sound parts takes place, amputation is, in few, if in any cases of mortification admissible. We never know, previously to this, where a gangrene or sphacelus is to stop, nor whether the powers of the constitution be sufficient to sustain the injury that the mortification has inflicted. Even when the adhesive inflammation comes on, it is in most cases best to allow some time to elapse before we operate, partly with a view to give time for the constitutional symptoms to abate; in other instances, to allow the patient's strength to be recruited by nourishment and cordials; and partly also with a view to learn whether the constitution of the patient be indeed capable of so great a fresh shock, as that which amputation must necessarily occasion." (See Thomson's Lectures, p. 582.)

A different doctrine and practice are now sanctioned. "Writers on gangrene or sphacelus of the extremities (says Larrey) indiscriminately recommend the amputation of a sphacelated limb never to be undertaken before the mortification is bounded or limited by a reddish circle, forming a true line of separation between the dead and living parts. This circumstance can only occur in a case of spontaneous gangrene from an internal cause; or if it happens, as is very unusual, in a case arising from a wound, its progress is different, and it would be exceedingly imprudent to wait for it. The gangrene from external injuries almost always continues to spread; the infection becomes general; and the patient dies." (*Mém. de Chir. Militaire*, t. iii. p. 142.)

In cases of mortification, arising from external injuries, Larrey maintains, that, "notwithstanding any thing that writers and practitioners may allege to the contrary, we should not hesitate about promptly performing amputation, as soon as the necessity for the operation is decidedly established. There is no reason to apprehend, that the stump will be seized with gangrene, as in the spontaneous mortification, which has not ceased to spread, because the traumatic gangrene, after having arisen from a local cause, is only propagated by absorption, and a successive affection of the texture of parts by continuity of the vessels. Amputation, performed in a proper situation, stops the progress and fatal consequences of the disorder.

"Supposing, then, the lower half of the leg should be affected with sphacelus, in consequence of a gunshot injury, attended with a violent contusion of the part, and a forcible concussion of the vessels, nerves, and ligaments, if the skin is elsewhere uninjured, the operation may be done in the place of election, without any fear of the stump becoming gangrenous, notwithstanding the cellular tissue of the upper part of the member may be already affected. But, when the skin of the whole leg is struck with mortification, the operation must be done on the thigh, and no time should be lost. The same practice is applicable to the upper extremities. We must be careful not to mistake a limb, affected with stupor, for one that is actually sphacelated. In the first case, warmth, motion, and sensibility are still retained, although the skin may be blackish and the parts may be swollen. Besides, if there were any doubt, it would be pro-

per to try at first tonic repellent applications, and cordial medicines, &c." (See *Mém. de Chir. Militaire*, t. iii. pp. 152, 153.)

When amputation has been practised, this author recommends the exhibition of bark, good wine, tonics, &c., in order to promote the good effects of the operation. (P. 154.)

In Larrey's memoir there are many cases recorded in favour of what he endeavours to prove, viz., that, in cases of mortification from external injuries, if the patient's life be in danger, amputation ought to be performed, although the sloughing may yet be in a spreading state.

It should be remarked, that the practice of amputation, in cases of spreading mortification, has generally had some partisans for many years past; but the weight of authorities has unquestionably been against it, and few surgeons in this country have ventured to deviate from the advice of Sharp and Pott. It is curious, however, that Mehee, a writer, who wrote for the express purpose of declaring his disapprobation of the early performance of amputation in gunshot wounds, should have admitted of only one case, in which the operation is proper, namely, *gangrene succeeding the wound made by a cannon shot*. Here he thinks, that amputation ought to be performed on the first appearance of the gangrene, in order to prevent it from spreading up the limb. (See *Traité des Plaies d'Armes à feu*. Paris, 1799.) It appears that about the year 1809, Mr. A. C. Hutchison performed with success two amputations in cases of spreading gangrene from gunshot wounds. (See *Practical Obs. on Surgery*, p. 72.) After the battle of Waterloo, I followed the same practice.

My friend Mr. Lawrence has successfully amputated at the shoulder joint in a spreading mortification of the arm, the consequence of external violence. "The skin of the amputated limb was greenish and livid; but the cuticle not yet detached. The cellular substance was distended with air, and with a discoloured offensive sanies; its appearance was not quite natural, where the incision took place; it was yellowish and anasarcaous. Small effusions of blood were observed here and there in the course of the nerves; even as high as the amputated part. No coagulation of blood in any of the arteries, even down to the ulnar and digital branches. All the soft parts were discoloured, dark red, and livid, and a frothy reddish fluid issued on incision." This case had the most favourable termination, and it clearly proves, that the *humid* kind of gangrene, which occurs in a healthy subject from severe local injury, which so rapidly affects a whole limb, and reaches the trunk in a few hours, must constitute an exemption to the general maxim, that amputation should never be done, before a line of separation is established between the dead and living parts. (See *Medico-Chir. Trans.* vol. vi. p. 184.) He also reports another instance, in which he saw the operation succeed, though the mortification was in a spreading state.

I was once consulted in private practice about the propriety of amputating at the shoulder in a spreading mortification of the arm from external violence. The operation was performed, and the patient, who without it would certainly have perished in a few hours, lived a fortnight; at one time he had a fair prospect of recovery, but afterwards died, not of gangrene of the stump,

but in consequence of a large abscess over the scapula.

The following are views adopted by Mr. Porter: "If amputation is determined on, it should be performed with the least possible delay, because the gangrene may spread with such rapidity as to cause the operation to be performed very high up, and consequently involve an unnecessary loss of a greater portion of the limb; and also because the constitutional symptoms, attendant on mortification, are not such as a patient can long endure, and their continuance even for a few hours may render the success of any operation very precarious. This latter consideration is of great importance; for, although I have seen the incision made in a part where the skin was discoloured, and the cellular tissue loaded with a semigelatinous kind of serum, without preventing recovery afterward; yet I am not aware of a case proving fortunate, where the system had previously been materially engaged. Of course, however, where it can be done, it will obviously be most prudent to perform the operation in a sound part, and even if possible, to interpose a joint between it and the apparent boundary of the disease." Mr. Porter recommends leaving large flaps both of integument and muscle. He considers, that, in such cases, no expectation of union by the first intention can be entertained. On the contrary (says he) there are usually abscesses and sinuses formed in the stump, discharging from time to time masses of ragged sloughy, cellular tissue, with profuse suppuration, and general wasting of the remnants of the muscles, so that, on being eventually healed, the stump is much smaller in size than the corresponding part of the other limb. During the progress of the case, it will be necessary to support the patient's strength with extraordinary care, and to give wine in liberal quantities.

Mr. Porter concludes his interesting paper with a statement of the particulars of several cases where gangrene was extending at the time the operation was performed. Several of the patients recovered; and where the result was not fortunate, it was not from mortification of the stump, but from circumstances which might have occurred after amputation, performed for the removal of any other disease. (See *Dublin Journ. of Med. Science*, vol. iv. p. 222.)

Amongst the experienced approvers of Larrey's advice, I must not omit to mention Dr. Hennen, who repeatedly amputated, under the circumstances above pointed out, without waiting for the line of separation; "and (says he) although I certainly was not uniformly successful, I have no reason to imagine, that death was occasioned by a departure from the rule so generally laid down by authors." (*On Military Surgery*, p. 243. ed. 2.)

There are even some cases in which amputation has been performed with success, though the mortification did not arise from an external cause. I amputated the thigh of Mr. Lucas, organ-builder in the Waterloo Road, on account of a spreading mortification from the bursting of a popliteal aneurism under the skin, and the stump healed up in the most favourable manner. (See *Med. Chir. Trans.* vol. xvi. p. 321.) Mr. Porter informs us, that "a limb has been removed with the best results, in cases of mortification occurring two or three



months after the artery has been tied for the cure of aneurism; and again, where it has originated in a fungoid tumour of the periosteum, both of which may be regarded as instances nearly of idiopathic disease. Nay, I am in possession of a case, which occurred in an hospital in this city (Dublin), where amputation succeeded, although many would have regarded it as a specimen of Pott's gangrene of the toes and feet." (See *Porter*, in *Dubl. Journ. of Med. Science*, vol. iv. p. 219.) A similar case was successfully operated upon by M. Amussat, though the gangrene was spreading. (See *Archives Gén. Jan.* 1835.)

In the article AMPUTATION, notice has been taken of a sloughing, which commences in the foot, and extends up the leg, and sometimes follows gun-shot injuries of the thigh, which involve the femoral artery: this is a case particularly instanced by Mr. Guthrie, as requiring the very early performance of amputation. Sir Astley Cooper also refers to cases, in which the rule was successfully deviated from, of not amputating, before limits are set to the spreading of mortification; the instances in question arose from injury of blood vessels, and other local violence, in patients of a healthy constitution. In such cases, it is admitted by this very experienced surgeon, that the practice should be different from what is usually pursued in mortification from constitutional causes. (*Surgical Essays*, part ii. p. 186.)

With regard to the early performance of amputation, where the substance of a limb perishes after exposure to cold, I find some difference of sentiment between two very high authorities. Thus Schmucker observes: "The mortification which comes on after a part has been frozen, increases so rapidly, if the limb be exposed to warmth, that in the space of twenty-four hours, its vitality and organization are quite destroyed, and nothing will now avail in restoring its sensibility. Here the speedy performance of amputation is the only means of preservation to be depended upon. In mortification from an internal cause, the case is different." (See *Vermischte Chirurgische Schriften*, b. 1. p. 15. 8vo. Berlin, 1785.) According to Larrey, however, this species of gangrene at length stops, and a line of separation forms between the dead and healthy parts. If the disorder be superficial, the sloughs are usually thrown off between the ninth and thirteenth days, leaving an ulcer of proportionate extent, that soon heals up. If the whole of the limb be sphacelated, nature cannot of herself effect a cure, or but very rarely; the patient mostly falling a victim to the effects of absorption, when the sloughs are detached, and the mouths of the lymphatics are opened on the recurrence of supuration. Larrey assures us, that he has seen numerous patients carried off by this cause, while the examples of a spontaneous cure were exceedingly few, and, in these, the stump was left irregular, and unfit for bearing the pressure of a wooden leg. He agrees, therefore, with the generality of surgeons, that in these instances, it is advantageous to amputate the mortified portion of the limb, but not before the extension of the gangrene has ceased, and the mischief is bounded by an inflammatory line. (See *Mém. de Chir. Mil.* t. iii. pp. 65—72.)

[Mr. Cooper appears to incline to the opinion that amputation should as a general rule be de-

layed till a line of demarcation is established; although, with his usual fairness, he allows the other side to speak, and admits of exceptions to his own doctrine. The matter illustrates the difficulty of laying down general rules; but certainly the general rule prevalent now is to amputate, whenever gangrene is rapidly spreading. In cases of traumatic gangrene:—of gangrene from injury of large vessels, bursting of aneurisms, &c., the rule in favour of amputating is universal. In the case of senile gangrene, and the cases of slow spreading gangrene, which cause no immediate danger to life, and in which the state of the constitution, and the state of the parts is such that the operation might be fatal, or at any rate that the disease might reappear immediately on the stump, the rule is the reverse.] *R. Druitt.*

*Fabricii Hildani* Tract. Methodicus de Gangræna et Sphacelo. *Quesnai*, Traité de la Gangrène, 12mo. Paris, 1749. *Encyclopédie Méthodique*, Partie Chirurgicale, art. Gangrène. *Kirkland* on Gangrene, and on the Present State of Medical Surgery. *Richter*, Anfangsgr. der Wundarzn. b. i. kap. 3. Various parts of *Hunter* on Inflammation, &c. *Sharp's* Critical Inquiry into the present state of Surgery, chap. 8. *Richerand*, Nosographie Chir. t. i. p. 215, &c. edit. 4. *Lassus*, Pathologie Chir. t. i. p. 30, &c. edit. 1809. *Leveillé*, Nouvelle Doctrine Chir. t. iv. p. 321, &c. Paris, 1812. *Larrey*, Mémoires de Chirurgie Militaire, t. iii.; particularly the Mém. sur la Gangrène de Congélation, p. 60, and that sur la Gangrène Traumatique, p. 141. *Callisen*, Systema Chirurgiæ Hodiernæ, vol. ii. p. 374. edit. 1800. *Dr. J. Thomson's* Lectures on Inflammation, p. 501. Edinb. 1813. *O'Halloran* on Gangrene and Sphacelus, 8vo. Dublin, 1765. *Pott's* Obs. on the Mortification of the Toes and Feet in his Chirurg. Works, vol. iii. *J. Kirkland*, Thoughts on Amputation, &c. with a short Essay on the Use of Opium in Mortification, 8vo. Lond. 1780. *J. A. Murray*, in Gangrænæ Scroti. Obs. (Frank Del. op. 10.) *Dr. C. Wollaston*, Phil. Trans., 1762. *C. White*, Observations on Gangrenes and Mortifications, accompanied, &c. with convulsive spasms, 8vo. 1790. *Pearson's* Principles of Surgery, p. 114. edit. 2. *Lawrence* in Med. Chir. Trans. vol. vi. p. 184. &c. *Delpech*, Mémoire sur la Complication des Plaies et des Ulcères, connue sur le Nom de Pourriture d'Hôpital; also, Précis Élémentaire des Maladies réputées Chirurgicales, t. i. p. 73. &c. Paris, 1816. *Boyer*, Traité des Maladies Chir. t. i. p. 105, &c. Paris, 1814. *John Bell's* Principles of Surgery. *Himly's* Abhandlung über der Brand der Weichen und harten Theile, Gött. 1800. For an account of the dry Gangrene, see particularly the writings of *Hildanus*, *Tulpius*, *Quesnai*, *Mém. de la Soc. Royale de Médecine*, t. i. Opere di *Bertrandi*; Medical Museum, &c. For a description of the mortification caused by eating cockspur rye, see *Odard's* letter in Journal des Savans, 1766. *Noël*, in Mém. de l'Acad. des Sciences, 1710. *Langius*, "Descriptio Morborum ex Esu Clavorum Scalinorum." *Duhamel*, in Mém. de l'Acad. des Sciences, 1748. *Dr. C. Wollaston*, in Philosophical Trans. 1762. *Tessier*, in Mém. de la Société Royale de Médecine, t. i. and ii. &c. *O. Prescott*, A Dissertation on the Natural History and Medicinal Effects of the Secale Cornutum, or Ergot, 8vo. Lond. 1813. *D. F. Heffter*, Doctrinæ de Gangræna brevis Expositio, 4to. Lips. 1807. *C. L. Liessening*, De Gangræna, 4to. Gött. 1811. *Hennen's* Principles of Military Surgery, p. 241, &c. ed. 2. 8vo. Lond. 1820. *G. J. Guthrie* on Gun-shot Wounds, &c. p. 111. &c. ed. 2. 8vo. Lond. 1820. *J. H. James*, Obs. on the Principles of Inflammation, p. 84, 287. &c. 8vo. Lond. 1821. *Sir A. Cooper*, Surgical Essays, part ii. p. 186. 8vo. Lond. 1820. *W. H. Porter* in Dublin Journ. of Med. Science, vol. iv. 8vo. 1833. *John W. Turner*, of the sudden spontaneous Obstruction of the larger Arteries, &c. in Edinb. Med. Chir. Trans. vol. iii. 8vo. 1828. *Baron Dupuytren*, Leçons Orales de Clinique Chir. t. ivme. Art. xi. 8vo. Paris, 1834. *Robert Carswell's* Illustrations of the Elementary Forms of Disease, Fasciculus vii. fol. Lond. 1835. *Cruveilhier*, Anatomie Pathol. du Corps Humain, livr. xxvii. *Jas. Syme*, on Pathology, &c., Edin. *Peter Handyside*, in Edin.

Monthly Journ. 1862. *Geo. Macleod*, Glasgow, 1855. *Kirke*, Med. Chir. Trans. v. xxxv. *Rokitansky*, Path. Anatomie i. p. 237. *Zeis*, Mém. de la S. de Biologie. 1855. *Goodsir*, An. Observations, Edinburgh. *Virchow's* Cellular Pathology by Chance, Lond. 1860. *Brodie's* Works by Hawkins. For Mortification as a consequence of injury of nerves, see Art. Inflammation.

**MOXA.**—The Chinese moxa consists of the omentum of the leaves of the *artemisia latifolia*. That which Baron Percy employs is made of the stalk of the great sunflower, soaked in a solution of nitre, and afterwards well dried; cotton, however, similarly prepared, completely answers the purpose. Mr. Dunglison, who has translated Larrey's memoir on this subject, and added to it some interesting matter, shows that the moxa has been used in the eastern parts of the world many centuries. The cone or cylinder of moxa is composed of a certain quantity of cotton wool, over which a piece of fine linen is rolled, and fastened at the side by a few stitches. This conical cylinder should be about an inch long, and of a proportionate thickness; the size, however, may be varied according to circumstances.

A porte moxa, is intended to fix the cylinder upon the precise spot, where the application is to be made. The metallic ring of this instrument is kept from touching the skin by means of three small supports of ebony, which is a bad conductor of caloric. After the extremity of the cone has been set fire to, the combustion is kept up by means of a blow-pipe; however, it should not be too much hastened, but allowed to proceed slowly. The precise spot, to which the moxa is to be applied, ought to be first marked with a little ink, and all the surrounding surface covered with a wet rag, that has a hole in the middle, so as to leave the part bare, which has been marked. After the top of the moxa has been set on fire, the base of it, held in the porte moxa, must be placed upon the intended part, and the combustion kept up with the blow-pipe, until the whole is consumed. In order to prevent the subsequent inflammation and suppuration from being too considerable, the liquor ammoniæ should be immediately applied to the burnt part.

The diseases, in which Baron Larrey has found the moxa efficacious, are amaurosis, and incipient cataract (cases in which he applies it over the course of the facial nerve, just behind the angle of the jaw); deafness and aphonia arising from cold; tic douloureux, and partial paralysis of the muscles of the face; palsy of the lower extremities; phthisis; diseased spine; disease of the hip-joint, &c.

M. Roux, when he visited the London hospitals, had two opportunities afforded him of applying the moxa, in order to convince the rising generation of surgeons in this country of its superior efficacy. The first was in a case of spontaneous paralysis of the deltoid muscle at St. Bartholomew's. The moxa was applied a little below the acromion, and a few days afterwards the motion of the arm began to be restored. This, however, was a case, which, according to the account of Roux himself, had relapsed, after having been cured by other means. I think one of the surgeons of St. Bartholomew's informed me, that notwithstanding the moxa, the relief proved again only temporary. If, however, the moxa had succeeded, a caustic issue, a blister, or the volatile liniment, would probably have answered equally well. The second instance, in

which M. Roux applied the moxa, was a case of white swelling at Guy's Hospital; but the disease had advanced too far to allow any hope of a favourable issue. (See *Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie Angloise avec la Chirurgie Française*, pp. 19, 20.) M. Roux flatters himself that, "*les chirurgiens anglois répugneront sans doute moins à l'avenir à faire usage du moxa.*" The truth is, English surgeons, as well as English farriers, knew very well before the arrival of M. Roux what might be done with moxa and the actual cautery. But, though the application of fire still prevails in the veterinary art, as a mode of curing diseases, it has long been abandoned as a means of relief in the English practice of surgery; not on the ground of its being always ineffectual; but, because equal good has been found to result from measures, which are milder, always less terrific, and frequently less painful. In order to convince an English surgeon that moxa and the actual cautery ought to be introduced into practice, M. Roux should prove, that there is at least some particular disease, which may in this manner be cured, but which cannot be cured by other means ordinarily employed in our practice. He should also make us forget, that the application of actual fire was once as common in English surgery as in French; but that it had not attractions enough to maintain its ground.

However, that the reader may know the arguments used by the advocates for the practice, I submit to him the following observations, which are contained in a periodical work. All the world knows, that counter-irritation is of great use in the treatment of disease; and almost all the world knows, that different forms of counter-irritation produce different effects on the human body. We do not pretend to specify what is the reason of these different effects, simply because we do not know. But, while such men as Percy and Larrey, and twenty others of character, speak so highly in favour of the actual cautery, we perhaps are scarcely authorized to say, that the action of the potential cautery can be made to resemble it in all cases. We can easily understand how the actual cautery should fall into disuse, however good a remedy it might be; for, if we ourselves were patients, we should be slow in believing, that the pain of the application was not so severe as our fears point out; but, the scepticism of the medical man ought to rest on different grounds. We may say, respecting the moxa, that its action may be more easily regulated than that of caustics; so that by the more or less sedulous use of the blow-pipe, we may create a superficial eschar, or a deep suppurating wound. In fact, in all cases, where more than a mere irritation of the skin is required, the moxa affords a certainty in its applications possessed by none of the other caustics. Of course, it would be improper to compare the moxa with blisters, or with any other counter-irritant, which acts by irritating the skin, without destroying it: if we compare it, therefore, with the emetic tartar ointment, issues, setons, and the caustics, properly so called, we shall find, that it possesses greater advantages than they do. The first of these is a long time in destroying the cutis, and it is very uncertain in the quantity of its effect: moreover, whether the effect be produced at all, generally depends on the diligence and knowledge of the patient's attendants, and not on the medical man. Hence, it is not



likely often to be properly applied. Issues and setons produce but little instantaneous effect; their efficacy, therefore, depends on the irritation and discharge daily kept up. Indeed, these also, if they are left to the care of the patient, which they almost always are, soon become inert and useless. The different caustics approach to the moxa in their properties. Their effect is, in some degree, rapidly produced, and a suppurating ulcer is formed; but, still to produce their smallest effect, a longer time is necessary than the surgeon can conveniently stay with his patient; so that, as the operation of the remedy is dependent on time, and that time varies according to the constitution of the patient, the quantity of effect produced can never be calculated upon. It is very different, however, with the moxa. The effect is almost instantaneous, and the surgeon's hand regulates the quantum of action; so that not only is the moxa the most manageable of counter-irritants that destroy the skin, but, as many medical men believe, that suddenness of operation forms not a small part of the efficacy of counter-irritants, the moxa stands also pre-eminent on this ground. (See *Med. Intelligencer*, vol. iii. p. 578; also *Larrey, Recueil de Mémoires de Chirurgie*, Paris, 1821, and particularly, *Dunghlison's Translation of the first memoir*.)

**MURIATIC ACID.** [*Hydrochloric Acid* in the concentrated form is a colourless liquid, highly corrosive, emitting fumes when exposed to the air. It is employed medicinally both internally and externally, occasionally for baths. Gargles containing this acid, are often made use of with advantage in various cases of sore throat, diphtheria and the disease known by the name of cancrum oris.] The following formula is employed at St. Bartholomew's Hospital. *R. Rosæ rubræ exsiccatae 3ij. Aquæ ferventis fbj. In funde perboram dimidium, dein cola, et adde Acidi muriatici 5j. Mellis Rosæ 3ij. Sacchari purificati 3vj. Misce.*

Muriatic acid appears to have been tried in syphilis earlier than the nitric, Dr. Zeller, of Vienna, having employed it as a remedy for this disease ever since the year 1789. (*Vide Sim. Zeller's Prakt. Bemerkungen über den vorzügl. Nutzen d. allerm. bekannt. Budeschwammes, &c. Nebst einem Anhang v. d. Salzsäure, &c.* Wien, 1797.)

As a medicine capable of improving the appearance of venereal ulcers, and of restraining for a time the progress of the disease, it was known to Mr. Pearson for many years. He says, that he was first induced to give this acid in venereal ulcers of the tongue, and of the throat, in consequence of the great benefit which he had seen result from its use in examples of cancrum oris: and without viewing it as an antidote for lues venerea, he has frequently availed himself of its useful qualities, when it was desirable to gain a little time previously to the commencement of a mercurial course. (*Obs. on the Effects of various Articles in the cure of Lues Venerea*, p. 193, ed. 2.) From what he saw, however, he never inferred, that the sulphuric and muriatic acids could radically cure the venereal disease; and he ascribed the benefit derived from them partly to their salutary effects on the stomach and constitution, and partly to their agency on ulcers of the throat and tongue, as local applications. (P. 117.) Hydrochloric acid is administered to correct alkaline conditions of the urine. The dose is from ten to twenty drops.

On this ground it is exhibited to counteract phosphatic deposits in the urine. From 5 to 10 minims thrice daily, will generally be sufficient. Mr. Balman relates a case of phosphatic calculus which was cured by injecting into the bladder a mixture of two drops of the acid in four ounces of water, always taking care to wash out the bladder previously with warm water. It gave rise to no unpleasant symptoms. (*Waring's Manual of Therapeutics*, p. 274.)

Muriatic acid has sometimes been employed, as the active ingredient in injections for the cure of gonorrhœa, in the proportion of eight or ten drops to four ounces of distilled water. It has, moreover, been found useful as a topical application in various affections of the skin, particularly in follicular acne. It may be applied diluted with glycerin, or concentrated. If used in an undiluted form it should be removed in less than thirty seconds, by washing with pure water, and afterwards with soap. (*Kletzensky, see Journ. de Pharm.* Oct. 1859, p. 301: quoted in *United States Dispensatory*, 1865, p. 44.)

In cases of poison from concentrated hydrochloric acid, the experiments, made by Orfila, lead him to consider calcined magnesia and prepared soap the most fit substances for neutralizing such portion of the acid as may not yet be combined with the texture of the œsophagus, stomach, &c. They should be given as soon as possible after the corrosive poison has been swallowed, care being taken to let the patient drink copiously of warm water, milk, broth, or some bland mucilaginous liquid. When, from the symptoms, there is reason to believe that inflammation exists in the viscera, or when spasms and convulsions come on, antiphlogistic remedies, and antispasmodics are indicated. (*Traité des Poisons*, p. 476, vol. i. ed. 2. Paris, 1818.) In order to detect the presence of muriatic acid, when mixed with wine, or other fluids, we are recommended to distil a portion of it from a small retort over a candle into a phial containing a solution of nitrate of silver. The precipitation of muriate of silver, which is soluble in ammonia, but not in nitric acid, will take place, if the poison contain muriatic acid. (*Thomson's Dispensatory*, p. 434, ed. 2.)

By Morveau, who employed himself in investigating the merits of Dr. Carmichael Smith's mode of destroying infection, the muriatic acid, in the form of gas, was alleged to have the very important quality of neutralizing putrid miasmata. The gas is extricated from common salt, by means of sulphuric acid. In this way, it is often employed in hospitals as a mode of preventing and obviating infection.

The use of muriatic acid, as an application to certain cases of sloughing and phagedæna, has been explained in the articles **HOSPITAL GANGRENE** and **MORTIFICATION**.

**MYDRIASIS.** (From *μεδᾶω*, to abound in moisture.) A preternatural dilatation of the pupil.

**MYOPIA.** (See **VISION**.)

**NÆVUS.** (*Congenita Notæ; Enviæ; Mutter-mahl; Mother Spots, &c.*) A mole, or congenital mark, thickening, or excrescence of the skin. Nævi comprehend all the stains, spots, and deviations of a part of the skin from its normal state, which are congenital. Although they are exceedingly diversified, all of them may be arranged under two principal kinds; one consisting of congenital

alterations of the colouring matter of the skin; the other of vascular productions and hypertrophies of the skin, and often of a new growth, or tumour, the texture of which was compared by John Bell and Dupuytren to the erectile tissues, naturally existing in various parts of the body. Hence, the latter structures are now frequently termed *erectile tumours*. (See ANEURISM BY ANASTOMOSIS.) Some of them (says Dr. Bateman) are merely superficial, or stain-like spots, and appear to consist of a partial thickening of the rete mucosum, sometimes of a yellow or yellowish-brown, sometimes of a bluish livid, or nearly black colour. To these the term *spili* has been more particularly appropriated. Others again exhibit various degrees of thickening, elevation, and altered structure of the skin itself, and consist of clusters of enlarged and contorted veins, freely anastomosing, and forming little sacs of blood. These are sometimes spread more or less extensively over the surface, occasionally covering even the whole of an extremity, or one half of the trunk of the body; and sometimes they are elevated into prominences of various forms and magnitude. Occasionally, these marks are nearly of the usual colour of the skin; but most commonly they are of a purplish red colour, of varying degrees of intensity; such as the presence of a considerable collection of blood-vessels, situated near the surface, and covered with a thin cuticle, naturally occasions. (See *Bateman's Practical Synopsis of Cutaneous Diseases*, p. 324, edit. 4.) When a nævus is of a dark red colour, its intensity is generally augmented by everything which tends to accelerate the circulation of the blood. Fits of anger, hot weather, fevers, and the period of menstruation, in particular, are observed to be attended with an increased turgescence and discoloration of the part affected. Indeed the excrescence sometimes bursts, and pours out a dangerous quantity of blood, and in females it has been known to become the seat of a regular menstrual discharge. (*Boyer, Maladies Chir.* t. ii. p. 277; and *John Bell's Principles, Discourse 9.*) Some nævi, especially those usually called *moles*, frequently have long, irregular hairs growing upon them; while the surface of others is streaked, and even granulated. Such as appear in the form of a mere red, purplish stain, have been absurdly supposed to arise from a desire for claret, or some other wine of that colour, entertained by the mother of the patient during her pregnancy. The granulated nævi have been compared with raspberries, strawberries, mulberries, &c., for which the mother's longing is described by the vulgar as a cause. The truth is, however, that this doctrine imputing the origin of nævi to fancies of the mother, is neither consistent with experience nor sound physiology. The causes (as Callisen observes), "*potius autem in evolutione primorum flaminum, a naturæ solita via aberrante, uti in aliis rebus monstrosis quærendæ erunt.*" (*Syst. Chir. Hodiernæ*, vol. ii. p. 201.)

From what has been said, then, it appears that certain nævi are merely cutaneous spots, of a red, violet, or purplish colour, of greater or lesser extent, and with scarcely any perceptible elevation. They are an organic malformation of the skin, the natural texture of which does not exist, but a fluxus of vessels is substituted for it, not endued with the natural sensibility of the cutis itself. Such spots generally continue stationary during life, and

may be regarded rather as a deformity than a disease. (*Lassus, Pathologie Chir.* tom. i. p. 477.)

Others are either of the same nature as the disease well known by the name of the aneurism by anastomosis, or bear a considerable resemblance to it. They are sometimes of great size; and their surface is subject to much variety. They are soft, and indolent, and of a violet or dark red colour. The skin which covers them is very thin, and when they are opened, their structure is like that of a spleen, whose blood-vessels are varicose. Some are covered with a delicate white skin, and do not increase with age. Others are more disposed to grow large. These tumours frequently occur in the skin of the face, and in other parts of the integuments, on the inside of the labia pudendi, and cheeks, and in the substance of the upper and lower lip, where they sometimes form a kind of elongation, attended with great disfigurement. Nævi of this kind, so situated in new-born infants, may produce a serious obstacle to the action of sucking. M. A. Severinus has particularly described them under the appellation of "*tuberculum atro-cruentum labii inferioris.*" (*De Abscessuum Natura*, cap. xxix. p. 803.)

The nævi, which form in the subcutaneous cellular substance, and were named by Petit "*loupes variqueuses*" (*Œuvres Posthumes*, tom. i. p. 276), are also of the same nature as the aneurism by anastomosis. In time, they attain a very large size. Mr. Latta says, he once saw in a child, two years old, a tumour of this kind, weighing fourteen ounces, which at the time of birth was only equal in size to a large bean. During the first year, it did not enlarge much; but it afterwards grew rapidly to the size already specified. (*System of Surgery*, vol. ii. chap. 22.) Lassus has even seen a tumour of this description as large as a man's head. (*Pathologie Chir.* tom. i. p. 479.)

Although the original causes of nævi are buried in obscurity, experience proves, that whatever produces irritation in the part affected, or an increased determination of blood to it, has generally the effect of accelerating the growth and enlargement of the swelling. Thus a trifling bruise, or a tight hat, will sometimes excite a mere stain-like speck, or a minute livid tubercle, into that diseased action, which occasions its growth. (*Bateman's Pract. Synopsis, &c.* p. 327, edit. 3.)

When these marks or swellings are superficial, without any disposition to enlarge or spread, and their trivial elevation does not expose them to accidental rupture, there appears to be no good reason for interfering with them. Indeed, if they were destroyed with caustic, the knife, or a ligature, these means would leave scars, accompanied with nearly the same degree of disfigurement.

But, when nævi evince a tendency to enlarge, or are very prominent excrescences, and either troublesome from their situation, or liable to be ruptured, either their growth must be repressed by sedative applications, or the whole congeries of vessels extirpated or obliterated. Mr. Abernethy proposed the application of cold washes, and the pressure of a bandage. This practice was found by him in several instances to have the desired effect of checking the growth of the tumours, which afterwards shrunk, and became no longer objects of any consequence. (*Surgical Works*, vol. ii. p. 224.) Boyer also knew of a case, in which a nævus of the upper lip was cured by the mother



pressing the part with her finger unremittingly for seven hours at a time, and the use of an alum wash. (*Maladies Chir.* t. ii. p. 269.) However, he is not generally an advocate for this treatment; and Dr. Bateman expressly states, that in the majority of cases, pressure is the source of great irritation to these maculæ, and cannot be employed. (P. 329.)

Modern experience proves, that superficial nævi may sometimes be successfully treated by plans calculated to produce an effusion of lymph in their structure, and an obliteration of their vessels. Doubtless, it is on this principle that some nævi yield to pressure, or to the effects, produced by the insertion of vaccine matter into several points of the tumour, or the injection of a stimulating lotion into their texture.

I was consulted, about two years ago, for a small superficial nævus situated on the bridge of the nose, where it completely spoiled the countenance of a little girl, about six years old. I touched it twice with the *argentum nitratum*, and it soon disappeared. Painting a nævus with the tincture of iodine has sometimes answered; and the proposal of Dr. Marshall Hall to pierce tumours of this sort in every part with needles, has cured them, though slowly, without leaving any scar. These methods are, however, only suited to limited forms of the disease. Lallemand has combined the use of needles with the ligature, not to produce such a degree of constriction as to destroy the vitality of the tumour, but to induce coagulation of the blood in the cells, and such inflammation as shall obliterate them. This treatment, which is also followed by Mr. Lloyd, I have explained more particularly in speaking of ANEURISM BY ANASTOMOSIS.

[Injections of the perchloride of iron have been of late years recommended, and have proved successful in several instances. It is right, however, to state that some fatal cases have occurred from their use. Mr. Robert Carter, of Stroud, details one which happened in his own practice. The patient was a child eleven months old, who had a rapidly advancing nævus affecting the exterior and interior of the nostrils, as well as the adjoining portion of the cheek. Five drops were injected by a jerk caused by an imperfection in the syringe. Instant death was the consequence. (*Med. Times and Gazette*, Sept. 5th, 1863, p. 262.) In the same journal for June 18, 1864, p. 683, Mr. Carter refers to another fatal case which took place in a colonial hospital. The post mortem examination shewed that the point of the syringe had penetrated the transverse facial vein. The blood in the right cavities of the heart was found firmly coagulated. These cases of death, arising from the accidental wound of a blood vessel in injecting a nævus, must ever form a serious objection to the practice. In plunging the point of a syringe into the texture of a nævus, the surgeon can never be sure of lodging the fluid he injects in the intervacular space, and not in a blood-vessel. Irritating fluids, therefore, or those acting chemically on the blood, such as the liquor ammoniac, or the perchloride of iron, should never be used for the purpose. The actual cautery as a means of destroying nævi, and which is not subject to this risk, has not, perhaps, been sufficiently appreciated by the profession. It is strongly recommended by Mr. J. R. A. Douglas, of Hounslow, who has published three successful

cases of considerable interest of its employment. Other remedies had been tried but failed to cure the disease. (*Lancet* for March 24, 1866, p. 328.)]

Dr. Pendleton, of New York, tried vaccination for a nævus situated on the face of a new-born infant. He introduced the vaccine matter at two opposite points on the margin of the tumour; "the infection was communicated, and had the two pustules met, the deformity would have been entirely removed. The only portion of the disease left is, that between the two cicatrices left by the pustules, and is very inconsiderable." Dr. Reese is of opinion, that vaccination merits a trial in every such case, and believes, that if three or more points of infection can be obtained, so as to envelope the tumour, it will doubtless succeed, and is preferable to excision, or the ligature. But, when the nævi obviously belong to the class of aneurisms by anastomosis, are situated on the head, very prominent, and disposed to increase with rapidity, Dr. Reese joins the generality of surgeons in deeming extirpation advisable. In such cases, Dr. Physick's method was to pass a scalpel round the tumour, cutting down to the pericranium, and then tying the arteries separately. Lint was then interposed to prevent union by the first intention. This plan, he says, has been very successful in the hands of Drs. Mott and Jamieson, as well as those of Dr. Physick, and he greatly prefers it to the cure by ligature. (*Reese in Amer. Ed. of this Dict.*) The apology for the ligature and caustic, however, we know is founded upon the danger of a sudden gush of blood to the life of an infant.

With regard to the injection of nævi with stimulating fluids, Messrs. Paget and Fullager, of Leicester, have recorded a case, in which a healthy and remarkably precocious child died in the course of a minute after a nævus, situated over the angle of the jaw, had been injected with diluted liquor ammoniac. It seems probable, that, in this instance, some of the injection passed into the venous system. (*See London Med. Gaz. Dec. 30, 1837.*) I have not heard, however, of any similar occurrence; but the fact merits recollection.

For all examples, which partake of the nature of aneurism by anastomosis, and are disposed to grow, the best general mode of cure is extirpation. The exceptions to this plan are certain examples, in which the tumour seems to derive its main supply of blood from some large artery, the trunk of which will admit of being tied. The prudence of extirpating the disease, ere it extend too far, and the necessity of taking away every particle of the disease, has been already explained: this is what was advised by F. Hildanus (Cent. v. obs. 46), what was strongly urged by the celebrated Petit (*Œuvres Posthumes*, t. i.), what was recommended in still more animated terms by Mr. John Bell (*Principles of Surgery*, discourse ix.), and it is what is particularly insisted upon in another part of this Dictionary. (*See ANEURISM.*)

The hæmorrhage from the excision of some nævi, however, is so profuse, and the difficulty of cutting away all the disease so great, that my friends, Messrs. White and Lawrence, sometimes prefer extirpating nævi by the introduction of a double ligature through their substance, and then tying each half of the swelling with sufficient tightness to make it slough. (*See Med. Chir. Trans.* vol. xiii.) When

the tumour is of considerable size, this plan appears safer than excision.

Mere thickenings, and discolourations of the rete mucosum, have sometimes been removed by a mixture of spirit, and the liquor potassæ. (*Bateman*, p. 330.)

I have touched several superficial nævi on infants with diluted nitric acid, by which means they have been gradually dispersed.

Formerly caustic was much in vogue for the removal of nævi; but, unless its action extend deeply enough to destroy every part of the disease, it may cause a dangerous and useless degree of irritation, copious hemorrhages, and a sudden and fatal enlargement of the tumour. It cannot be denied, however, that the old surgeons had success with their caustics, when nævi did not extend too deeply. Thus, in speaking of caustic remedies, *Callisen* observes: "inter quæ eximio cum successu adhibetur sapo cum æquali parte calcis vivæ subtilissime commixtus, nævo per emplastrum perforatum admovendus, et alio emplastro imposito firmandus; hoc remedio eschara inuritur, qua soluta, cicatrix alba remanere solet." (*Syst. Chirurgiæ Hodiernæ*, vol. ii. p. 202.)

Mr. Wardrop, having seen cases in which nævi were cured by accidental attacks of ulceration and sloughing, which destroyed a great part of the tumour, and brought on such inflammation as consolidated the rest, was led to imitate this process by adopting the ancient practice of applying the kali purum. He found the method answer in several instances. I lately attended, with Jephson, a child at Hampton, which had a nævus of some thickness on the fore-arm, and equal to a crown-piece in size. We attacked it with the kali purum, and a cure was soon effected.

In the article ANEURISM, in speaking of aneurism by anastomosis (p. 197), I have noticed Mr. Keate's improvement in the mode of applying ligatures by transfixing the tumour with long pins and then surrounding its base with a ligature. "Small and trifling erectile tumours (says Mr. Liston), favourably situated may be removed with the knife; but it is not a safe practice, and an instantly fatal result from hemorrhage has more than once followed the attempt. In children, it is seldom admissible, for, as is well known, they bear the loss of blood badly. The mode of removing this disease by ligatures was well known to Mr. Bell, and it has been followed by Messrs. A. White, Lawrence, and a variety of others. The ligature cannot be applied with propriety, when the skin is much affected; and when extensively included, the strangulation of the mass can only be effected by slow degrees; the tumour perishes only from inflammation, and from deficient power in the part; deformity besides is produced. This is a very painful and tedious process, but it may be accelerated by the application of fresh ligatures from time to time. The ligature alone is applicable in some instances, as where the diseased part is small, prominent; and nearly the whole of its covering is involved. The object must be to remove the adventitious tissue thoroughly, so that there shall be no return. Should it be impossible to include it entirely, and should some small portions be by chance left out, it may possibly happen, that its vessels shall be closed by fibrinous deposit, but this is not to be depended upon. Reproduction of the disease has too often followed operations thus

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imperfectly performed." Mr. Liston then describes his mode of applying the ligatures. "When the skin is of necessity to be tied with the tumour, one or more ligatures are to be passed underneath. A double ligature, carried by a common suture needle (or another instrument represented in his work) will answer perfectly. The loop is cut, and one portion tied on each side, in order to make the ligatures embrace the base thoroughly; a second needle, or hare-lip pin, may be thrust across in the opposite direction, and removed after the threads are drawn and fixed under them; or the pin may be clipped short, and left to come away with the threads and tumour. This mode I have followed with good success for a series of years, and in numerous cases. When the skin is slightly, or not at all affected, and the subcutaneous tumour is large, the covering should be turned back, and the ligatures then employed. I operated, for a tumour in this situation, a few weeks ago, on a little girl, who had been subjected to several unsuccessful operations previously. One needle, that across the morbid mass, was in the first instance introduced without a ligature, after the incisions had been made; the tumour was raised by means of it, and the second needle passed underneath the first, carrying a strong thread; the loop of this was laid hold of with a hook, and the needle withdrawn upon the ligature. The first needle was then armed also, and the double ligature brought through with it. These were then secured." (See *Liston's Practical Surgery*, p. 281.)

For additional remarks, see ANEURISM.

Consult *Petit's Œuvres Posthumes*, t. i. *Lassus*, *Pathologie Chir.* t. i. p. 476, &c. ed. 1809. *Callisen's Systema Chirurgiæ Hodiernæ*, vol. ii. p. 201, Hafnia, 1800. *Abernethy's Surgical Works*, vol. ii. p. 224, &c. *Latta's System of Surgery*, vol. ii. chap. 22. *J. Bell's Principles of Surgery*, vol. i. Discourse 9. *Boyer*, *Traité des Maladies Chirurgicales*, t. ii. p. 225, &c. Paris, 1814. *A Practical Synopsis of Cutaneous Diseases*, by *T. Bateman*, edit. 3. 1814. *Delpech*, *Précis Élémentaire des Maladies Chir.* t. iii. p. 244, Paris, 1816. *Scarpa*, *Opuscoli di Chirurgia*, vol. ii. Obs. 374, Pavia, 1825. *J. Wardrop*, on one Species of Nævus, with the Case of an Infant, where the Carotid Artery was tied, in *Med. Chir. Trans.* vol. ix. p. 199, &c. *W. Lawrence*, in vol. xiii. of the same work. *P. Rayer*, *Maladies de la Peau*, t. ii. p. 22. 8vo. Paris, 1827. *Robert Liston on Practical Surgery*, p. 278. 8vo. Lond. 1837.

NECROSIS. (From νεκρω, to destroy.) This word, the strict meaning of which is only mortification, is, by the general consent of surgeons, confined to this affection of the bones. It was first used, in this particular sense, by the celebrated M. Louis, who restricted its application, however, to examples, in which the whole thickness of a bone was destroyed. See *Mém. de l'Acad. de Chir.* t. v. 4to.) By the ancients, the death of parts of bones was not distinguished from caries. However, necrosis and caries are essentially different; for, in the first, the affected part of the bone is deprived of the vital principle; but this is not the case when it is simply carious. Caries is very analogous to ulceration, while necrosis closely resembles mortification of the soft parts.

Between caries and necrosis, says Weidmann, there is all that difference, which exists between ulcers and gangrene, or sphacelus, of the soft parts. In caries, the nutrition of the bone is only impaired, and an irregular action disunites the elements of the bony structure, which consequently sustains a loss of substance; but every remaining



part of it is yet alive. In necrosis, on the contrary, the vitality and nutritive functions cease altogether, in a certain portion of the bone, the separation of which then becomes indispensable. (*De Necrosi Ossium*, p. 7.)

I have mentioned, that M. Louis confined the term necrosis to cases, in which the whole thickness of a bone perished; but Weidmann judiciously criticises this limitation of the word, and maintains, that the nature of the disorder is the same whether it affect a single scale, the whole, or a mere point, of the bone. He also objects to the definition of necrosis proposed by Chopart (*Dissert. de Necrosi Ossium*, Paris, 1765), and adopted by David. (*Obs. sur une Maladie connue sous le nom de Nécrose*, Paris, 1782.) These two authors have defined necrosis to be a disorder, in which a portion of bone perishes, and turns dry, in order to be soon separated from the living parts, and replaced by a new bony substance, which is to perform its functions. But, as Weidmann observes, it may happen, that a piece of bone, which dies and separates, may not be replaced by any new formation of bone, though the disease is of the same character, and merely varies in some modifications. He therefore argues, and every rational surgeon will agree with him, that a true necrosis must always be said to exist, whenever a dead portion of bone has either separated, or is about to separate. "*Vera demum necrosis semper est, si aliquod ossis ramentum, in quo vis vitæ extincta est, abscessit, vel proxime abscessurum est.*" (B. 7.)

[The bones most commonly attacked by necrosis are the tibia, femur, lower jaw, humerus, clavicle, ulna, radius, and cranium. The upper jaw is occasionally the subject of this disease, and when such is the case, no reproduction of bone ever occurs. (*Stanley on Diseases of the Bones*, p. 72.)]

In fact, excepting the lower jaw and scapula, the process of regeneration has only been noticed in the cylindrical bones. From 12 to 18 years of age, is the time of life most subject to necrosis, but it may be met with at any period; it is not however common in old people unless the result of an injury. Necrosis of the lower jaw seldom is found before the age of 30.

No climate, age, sex, mode of life, nor condition (says Weidmann), is exempt from this disorder. Childhood and puberty, however, are the periods most liable to it. The same thing may be said of persons, who labour hard, and are much exposed to external injuries. Every bone of the human body is liable to necrosis; but those which are superficial, and enter into the formation of the extremities, are more frequently affected, than others whose situation is deeper. Necrosis less commonly attacks the spongy substance of the bones, because this being endued with a higher degree of vascularity and life, suppuration is more apt to occur. Necrosis, on the contrary, is oftener seen in the compact substance, where the vital principle is less energetic, and more readily extinguished. It has been truly remarked that a very slight injury will frequently occasion an extensive exfoliation from the surface of the cylinder of a long bone; whilst a musket-ball may pass through the cellular structure of an epiphysis, or lodge in its substance, without giving rise to necrosis, suppurative inflammation being more likely to occur, than the latter affection. (*Bell on Diseases of the Bones*, §c. p. 49.) Lastly, necrosis may affect the long bones,

or the broad; the large or small, and even those the very least in size; since it is well known, that the ossicula of the ear may be destroyed by necrosis, and separate. I have seen this happen in two instances, and the fact is recorded by several writers. (See *Astruc de Morbis Veneris*, lib. iv. cap. I. *Henri, Journal de Médecine*, t. xv. p. 363.)

Though necrosis mostly attacks the cylindrical bones, the flat ones are not exempt from the disease. Pott makes mention of a parietal bone, the whole of which was detached, and of an os frontis, the greatest part of which came away. [Our museums furnish also many specimens of extensive necrosis of the cranial bones; in these cases syphilis is a very frequent cause of the disease, but it may be the result of an injury.]

In a thesis on necrosis, written in 1776, may be found the case of a young man, a very large part of whose scapula perished and separated. Chopart, who relates the case, mentions, that he saw the patient quite recovered, and felt a new triangular moveable bone, firmly supporting the clavicle, but smaller and flatter than natural, and without any spinous process. The same has happened to the lower jaw, as may be seen by referring to the *Ephemerides Nat. Cur.* and *Mém. de l'Acad. de Chirurgie*. In the fifth volume of the latter work, is an account of a woman who applied to be relieved of some venereal complaints. From the beginning of the treatment, the bone was discovered to be loose just under the gums, and seemed, shortly afterwards, to move backwards and forwards with a tooth. M. Guernery took hold of the tooth with a key-instrument, and found it firmly inserted in the moveable jaw; he made with caution the necessary manœuvres for extracting the portion of bone; but was greatly surprised on finding what an extensive part yielded to his very moderate efforts. It was the whole of the lower jaw, above its right angle, from its division into the coronoid and condyloid processes to the space between the first and second of the front grinders of the left side. On the right, there only remained the condyle in the articular cavity of the temporal bone. This destruction left a considerable empty space, from which great deformity was apprehended, in consequence of the unsupported soft parts falling down. The woman, however, got well in two months, and had the most perfect use of a new jaw. A similar fact is recorded in the *Journal de Médecine*, 1791. [Mr. Perry removed the whole of the lower jaw, affected with necrosis from one ramus to the other; and such a reproduction of it took place, that the woman could compress substances placed between the jaws, with some force. (*Med. Chir. Trans.* vol. xxi.) Similar instances are also recorded by Desault, Tyrrell (*Cheilus's System of Surgery*, by South, vol. ii.) and Syme.]

When the body of a cylindrical bone, or the middle portion of a flat bone is destroyed by necrosis, their extremities, which are of a cellular texture, generally continue unaffected, so that in the cylindrical bones, the articular ends are portions of the original bone, which are engrafted, as it were, on the new production. There are, however, a few bad cases, in which the necrosis does not altogether spare the heads of the bones, and the disease communicates with the joint. These examples are not very common, and are attended with considerable danger to the limb: indeed they generally require amputation. (See *Boyer, Mal. Chir.* t. iii. p. 442.) Sir Benjamin Brodie knew an

instance, in which, without any obvious cause, the head of the tibia died, and exfoliated, and the destruction of the knee-joint was the consequence.

[He also mentions cases where the joints were destroyed in consequence of necrosis of the lower end of the tibia, and of the condyles of the femur. (*Brodie's Works, by Hawkins, vol. ii. pp. 264 et seq.*) The same author observes that death of the articular extremity of a bone must necessarily cause immediate destruction of the entire joint: and the examples related by Stanley and others would appear to support this opinion. But that an epiphysis may perish, without the joint becoming affected, is shown by a specimen in the Museum of St. Mary's Hospital, where the upper half of the tibia and its articular end are the seat of necrosis: the epiphysis is separated from its shaft, and the cartilage covering it is still adherent to the exfoliated piece, and retains its characteristic appearance, except at one spot, where it is thinned, converted into fibrous tissue, and coated over by an exudation of lymph. Amputation through the knee joint was performed, and the cartilages upon the patella and condyles of the femur were found to be perfectly healthy. In the same museum is a preparation showing necrosis of the lower end of the femur where there is a loose sequestrum, about the size of a nut, contained in a cavity within the condyles, which has no communication with the knee joint: the cartilages of this articulation are unaltered, except on the external condyle, where a small point has degenerated into fibrous tissue, as in the preceding case, and is not so thick as elsewhere.

The cancellous texture of the head of the tibia appears to be more prone to necrosis than any other articular extremity of the long bones, as indeed it is to the other affections to which bones are liable. The epiphyses are more subject to disease in persons of a scrofulous tendency than in others, owing to the lower degree of vitality which the bones possess in such cases.]

In Weidmann's celebrated work may be seen engravings, taken from various specimens in which the heads of bones, and even their articular surfaces were implicated; and in Mr. Liston's collection is a fine example, in which the knee-joint was involved. It is not, therefore, correct to assert absolutely, as Sir C. Bell has done, "that the extremities of bone are not subject to necrosis." (*Surg. Obs. p. 321.*) It would be more accurate to say, that those parts are not frequently attacked. Our museums contain many specimens of necrosis in the compact texture of bones, though but few in the cancellous structure. "This is evidently the result of the lower degree of vascularity, and it may be said, of vital power, in the compact structure; and it is well illustrated by the effects of the excessive use of mercury on the bones of the upper and the lower jaw. The former rarely perishes; the latter very frequently from this cause; and so too, in necrosis of long bones, the articular extremities are very rarely included in the disease." (*See Lond. Med. Gaz. vol. xx. p. 497.*) Yet, I must confess, that numerous instances have fallen under my observation, where portions of the upper jaw perished, from the abuse of mercury. I know of a melancholy case, in which this happened, where syphilis was entirely out of the question, calomel having been carelessly administered for supposed disease of the liver. (*See also Stanley, loc. cit. p. 72.*)

Besides the differences arising from the particular bones affected, necrosis also varies, according as the portion of bone attacked happens to be thin and of little extent, or large and of considerable thickness. The disease is *simple*, when it is confined to one bone, and the patient is in other respects healthy; *compound*, when several different parts of the same bone, or several distinct bones are affected at the same time; when the health is bad; and other parts of the body are also diseased. It should also be known, because the information is of practical importance in the treatment, that necrosis has three different stages, or periods. In the first, the bone affected perishes; in the second, the process of exfoliation, or separation of the dead bone from the living, is going on; and, in the third, the separation is completed. (*See Weidmann, p. 8.*)

Necrosis is divided by some writers into the *traumatic* and *idiopathic*. In the latter, the exfoliations are generally more extensive and deep, than in the former, and frequently comprehend the whole thickness of a bone. The idiopathic is also that which is mostly met with in the flat bones. (*See Bell on Diseases of the Bones, p. 50.*)

The causes of necrosis are precisely analogous to those which produce gangrene of the soft parts. As, however, the vitality of the bones is weaker, we may infer, that necrosis may be occasioned in them by causes, which are less numerous and intense, and such as would only give rise to suppuration in the soft parts. Every thing, whether in the periosteum, or the substance of the bone itself, that tends to interrupt the nutrition of the bone, must be regarded as conducive to the origin of necrosis.

[This affection depends essentially upon an obstruction to the circulation, whether occurring in the substance of the bone itself, or in the structures surrounding it, so that the quantity of blood conveyed to the part is insufficient to maintain its vitality, and necrosis or death takes place.]

If the mischief in the periosteum, medulla, or substance of the bone, be of trivial extent, the consequence may be merely an abscess, but this termination is very rare. Some of the causes of necrosis are *external*, while others are *internal*, or constitutional. Sometimes the life of the bone is instantaneously destroyed by them; but in other instances, the bone is first stimulated and its death is preceded by true inflammation.

[Gerdy, in his valuable monograph (*Maladies des organes du mouvement, p. 217*), asserts that necrosis is never caused by inflammation of the osseous tissue, and some modern writers share this opinion. He admits, however, that portions of bone, even of considerable size, may perish from the effects of osteitis, but considers that the diseased action which brings about their removal is that of caries and not of necrosis. There can be no doubt that inflammation will occasion the death of bone, and whether we refer the process by which these sequestra are separated "to the ulcerating inflammation of caries, or to the eliminating inflammation of necrosis" (*op. cit. p. 159*), the cause of death is still the same, viz., a deficient nutrition of the part in consequence of some impediment to the circulation through it. This hindrance to the passage of blood is produced either by the pressure of inflammatory exudation upon the vessels within the Haversian canals,



causing thus a narrowing of their channels, or by a complete obliteration of the vessels themselves.]

When a bone perishes from inflammation of its substance, as Mr. Stanley has observed, we are not always able to recognise the presence of inflammatory symptoms; yet that this loss of vitality is sometimes preceded and produced by inflammation seems to have been exemplified in the following case, recorded by that gentleman. A female, aged 17, died a month after the commencement of an attack of deep-seated inflammation of the leg. On examining the limb, the periosteum was found separated from the shaft of the tibia, in its whole extent. The space between it and the bone was filled with purulent fluid; the bone itself was of a deep red colour, which could not be wiped away, and was evidently produced by blood stagnant in the vessels. (See *London Med. Gaz.* vol. xx. p. 497.) And, in another place, he remarks, that the canals, transmitting the vessels in bones, are larger than the vessels themselves, which thus have space afforded for enlargement, so that the bone will contain more blood. It may be presumed too, that vessels, which previously could not admit the red globules of the blood, are now pervaded by them, and hence the bone acquires a deep red colour. Thus, in a bone, from which the periosteum had been stripped, Mr. Stanley observed first a pale rose, and afterwards a bright red colour produced; and, "in an operation to extract a sequestrum, a flow of blood from the cut surface of the surrounding inflamed bone, as free as from a divided muscle." (Vol. cit. p. 422.)

The external causes, which injure the periosteum and medullary structure, and thus produce necrosis, are wounds, contusions, pressure, fractures, comminutions, acrid substances, caustics, and extreme degrees of heat or cold.

When the periosteum, in consequence of an external cause, inflames and sloughs, or is at once deprived of its vitality, as it may be by the action of caustic, fire, or intense cold, the vessels which conveyed nourishment to the bone are destroyed, and the death and exfoliation of the denuded portion of the bone are inevitable. But, if the detachment of the periosteum be not extensive, the patient young and healthy, and the treatment calculated to prevent inflammation, and preserve uninjured the vessels distributed to the bone, hopes may be entertained, that no part of it will die, but that granulations will very soon arise from its surface, being adherent to it as the periosteum was, and that they will grow to, and cicatrize with the surrounding parts. Weidmann has explained, that the fact of bones not always exfoliating when deprived of the periosteum, which is a point of practical importance in the treatment of wounds, was inculcated by Felix Wurtz, Cæsar Magastus, and Belloste, at a time when the contrary opinion prevailed. Weidmann also adverts to his own experience and to the experiments of Tenon, in further proof of the preceding fact. (*Mém. de l'Acad. des Sciences*, 1758, p. 372.)

On the other hand, when the detached piece of the periosteum is large; when the bone itself is contused; or when it has been long exposed to the air; when the inflammation is violent and extensive; when the patient is old, decrepit, or of bad constitution; and, more especially, when improper applications are used, necrosis cannot be avoided.

An internal necrosis, affecting the spongy tex-

ture of bones, generally arises from constitutional causes; though sometimes an external cause, which seems to affect only the surface of a bone, extends its action to the interior, so as to destroy the medullary membrane, and produce an internal necrosis.

In external injuries of the head, where the pericranium is lacerated, contused, or otherwise hurt, or where the outer table, or the diploe of the skull, is injured, the inflammation frequently extends to the inner table, and the dura mater becomes detached. Hence, a collection of matter forms, which may occasion many bad symptoms, and even death itself; or, if the patient survive, exfoliation of part of both tables of the skull is the consequence. (See *Pott's Chir. Works*, Lond. 1779, vol. i. p. 32.)

The same thing may occur in other bones, as well as in those of the cranium. Bromfield had an opportunity of seeing a necrosis of the spongy tissue of the upper and internal part of the tibia, brought on by the improper mode in which an issue was dressed. In order to keep the peas from slipping out of their places, a compress with a shilling in it, and a tight bandage were applied; but the part was attacked with excruciating pain, and the spongy texture of the tibia in the vicinity became affected with necrosis. (*Chir. Obs. and Cases*, vol. ii. p. 9.)

This circumstance, as Weidmann observes, ought not to surprise us: as numerous vessels quit the periosteum to descend into the substance of the bone, to ramify on the medullary cells themselves, and freely anastomose there, it cannot be difficult to conceive how inflammation, which is at first confined to the outside of the bone, may (through the medium of the vessels, which serve as conductors to it) penetrate more deeply, and extend its ravages in every direction.

As a general rule (Mr. Stanley observes) when the walls of a cylindrical bone perish in their whole extent, the medullary texture suffers with them; but he met with one remarkable exception, in which, in consequence of the application of nitric acid to a phagedenic ulcer of the leg, the whole of the periosteum of the tibia became inflamed, the walls of the bone perished; yet the medullary texture remained entire and with its vitality unimpaired (*loc. cit.* p. 82).

[The medullary membrane performs the same functions with respect to the internal lamellæ of the bone, that the periosteum does to the external; when, therefore, inflammation is excited in it, whether by disease or injury, necrosis of the layers which form the walls of the medullary canal will occur, giving rise to the severe symptoms hereafter mentioned as distinguishing an internal necrosis. Operations upon the bones, amputations, and fractures may cause this: it may follow a violent concussion, as from a fall, a blow from a musket ball, &c., by which the membrane is detached from its connexions, and death of that part of the bone takes place. Suppuration of the medullary texture may ensue from any of these causes, and is attended by very grave local and constitutional results.]

But necrosis may proceed from another description of causes, which are of a constitutional nature. In fevers of bad type, in small-pox, and in measles, experience fully proves that the bones are sometimes attacked with necrosis. Scrofula, syphilis, rheumatism, and scurvy, also frequently pro-

duce such mischief in the bones as terminates in necrosis.

[When this disease is the result of scrofula, the cancellated texture of bone is its usual seat. In syphilis the compact tissue is mostly affected, and especially in those bones which are superficial and thinly covered by integuments or mucous membrane. Rheumatism is not an infrequent cause; the tendency of this disease being to attack the fibrous tissues, the periosteum occasionally suffers, and either the inflammatory action extends to the bone, or its nutrition is interfered with. (*Stanley, op. cit.* p. 77. *Path. Soc. Trans.* vol. xiii. pp. 198, 207.) Necrosis in scurvy generally occurs in the lower jaw, but, in advanced cases, other bones have been found affected.]

It has been already noticed that mercury may itself give rise to the disorder, especially in the lower jaw-bone. (See *Mém. de l'Acad. de Chir.* t. v. p. 356. 4to.) This happens either in consequence of mercury having been introduced too quickly into the system, or because the patient exposes himself to cold, or deviates in some other respect from a proper regimen, whilst undergoing a course of treatment by that drug.

Certain necroses of the jaw appear also to have been caused by blows, and the application of acrid substances to carious teeth, or morbid growths from the gums.

[But a very peculiar cause of necrosis in the jaws is that produced by the action of phosphorus, in those who are continuously exposed to its fumes, as in lucifer-match makers. This form of necrosis was first observed by Lorindser, of Vienna, who published a memoir upon it. Heyfelder, of Erlangen, has specially described the disease from cases he had seen amongst this class of workpeople at Nuremburg. (*Arch. Gén. de Méd.* Oct. 1845, p. 204.) Bibra has collected over 50 cases of it, and has analyzed the diseased bones, and found "the organic and fatty substances in greater proportion than was the case in the healthy condition." The lower jaw is most frequently affected, but the upper is often attacked: both jaws were implicated in 5 cases out of the 51 recorded by Bibra and Geist. (*Brit. and For. Med. Chir. Rev.* April 1848.) The subjects of this disorder are generally from 20 to 30 years of age. The disease commences with deep-seated pain in the face, very similar to that of tooth-ache: the gums become spongy, and swell; the teeth, more particularly the molars, loosen and ultimately fall out; great swelling of the cheek occurs, with much inflammation; abscesses form and burst, discharging very foetid matter, and leaving fistulous openings which lead down to bare bone; the general health is usually much impaired. The bone when removed often presents a dead grey worm-eaten appearance, similar to a piece of pumice stone, caused by the deposition upon its surface of an ill-formed osseous material: at other times, this incrustation does not exist, but the sequestrum will be found embedded in a mass of ossifying exudation, which gives rise to great swelling of the face. No attempt at reproduction has ever been observed for the upper jaw, and it is commonly very imperfect for the lower; whilst, according to Mr. Salter, even the scanty repair met with in these cases is not permanent, the new bone becoming gradually absorbed. (*Holmes' System of Surgery*, vol. iv.)

No other bone is affected by this disease: according to M. Strohl (*Gaz. Méd. de Strasbourg*),

the vapour of the phosphorus derives oxygen from the air, and becomes converted into phosphoric acid: this causes softening of the gums, attacks the teeth, and so extends to the alveolar process, which is the part of the bone usually implicated: it has been stated that the disease only occurs in those whose teeth are carious, and that the phosphoric vapour reaches the sockets through their medium.]

It was formerly supposed, that purulent matter collected near a bone, might in time become acrimonious, corrode it, and produce necrosis. Hence, it was a rule to open such an abscess as soon as its existence was known. But, Weidmann questions, whether there was any real necessity for this practice. No doubt, says he, the preceding erroneous opinion arose from the circumstance of the bones being often found bare, carious, or even affected with necrosis, when abscesses were near them; but this happens because the inflammation, which caused the suppuration, had also extended its effects to the periosteum and bone. He affirms that he has witnessed ulcers, in which the surface of bones, bare and uncovered by the periosteum, lay bathed in pus for a very considerable time; yet, being dressed with a mild ointment, they continued entire, granulations grew from them, and cicatrization followed. He had also in his possession portions of bones, affected with necrosis, which had lain for years in pus: still their surface was smooth, and presented no marks of erosion. If then these pieces of bone underwent no alteration, how much less likely to do so are bones, which are endued with life!

But, though Weidmann wisely rejects the doctrine that pus is capable of destroying the periosteum and bones by any corrosive qualities, he acknowledges his belief, that the matter of an abscess may by its quantity compress and inflame the adjacent parts, and occasion their removal by the absorbents. While the periosteum intervenes between an abscess and the bone, he does not see how the latter can be hurt by the pus; but, when the abscess is copious and lodged between that membrane and the bone, the vessels passing from the former will be destroyed, and either caries or necrosis ensue.

The inflammation, arising from the causes which excite necrosis, may be *acute* or *chronic*. It is chronic, when it begins and passes through its different stages slowly, and when the mildness of the symptoms may lead us to mistake the nature of the case. This sort of inflammation chiefly happens in debilitated constitutions, and originates from some chronic cause, such as scrofula, syphilis, and scurvy. But, when necrosis attacks the interior of the bone, and the disease occurs in a strong, irritable, plethoric subject, inflammation is immediately kindled, attended with most acute symptoms, severe pain, considerable fever, restlessness, delirium, &c. Chronic inflammation is more supportable, but its duration is longer: acute inflammation is more afflicting, but sooner comes to a crisis.

The part, in which a necrosis is situated, is affected with swelling. What has been observed, respecting the inflammation, is also applicable to this tumour, which most frequently forms gradually, but sometimes with great rapidity. In the first case, the accompanying pain is dull and inconsiderable; in the second, it is violent. The swelling has not, like that of abscesses, an elevated apex. On the contrary, it is so widely diffused, that the limits



which circumscribe it can hardly be distinguished. This diffusion of the swelling is the greater, in proportion as the diseased bone is more deeply buried in soft parts: it may extend along the course of the affected bone, or even over the whole limb. The swelling comes on at the very beginning of the disorder, and continues to increase, until the matter which it contains finds its way out, when the evacuation is followed by a partial subsidence of the tumour. The swelling is sometimes also combined with œdema, especially in persons whose constitutions have been impaired by the severity of the disease, the violence of their sufferings, and the long and profuse discharge.

When the inflammation is acute, purulent matter of good quality soon collects in the vicinity of the necrosis. In the contrary case, the pus forms slowly, and is thinner and less healthy.

The abscess which accompanies a necrosis, naturally soon bursts when it arises from intense inflammation, and is situated near the skin, which is itself inflamed. But, when the bone is surrounded by a great thickness of soft parts, and the inflammation is chronic, the quantity of matter daily increases, the cavity which it occupies becomes larger and larger, and considerable pressure is made by the abscess on every side. The bones and tendinous expansions resist for a long while the progress of the matter; but the cellular tissue yields and sinuses form, which sometimes run to a great distance from the seat of the disease, especially when the abscess lies under a fascia.

It was formerly supposed, that, in necrosis, the matter was invariably sanious, acrid, and fetid, but Weidmann has exposed the error of this opinion. He had often seen abscesses, arising from necrosis, discharge a whitish, inodorous, thick pus, absolutely devoid of any bad quality whatsoever. He had particularly met with this in patients, whose necroses proceeded from an external cause, or an internal one of a slight nature, and whose health was generally good. (*De Necrosi Ossium*, p. 16.) If, says the same excellent writer, we sometimes find in practice the matter dark-coloured and fetid, we must not ascribe it to the affection of the bone, but to the weakness and bad state of the patient's health. Under the same circumstances, common sores of the soft parts would also discharge pus of a bad quality.

[After the abscesses have been discharging for some time, they begin to contract, become lined with a thin smooth membrane, and show no disposition to close, forming sinuses; they then receive the appellation of *fistulæ*. The dead pieces of bone, whether loose or adherent, act as foreign bodies, and prevent the cicatrization of these openings, as also does the pus, which is formed during the progress of the disease, and is discharged through them. Sometimes these fistulous sinuses, if very extensive, will not heal, although the necrosed bone has come away, because the amount of secretion from the membrane lining their surfaces is so great as to prevent contact of their walls, and adhesion therefore cannot take place.]

The *fistulæ* vary in number; but, they are fewer in proportion as the disease is slighter. In an extensive necrosis, several of these openings are seen, either near together, or separated by considerable spaces; and, when the necrosis affects the whole circumference of the bone, the *fistulæ* in the integuments occur on every side of the limb.

The inflammatory fever, which always attends a severe case of necrosis, and is sometimes accompanied with exceedingly violent symptoms, usually abates when matter is formed, and the patient is then subject to another fever of a low hectic type. This takes place in the decline of the disease, is the effect of the long continued profuse suppuration, gradually reduces the patient, and at length, in the more severe cases, will bring him to the grave, unless the timely removal of the sequestrum be effected either by nature or art.

Let us next endeavour to trace the signs, by which we may not only ascertain the presence of the disease, but its modifications.

In the first place, we should make ourselves acquainted with every thing, which may have predisposed to the disorder; as for instance, what accidental circumstances have occurred, and what symptoms followed them. We should also inquire into any previous treatment, which may have been adopted; for, as Weidmann truly remarks, injudicious remedies have caused many a necrosis, that would not have occurred at all, if the case had been properly treated, or confided to nature.

The kind of inflammation, with which the disease commences, may afford grounds for suspecting that necrosis will happen: it is generally slow and deeply seated, passing through its stages tardily, whilst the attendant symptoms are severe. The skin retains its natural colour a long while; but, at length, exhibits a reddish or livid discoloration. The matter does not reach the skin, till a varying, though often a long time has elapsed, and when the abscess bursts, the inflammatory symptoms are slow in subsiding. When the inflammation is acute, the patient suffers intolerable pain for a considerable period.

There are also other symptoms of a necrosis; viz. the swelling which accompanies the inflammation, is situated along the course of the bone, or rather the bone is included in the tumour, so that its outline cannot be defined: the swelling is at the same time very diffused, the matter lies deeply, and can only be felt in an obscure way: the tissues covering it are soft and quaggy: the skin is often œdematous. The fistulous openings, beneath which a necrosis is situated, discharge a large quantity of matter; their edges are hard and bent inward; they are surrounded by granulations which are either yellowish and pale, or else of an intense red colour; these are generally large and flabby, though not very sensitive; sometimes, however, they are extremely painful, and will bleed on the slightest touch.

[These pale fungous granulations, around the margin of a fistula, are highly characteristic of the presence of diseased bone. Sometimes the integuments over a necrosed bone will perish from the violence of the inflammatory action, leaving an unhealthy ulcer, which discharges freely a thin ill-formed pus, is often very sensitive, and does not heal until the dead bone is removed.]

If the patient's general health be good, the suppuration from the *fistulæ* and ulcers, situated over diseased bones, continues white and laudable; but it deviates from these properties, in proportion as the health becomes impaired.

Neither is the black colour, imparted to the dressings of ulcers, a circumstance, which necessarily indicates the existence of necrosis; for it may

occur, when the bone is sound, and may not happen when the bone is affected.

None of the preceding symptoms convey such information, as to leave no doubt of the positive existence of necrosis. The touch is the only thing, which can give us this knowledge, in those cases where the bone is not too deeply situated, the sinuses not tortuous, or obstructed with fungous growths.

When the fistulous openings are large, the finger may be introduced. If in this way the bone can be felt to be extensively uncovered by the periosteum, the surgeon may conclude, that all such portion of the bone has perished. He may be still more certain of the fact, when he finds the edges of the denuded bone unequal and rough.

The examinations, made directly with the finger, give the most correct and exact information of the state of the bone; but the orifices of the sinuses are sometimes so small, that the finger cannot be introduced without causing great pain. A probe must then be used for the purpose of ascertaining the extent of the denudation of the bone; whether its edges are rough; whether the dead portion is loose, and likely to separate soon.

Sometimes the dead fragment of bone, called the *sequestrum*, protrudes from the ulcer or is visible on separating its edges. When it is black, there cannot be a doubt of its being actually dead; but, on the other hand, when its whiteness is increased, the diagnosis is difficult, because bones being naturally white, much experience is necessary to be able to judge whether they are so in excess.

It merits attention, also, that the black colour of the bone is not owing to the necrosis itself, but seems rather to depend upon the fragment having been exposed to the air. In fact, dead pieces of bone with which the air comes into contact, often turn black, while those, which are covered with matter, retain their whiteness. The cylindrical portion of a humerus, which was almost totally affected with necrosis, was universally black at the part, which protruded through the flesh; but the rest, which lay under the integuments, was white. (*Weidmann de Necrosi Ossium*, p. 19. et tab. 9. fig. 1.)

[When the vascular supply to a bone is suddenly and completely arrested, so that it dies rapidly, the dead part presents a white, or pale yellow colour, without any apparent change in its structure; but if the stoppage of the circulation be slow and gradual, the necrosed portion is of a brown or black colour; this is owing to the presence of decomposed blood within it, which has stained its whole thickness, and, in this case, the bone is often softer than usual. When discoloration results from exposure to the air, it does not extend deeper than the surface.]

If the early symptoms of the disease are mild, the surgeon may infer, that it is only a superficial portion of the bone, which is about to be separated. But this judgment will be more certain, if confirmed by examination with the finger, or probe: or if the swelling, which occurred in the beginning, has not spread beyond the affected point, and if the pain affects only the outer part of the bone. In a case of this sort, there is also great probability, that the dead bone will be separated within a moderate time.

It is also of importance to ascertain the existence of an internal necrosis, and to learn whether it is situated in the spongy substance, or in that

part of the bone which forms the wall of the medullary canal; whether it affects only a portion, or extends to the whole body of the bone. When there is an internal necrosis, says Weidmann, the disease is generally more aggravated, and of longer duration; and in the first stage, the patient is affected with severe symptoms, intolerable pain, loss of rest, a great deal of fever, profuse perspirations, and such disorder of the system as may prove fatal, unless the patient be young and strong. The hard swelling, which was observable at the commencement of the disease, increases but slowly, and extends very gradually over the circumference of the limb, while the skin yet remains free from redness and tension. *If the part be somewhat roughly handled, the pain, which is fixed in the bone, is not rendered more acute, as would happen, were the case an external inflammation.* In this suffering condition, the patient continues a good while, before the escape of matter brings a degree of relief. When the pus is formed, it spreads through the adjacent cellular tissue, amongst the muscles and other parts, and generally finds its way to the surface, after a considerable time, by several openings, which may be very distant from the main collection of matter, as also from each other, sometimes in diametrically opposite situations. The evacuation of the pus, however, does not produce any material subsidence of the swelling. The pus is of good quality, and issues in large quantities from the ulcerated apertures, *the quantity, however, not being increased when pressure is made.* If some of the openings heal, others are formed; but in general, the edges become callous, and have no disposition to cicatrize. When the case presents the foregoing symptoms, and the weakened limb can neither bear the action of the muscles, nor the weight of the body (and by either of these causes its shape may become altered), the surgeon may conclude that the disease is an internal necrosis. But, in order to avoid mistake, he should introduce into the sinuses a probe, which, passing through the openings in the adjacent bone, will touch the dead piece which it contains, and which will sometimes be even distinguished to be loose and moveable. *The extent of the sequestrum must be judged of, by the extent of the swelling, and the distances, between the apertures in the bony shell, which includes the sequestrum.*

[Troja, David, Bichat, and others, have stated that disease of the medullary membrane always produces necrosis of the whole thickness of the bone: that such is not invariably the case has long been shown, but it should be borne in mind that when necrosis arises from some affection of the medullary tissue, the internal lamellæ of the bone usually perish to a very considerable extent.]

The surgeon should also endeavour to ascertain with the probe, whether there is only a single sequestrum, or several. When there are several, they may be felt with the probe in different places, down to which this instrument is passed, and the removal of one, or two of the fragments, is not followed by a cure. It ought to be remembered, however, that this same fragment may be touched by the probe in several different places, when it is very extensive. If there are several dead pieces of bone, situated at a distance from each other, each of them is generally accompanied with a distinct swelling and sinuses. Frequently these fragments are so concealed by new bone, or



by granulations, that they cannot be felt with a probe; but, their existence may then be suspected from the fistulæ not healing, which can be ascribed to nothing else.

It is also necessary to distinguish with the greatest attention the different stages of the disease. The *first stage* may be considered as existing, when the attack is yet recent, and the inflammation and its concomitant symptoms, the pain, swelling, and symptomatic fever, prevail in a high degree, and no suppuration has taken place, or at least no discharge of matter. The *second period*, in which the dead bone is undergoing the process of separation, is indicated by a diminution of the inflammation, a partial subsidence of the swelling, and the discharge of purulent matter. When a probe is passed into the sinuses, the bone is felt bare and dry, and, towards the limits of the swelling it is rough, where, as will be afterwards noticed, an excavation is formed. Every part of the bone, however, which is to be detached, still continues adherent to the rest of the living bone. At length, the surgeon knows, that the disease has reached its *last stage*, or that in which the dead portion of bone is entirely separated, when sufficient time for the completion of this separation has transpired, and when the dead bone can be distinguished with the finger, probe, or even the eye, to be loose and free from all connexions.

Although a necrosis must generally be classed with diseases which are serious and of long duration, yet the character of the disorder is not essentially bad, since it is often cured by nature, or with the assistance of surgery. Confident hopes of a cure may be entertained when the necrosis is confined to the external part of a bone; when it is simple and of moderate extent; when it is not situated near any organ, that may be injured by it; and when it proceeds from an external cause, and the general health is good. On the contrary, the cure is difficult and the prognosis doubtful, when the disease is extensive and complicated with other affections, either of the same, or different bones; when it attacks bones, which are of high importance on account of their functions, or situation; when it is situated in the interior of the bone, affects several parts of it, or implicates a large joint; when it arises from an internal cause of constitutional origin; when the patient is weakened by age, or disease; and especially when the sinuses extend into the neighbouring articulations. (*Weidmann de Necrosi Ossium*, p. 22.)

[The period required to effect a recovery in these cases varies very considerably, but the process of cure generally takes place more rapidly in the lower jaw than in any other bone of the body.]

Mr. Russell has never known a necrosis of the tibia get well in less than a year; but, in general, the case is protracted to a much greater length of time. Here, however, much will depend upon what can be done by the surgeon for the removal of the dead portion of bone.

Necrosis of the lower jaw and clavicle rarely or never proves fatal; that of the lower extremities is far more formidable, but seldom destroys life; when death occurs it is either from the violence of the first inflammatory symptoms, or from the profuse suppuration followed by hectic fever, which sometimes proves incurable, unless its local cause be removed by timely recourse to amputation. When the violence of the first stage, however, has abated,

the constitutional irritation and inflammatory symptoms are generally moderate. Nor is this state of tranquillity disturbed till the sequestrum, in making its way outward, again produces irritation. At this second period of urgency, extensive inflammation may arise, ulceration spread widely over the limb, assume an unhealthy appearance, violent fever succeed, and the patient either perish or sink into a state, in which he must consent to an operation, as the only means of saving his life. This is the last crisis of imminent danger; but in general it less imperils life than when the inflammation occurs in the earliest stage of necrosis. (*Russell, Practical Essay on Necrosis*.)

In the treatment of necrosis, the first object of the surgeon should be to aid nature in her endeavours to effect a cure, and not to disturb her operations by any superfluous or unseasonable interference. The second should be to assist her sometimes by operative proceedings, when she cannot by herself accomplish what is necessary. But in order not to attempt anything wrong, it must be correctly understood what nature does in this disease; what she has in her power to perform; what she cannot accomplish at all, or not with any degree of certainty: and, lastly, the circumstances in which she may err, and endanger the patient's life.

When a portion of bone dies, nature uses all her endeavours to bring about its separation from the part of the bone, which still remains alive. Surgeons have denominated this process, which resembles the separation of the soft parts affected with sphacelus from the living, *exfoliation*, (see this word.) The exfoliation of bone, however, proceeds much more slowly than the separation of a slough. Exfoliations are not completed at any regular and fixed period; of they proceed most quickly during youth, when the constitution is usually more full of energy, the bones more vascular, and less replete with solid inorganic earthy matter. On the other hand, the process is slower in old debilitated subjects, whose vitality is less active. A thin small scale of bone separates sooner than a large thick portion; and the most tedious exfoliation is that of a thick bone, from which a portion, including its entire diameter, is coming away. The separation of a necrosis takes place more expeditiously in bones of a light texture than in those of a solid structure; and sooner in the less compact part of bones, such as the epiphysis and spongy substance, than in those of greater density.

[When necrosis arises from syphilis, scurvy, &c. the appropriate remedies for these diseases must be administered, to assist nature in her endeavour to cast off the dead bone; since, in these cases, without the aid of constitutional treatment, her efforts are generally insufficient to accomplish the process, and life becomes imperilled.]

The separation happens precisely at the different points where the living and dead parts of the bone come into contact; and it is obvious, that the particles of the dead bone which are at a distance from that portion which retains its vitality, cannot be acted upon by it.

A variety of opinions have been entertained concerning the means employed by nature in effecting this separation. Hippocrates believed, that the dead part was pushed away by a fleshy substance which grew underneath it. (*De Cap. Vuln. cap. xxiv.*) Ludwig, Aitken, Bonn, and many

others adopted the same idea. (See *Adversaria Med. Pract.* vol. iii. p. 63. *Systematic Elements of Surgery*, p. 287. *Thesaur. Oss. Morb.* p. 1.) Van Swieten conceived that the dead part was forced away by the incessant beating of the arteries. (*Comment. in Aphor. Boerhavi*, § 252.) M. Fabre ascribed the separation to the extension and expansion of the vessels. (*Mém. de l'Acad. de Chir.* t. iv. p. 91.) Others supposed that the exfoliating piece of bone became loosened partly by the suppuration, and partly by the rising of the new granulations. (See *B. Bell on Ulcers*.)

As Weidmann observes, there is unquestionably a reddish fleshy substance formed between the dead and living bone, and which Celsus has noticed under the appellation of *caruncula*. (*De Medicina*, lib. viii. cap. 3.) But it would be erroneous to refer the expulsion of the dead portion of bone to it, since it can never be produced before a change has taken place in the structure of bone, there being in fact no space for it to grow in; and hence it is never seen before the disunion of the parts has considerably advanced. There must consequently be some other power, which destroys the cohesion between the dead and living bone, and produces the groove or interspace, in which the soft granulations arise. Besides, amongst other facts proving the falsity of the idea that the granulations push off the dead bone, Weidmann particularly adverts to the occasional exfoliation of the whole circumference of a cylindrical bone. Here, if the granulations had the power of causing a disunion on one side, they could not have the same effect on the opposite one, but would tend to make the contact more intimate.

[It would appear, however, that the granulations may take some action in the extrusion of the dead bone when it is completely detached from the living, although they are not the agents by which the separation is effected. (*Stanley, op. cit.* p. 93.)]

The separation cannot take place by the pulsation of the small arteries, nor by the weak expansive motion of the vessels of the bone. Weidmann knows not what motives have induced certain writers to impute the result to suppuration, and observes, that as the doctrine is not founded upon reasoning, it is superfluous to offer any arguments against it. If the least attention be paid to what nature really tries and accomplishes in this operation, nothing will be more manifest, than that it is completed in a very different manner. Swelling first affects the periosteum and bone, which by degrees softens. (Vid. *Troja, passim*; *Bonn, Thesaur. Oss. Morbos*, p. 122, and *Weidmann de Necrosi Ossium*, tab. 4. figs. 1 and 3.) At the margins of the necrosis, the bony surfaces, which were smooth, become rough and irregular. A fissure is there produced, which extends in every direction under the piece of bone, that is about to be detached. The bony texture is also daily rendered less solid, so that the number of adhesions between the dead and living parts diminish, and in the end are totally destroyed. Weidmann then explains that the true mode by which the separation is effected, consists in the absorption of the particles situated betwixt the living and dead parts of the bone, in such a way, however, that the first loses a great deal of its substance; the last scarcely any thing. (P. 25.) After the dead bone has come away, the swelling of the neighbouring periosteum subsides, and the living

bone recovers its original hardness and solidity. (*Troja*, p. 67.)

[Hunter supposed that the earthy material of the living bone, which is in contact with the dead part, is first absorbed, and afterwards the animal constituent, so that a groove is formed between the living and dead tissues, which gradually deepens until the necrosed portion is entirely detached, the dead piece of bone undergoing no change or alteration in size. (*Hunter's Works by Palmer*, vol. iv. p. 318.) This opinion as to the successive absorption of the inorganic and organic elements of bone, and its consequent softening before the groove of separation has formed, has not been confirmed; as examination has shown that the sequestrum, before its final detachment, is always connected with the rest of the bone by true osseous tissue. Paget, however, inclines to this view of Hunter's as to the softening of the bone before its separation. (*Surg. Path.*, vol. i.) The very important agency ascribed by Hunter to the absorptive process in detaching the dead bone from the living is generally admitted; although whether this operation takes place by means of the lymphatic system, as Hunter taught, or is due to the absorbent power of the blood vessels, as stated by the more modern pathologists, is yet a matter of doubt. Rokitsansky differs from both of these opinions, and considers that the disjunctive process is caused by a "solution of the layer of healthy bone adjoining the dead by means of the purulent matter;" and he further says that "in the attendant formation of granulations, I find enough to account for the demarcation and separation of the sequestrum: and the absorption which has been assumed to go on at the borders of a portion of necrosed bone, I hold to be incompatible with the inflammatory process, while the analogy of the process by which mortified soft parts are cast off renders such a view inadmissible." (*Pathol. Anat.* vol. iii. p. 167. *Syd. Soc.* 1850.)

Although at variance with other observers as to the mode of removal of dead bone, Rokitsansky yet agrees with them in regarding the process of exfoliation as precisely similar to the separation of a slough from the soft parts, regard being had to the differences in the tissues. (See also *Anatomical and Pathological Observations*, by J. and H. Goodsir, Edin. 1845.)

When a piece of dead bone is undergoing necrosis, it is, to the rest of the body, an extraneous substance, and, as such, proves a source of irritation to the adjoining surface of the living bone, which becomes inflamed, and acquires increased vascularity, forming a red margin around the affected portion. At this line of demarcation between the living and dead bone, a groove forms, deepens, and ultimately causes the separation of the necrosed piece. The process is effected as follows: the healthy bone surrounding the diseased part is everywhere acutely inflamed, and lymph is poured out from the engorged vessels within the Haversian canals, so as to fill up completely these bony channels. This exudation, together with the distended blood vessels, exerts pressure upon the osseous tissue, and causes its absorption; by this means the Haversian canals become gradually enlarged, and their walls thinned, until at last they entirely disappear. Whilst these phenomena are taking place, the primitive vessels of the bone extend into the effused lymph; this becomes organized and forms a mass of small vascular granulations, which



cover the surface of the living bone, and alone maintain the connexion between it and the dead portion.

The necrosed bone is thus completely isolated from the rest, is loosened, and may be easily removed, exposing a layer of florid granulations which spring from the surface of the healthy bone, and fit accurately into small depressions on the side of the exfoliated piece in contact with them. The sequestrum is not only detached from the living parts by this granular formation, but may even sometimes be extruded from a bony cavity in which it is contained, through the pressure continuously exercised upon it by the surrounding granulations.

The pus which is formed during the progress of this affection, has, on chemical examination, been found to contain a much larger proportion of earthy ingredients than in other cases. This must be owing to the presence of a large quantity of the solid elements of bone in the discharge, as much as four and a half per cent. of phosphate and carbonate of lime having been obtained by analysis; whilst pus from other sources merely exhibits traces of these salts. (*B. Cooper, Medical Gazette*, May 1845. *Stanley, op. cit.* p. 89.)

That a piece of necrosed bone may be removed, without any perceptible exfoliation, is a point upon which all are agreed, but the manner of its removal has received different explanations. Miescher (*De Inflamm. Ossium*, p. 201.) states that it is got rid of by a process of molecular disintegration, in which the fragments are so small as to escape observation; he calls this *insensible exfoliation*, and Stanley is disposed to favour his opinion. Nélaton, Gerdy, and others deny that loss of substance takes place in this way, and consider that the minute particles of bone are removed by absorption. It is probable that both these views are correct; for the large increase of those earthy salts, which compose the inorganic element of bone, in the matter discharged during the course of a necrosis, is strong evidence that the constituents of osseous tissue may be got rid of in a molecular form with the pus; on the other hand, experiments show that pieces of dead bone, driven into a healthy shaft and allowed to remain in close contact with it for some time, will lose weight and almost disappear, without the formation of pus, or discharge of any kind by which the bony fragments can be thrown off, since no external opening exists. (*Savory on the Absorption of dead Bone. Med. Chir. Trans.* vol. xlvii.) The sequestrum is always smaller than the space in the sound bone from which it has separated; this is due to the process of absorption—by means of which the disjunction occurs—taking place at the expense of the living bone. There can be no doubt about the absorption of necrosed bone whilst still united to the living; numerous cases evince this fact, but when dead bone is *completely separated*, can the absorbents of the surrounding parts act upon it? Mr. Hunter maintains the affirmative, and considers that the removal of the necrosed portion is effected partly by this process; he states that granulations arise from the living bone “which push up the dead piece against the upper sides of the cavity; and in consequence of this pressure against the newly formed bone, the absorbents are set to work to remove it, and in proportion as this is absorbed the piece is pushed out, the granulations filling the space behind it.” Russell, Velpeau, and Lawrence are of opinion that a piece of necrosed

bone, when separated, may be absorbed. Paget says that dead bone, which is continuous with the living, “may be in part absorbed, or otherwise removed, not indeed in mass, but after being disintegrated or dissolved.” (*Surg. Path.* vol. i. p. 472.) The same author notices also that when ivory pegs have been driven into bones, for the repair of ununited fractures, only those portions of them which were embedded in the bone have been absorbed. Savory has revived Hunter’s opinion, that pressure upon the dead bone is necessary to effect its absorption, and his experiments would certainly appear to be conclusive on this point. (*Med. Chir. Trans.* vol. xlvii.)

Stanley remarks, the question has been repeatedly investigated by experiment; yet, he thinks, with negative results. “It has been stated (says he) on the best authority, that Sir W. Blizard tied a piece of bone, which he had carefully weighed, in an ulcer in a man’s leg, and that, after a time, having removed it, it was found to have lost part of its weight, and was besides visibly altered on the surface in contact with the ulcer.” But Mr. Stanley has repeated the experiment without obtaining similar results: pieces of bone were often placed by him in issues for the purpose of keeping them open, but no action of the absorbents on them could ever be detected. Mr. Gulliver’s experiments, communicated to the Royal Med. and Chir. Society of London, also support the inference, that bone, completely disjoined from the living, is not acted upon by the absorbents. (See EXFOLIATION.)

[Liston observes, that “a dead piece of bone detached from the surrounding parts is in every respect an extraneous body, and it is not, and cannot be acted upon by the absorbents any more than a piece of metal, wood, or stone.” Rokitsky does not admit that any absorption of the sequestrum takes place, but believes that “the solving or corrosive power exerted on its tissue by the matter” might remove it in this manner altogether. This question of the absorption of necrosed bone when loose, and separated from the living, is yet far from being settled.]

When dead portions of bone are separated and loose, they still lodge in the ulcers and sinuses; like other extraneous bodies they occasion irritation of the soft parts, and keep up a discharge of matter; sometimes, however, nature succeeds in expelling them. This happens when the size and shape of the opening are calculated to facilitate the issue of the dead bone, which does not lie too deeply, and is propelled outward by its own weight. In necrosis of trivial size, indeed, the small broken fragments of bone may be blended with the pus, and come away with it (*David, Boussetin, Hist. de la Société Royale de Médecine*, tom. iv. p. 308.; *Weidmann de Necrosi Ossium*, p. 26.); but such an event can never be expected, when the dead portion of bone is extensive.

That exposed and apparently dead portions of bone sometimes disappear, and no longer prevent the healing of wounds and ulcers, is a fact often exemplified after injuries of the skull. I have many times had opportunity of observing it in such cases, and it has not escaped the notice of others, who have recorded numerous instances, both in the cranial and other bones, where this has occurred, even though a piece of considerable size has been necrosed. The subject is particularly adverted to by M. Velpeau, as well as by MM. David, Bous-

selin, and Weidmann. "At the hospital, Saint Antoine, twice, and at that of La Pitié, I have seen (says M. Velpeau) the bones of the cranium, after being denuded, and in contact with pus, for ten days or a fortnight, no longer interfere with the healing of the wound, and in another week the patients were cured. The occurrence, moreover, is far from being rare, and I have noticed it in other bones—the tibia, the bones of the nose, the phalanges, &c. There is no reason to be astonished at this; for necroses of a much deeper kind may disappear in the midst of the soft parts, and prove but feeble obstacles to cicatrization. Certain patients have afforded me proof of this after amputation of the leg. In two of them, the end of the fibula; in one, the angle of the tibia; and in a fourth, the surface of both bones remained in a state of necrosis quite visible for more than a week, and then becoming gradually enveloped by the granulations, caused no obstacle to the healing of the stump." From these and other cases which fell under the observation of M. Velpeau, he infers that there is a dissolution or absorption of the dead bone, and not an imperceptible exfoliation; and that certain necroses may disappear without any detachment of the sequester. Hence, in particular instances, he recommends leaving a necrosis alone. The facts and practice to which it leads, he admits, were not unknown to Russell. (See *Velpeau de l'Opér. du Trépan*, p. 20. 8vo., Paris, 1834.) In some instances, a thin layer of bone separates, and is imperceptibly destroyed, or else expelled. Rarely the dead layer of bone, though very thick, ceases to keep up suppuration, and yields to the molecular action of the surrounding textures. (*Id.*)

[M. Paul Broca relates two cases where a large sequester remained encysted in the soft parts, in one instance for fifty-three, in the other for forty-three years, without causing any discomfort or undergoing any alteration in form or size. (*Costello's Pract. Surg.* vol. iii. p. 261.) Stanley also gives examples of pieces of necrosed bone having been encased by the soft parts, which then healed up firmly over them. Rarely, though occasionally, the same thing may be observed in the complete disappearance from view of the necrosed stump of the shaft of a bone after amputation, without any perceptible exfoliation.

A piece of dead bone, when completely separated, may become attached to the living bone around it, through the medium of new osseous deposit, and cease to keep up irritation in the neighbouring structures. Gulliver, in his experiments, found this to occur. He introduced a piece of bone into the medullary canal of the tibia of a rabbit, and at the end of some weeks it was firmly united to the living bone, whilst upon its surface small nodules of new bone were deposited. In a case, recorded by Mr. Perry, where the lower jaw was removed for necrosis, it was covered by a quantity of unhealthy looking osseous material closely resembling pumice-stone. (*Med. Chir. Trans.* vol. xxi.)

The last thing, which nature does, is to restore the loss of substance which the bone has suffered. Although this operation is so extraordinary and wonderful, that one might be disposed to doubt its reality, numerous examples, recorded in the annals of surgery, prove not only its possibility, but also its frequency.

In works referred to at the conclusion of this article, the following authors speak of the regeneration of a part, or the whole of the lower jaw-bone; viz. Bonetus, Bayer, Guernery, Belmain, Acrel, Van Wy, Trioen, Bonn, Reiplein, Desault, Henkel, and Dussaussoir. A student showed Weidmann a lower jaw-bone, which had been thus regenerated, and taken from the body of a man, whom the latter distinguished writer had been well acquainted with. The bone could not be freely depressed: yet it performed its functions tolerably well.

[Syme removed the entire ramus of the jaw, with its condyle and coronoid process, the whole of which was restored. (*Edin. Med. and Surg. Journ.*) Lessen has collected about thirty cases of reproduction in this bone after necrosis (*Graefe and Walther's Journal*, vol. xxii.), and others have been recorded. Schulze reports a case where teeth were formed in the new jaw. (*Arch. Gén. de Méd.* 1853. vol. ii. p. 726.) Dr. Sieveking relates an instance of necrosis of the whole lower jaw, excepting the condyles, where there was complete restoration. (*Jones and Sieveking, Path. Anat.* 1854.) An example is also recorded in St. Bartholomew's Hospital Reports, vol. i.]

Moreau saw a case in which the clavicle was regenerated, and the new bone was presented by D'Angerville, after the patient's decease, to the Academy of Surgery at Paris. (*Mém. de l'Acad. Roy. de Chir.* tome v.)

[A nearly similar instance may be found in the *Répertoire d'Anatomie et de Physiologie*, vol. ii. Meyer, of Zurich, extirpated this bone for disease, and it was replaced by a new one nearly four inches long. (*Graefe and Walther's Journ.* vol. xix.)]

Chopart had an opportunity of witnessing the death and reproduction of a scapula. (*De Necrosi Ossium Theses*, Præs. F. Chopart, resp. P. G. Robert, Parisiis, 1776.)

[Klencke has also met with this in the human subject. (*Wagner on Resections of Bones. New Syd. Soc.* 1859.) Specimens of it in the horse are to be seen in the Museum of the Veterinary College at Alfort; in these the original bone forms a sequester, which is enclosed in a case of newly-formed osseous tissue.]

Weidmann saw an instance, in which nearly the whole cylindrical shaft of the humerus perished, and was afterwards regenerated; a phenomenon, that had been observed at earlier periods by Job of Mekren, Cajetano, Taconi, E. Blancard, Duhamel, David, Acrel, Boehmer, Cheselden, and Vigaroux, whose respective works are cited at the end of this article. Morand, Cheselden, and Bromfield, published engravings respecting a reproduction of the upper part of the humerus, where the old dead bone was included in a sort of bony tube.

[Dupuytren has preserved a specimen where the entire shaft of the humerus is necrosed, and almost completely surrounded by new bone, and another where the whole of the middle part of this bone has been restored. Ricord (*Gaz. Méd. de Paris*, 1842, p. 639) gives a case of reproduction of a humerus, eight-and-a-half inches in length, after necrosis.]

Régenerations of the ulna have been observed by Ruysch, Duverney, and Fowles. (See *Thesaur. X. No. 176. Traité des Mal. des Os*, Paris, 1751.; and *Phil. Trans.* No. 312.) A similar reproduction of the lower ends of the radius and ulna was



witnessed by Acrel. (*Chirurgische Vorfälle von Murray*, vol. i. p. 194.)

[Mr. Savory took away the whole shaft of the radius for necrosis in a boy; at the end of eight months it was nearly restored, although the new bone was smaller than the old one. (*Med. Times and Gazette*, vol. ii. 1857.) Nearly similar examples have also been recorded by Blandin and Robert.]

Partial reproductions of the thigh-bone are recorded by Wedel, Battus, Koschius, Hoffmann, Scultetus, Diemerbroeck, Wright, Fabricius Hildanus, Raw, Dobyns, M'Kenzie, Ludwig, David, Boussetin, Larrey, Hutchinson, &c. Dr. M'Kenzie relates the case of a boy thirteen years of age who had been suffering for a long time with necrosis of the femur. One morning he felt the bone loose, and forcibly pulled it away, thus extracting a piece  $7\frac{1}{2}$  inches long. On recovery, the thigh was as firm as the other, only a little thicker and more curved. (*Med. Obs. and Inquiries*, vol. ii.)

[Stanley mentions an instance of necrosis of the neck and a portion of the shaft of the femur, which exfoliated, and the patient recovered with a firm limb, but little shortened.]

We may infer that regeneration is more frequent in the tibia than any other bone, from the accumulated facts, mentioned by Albucasis, La Marche, Muralto, De La Motte, Ellinchuys, Ruysch, Tacconi, Laing, Johnson, Hunter, David, Boehmer, Sigwart, Th. Bartholine, Hoffmann, Saviard, Le Dran, Duverney, Trioen, Gunther, Ludwig, Michael, Boussetin, Weidmann, Russell, Whately, Desault, &c., and from the evidence afforded by every Pathological Museum.

Weidmann saw a shoemaker who, after much suffering, extracted, with his own hands, the greatest part of the diaphysis of the tibia; yet, the loss was so well repaired, that the man could walk afterwards nearly as ably as ever. (*De Necrosi Ossium*, p. 29.)

[Cases may be multiplied where the whole shaft of the tibia has perished, separated from its epiphyses, and been replaced by one of new formation, which has proved quite as serviceable and almost as perfect as the original bone. When the bones of the lower extremity have been the seat of necrosis, sufficient time must be allowed for the newly formed osseous tissue to become consolidated, lest the superincumbent weight of the body, or the action of the muscles should cause them to yield or fracture. Should this latter accident occur, union will readily take place, although more slowly than in a healthy limb. Stanley records a case of necrosis of the fibula, in which the reproduction was perfect; and Robert found the same bone more than half restored at the end of a year after its removal for necrosis. (*Wagner, op. cit. appendix.*)]

"We are not to imagine (says Weidmann), that these regenerations happen by chance: experiments made upon living animals by Troja, Blumenbach, Koehler, Desault, and myself, prove that they invariably follow certain laws."

Subsequent observers have repeated these experiments, which all tend to show that whenever the medullary structure of the long bones of pigeons, or dogs, is destroyed, these bones become affected with necrosis, and are afterwards reproduced to the full extent of their destruction. [They have also ascertained that when a portion of bone is extir-

pated, if the periosteum is preserved, new bone will completely replace that which has been taken away. (*Stanley, Syme, Flourens, Wagner, &c.*)]

The observations and experiments, above alluded to, further prove that it is the long bones which are usually reproduced, though the flat ones are not entirely destitute of the power of regeneration; since experience fully evinces, that, when a portion of the skull is removed, either by a wound, by disease, or by the trepan, nature endeavours to restore the deficiency; the edges of the aperture extend themselves by means of a bony substance, which is furnished by the periosteum, the dura mater, and cranium itself. (*Tenon, Mém. de l'Acad. des Sciences*, 1758, p. 412, 413, 415, 416, 418.) But, still the reproduction is imperfect, as an unossified place is nearly always left, even when the bone has lost only a small piece, such as is taken out by the trephine; and when the destruction of the cranium is very extensive, there is seldom any attempt at reproduction. This fact, which is proved by the observations of Savard, Pott, Sabatier, &c., is particularly noticed by Sir A. Cooper. In University College Museum, however, there is a fine specimen of the partial regeneration of a considerable portion of the skull, which has been removed by trephining, forty-five years before the death of the individual. [Cullerier also records a case of partial ossification of the dura mater after an extensive necrosis of the cranium. (*Annuaire Med. Chir. des Hôpitaux.*)]

[There is much diversity of opinion as to the amount and mode of repair in the cranial bones after necrosis or operation. Stanley asserts that reproduction never occurs in them, owing to the difference in the relation between them and the dura mater and pericranium, when compared with that which exists between the periosteum and the other bones: he considers that the pericranium has no tendency to form new bone, and the dura mater to a very slight extent only. (*Op. cit.* p. 114.)

Gerdy writes, that "reproduction does not take place in the bones of the cranium, where it is habitually so imperfect, that it can scarcely be said to exist;" the outer table may, however, sometimes be replaced by an irregular bony formation, and the inner by a lamellar ossification of the dura mater. (*Op. cit.* p. 234.)

According to Nélaton, when the pericranium is preserved, the external table, or even the whole thickness of the bone, may be reproduced: but, if that membrane be destroyed, no repair takes place beyond a thickening of the dura mater with, sometimes, a calcareous incrustation upon it. (*Op. cit.* vol. i. p. 621.)

Rokitansky says, that openings in the skull are closed by a "fibroid plate," which generally ossifies incompletely, or not at all: the scanty formation of callus in these bones has not yet been satisfactorily explained. (*Op. cit.* vol. iii. p. 218.)

Dubreuil is of opinion that the osseous deposit depends upon the pericranium and dura mater chiefly, although the cranial bones have some slight share in it: and the regeneration of these bones, after disease or injury, is very imperfect, in consequence of their membranes being usually involved at the same time; he examined a man, who died eight years after trephining, and found the hole in the skull filled up by a fibrous membrane; whilst the external table of the os frontis, which had suffered a loss of substance from the same accident,

was replaced by new bone, and covered by the pericranium. (*Presse Médicale*, 1837. No. 57.)

Heine attaches considerable importance to the diplôe in the formation of bone, and believes that this tissue, with either the pericranium or the dura mater, can completely restore the deficiency in the skull: he considers that the diplôe, or the membranes, alone, are insufficient to accomplish this.

Wagner states, that apertures, however made in the skull, are filled up by a fibroid mass, which is derived from the skin, dura mater, and bones, and is intimately connected with the pericranium and dura mater: into this small osseous growths may extend from the edges of the bones. When the piece removed does not comprise the whole thickness of the skull, it is completely restored by new osseous formation. He narrates a case by Guensberg, of a woman who lived 78 years after trephining: at her death, the opening was covered in by fibrous membrane, which was adherent to the dura mater, and ramifying on its surface were spicula of bone. (*Op. cit.* p. 135. *New Syd. Soc.*, 1859.)

Klencke has published a number of cases where the bone has been restored after the loss of both tables of the skull: in all of them, the dura mater was preserved, and from these observations, together with his experiments on animals, he concludes that the dura mater is the source from which the cranial bones are re-formed.

Koehler removed with the trephine portions of the skull in dogs, without injuring the pericranium, and afterwards found the openings filled up by a cartilaginous material, firmly adhering to the pericranium and dura mater, in which bone was beginning to form. This deposit was derived from the dura mater and the cut edges of the bone, and was in sufficient quantity to close the hole within three weeks of the operation. (*Experimenta circa regenerationem Ossium*, 1786.)

From experiments which have been performed, it would seem that in animals the dura mater is the principal agent in the reproduction of bone; whilst, from observations upon the human subject, the pericranium appears chiefly to supply the material for repair.

Broca states that regeneration in the cranium, although very incomplete, is more frequently met with than in the other flat bones. (*Costello's Surgery*, vol. iii. p. 278.)

Examples of reproduction of the other flat bones are very rare, although they have been met with. A case of extensive necrosis of the sternum, undergoing repair, is recorded by Stanley. (*Op. cit.* p. 118.) Murray excised a piece of the breast-bone of a pigeon, together with the periosteum, and after some weeks the loss of substance was nearly restored. (*Edin. Med. and Surg. Journal*, October 1831.)

Wagner mentions two cases where there was partial re-formation of the rib, after resection for disease. (*Op. cit.* p. 133.) Michel Medici removed a piece of rib, an inch long, from a sheep fourteen months old, with the periosteum and the intercostal muscles attached. After four years the animal was killed, and the loss was not only repaired, but the new piece much exceeded in length that which had been taken away. Reparation of the ilium is very rare, although necrosis is by no means uncommon in this bone: partial regeneration has been observed in a very few cases only. According to Weidmann, the short and irregular bones are never reproduced, and Stanley considers

it doubtful. Although complete restoration of one of these bones has never been met with, yet in several instances some of them, and especially the os calcis, have been found partly re-formed after disease or operation. Fergusson has published a case where the os calcis, having been extensively removed for disease, was found imperfectly reproduced seven years and a half afterwards. (*Med. Times and Gaz.* June, 1851.) Thierry, in the *Moniteur des Hôpitaux*, 1856, vol. iv., relates an instance of the same bone being restored after excision for necrosis: and the newly formed bone was subsequently removed for the same affection. Gerdy mentions two specimens of partial reproduction of this bone, in his possession; and other illustrations of it might be given.]

When, in a case of necrosis from destruction, or detachment, of the periosteum, a scale or table of either a long or flat bone is separated, regeneration seldom follows, because the granulations, which rise up under the sequestrum as soon as the dead bone is removed, become united to the adjacent parts. It is true, that, when the external wound has healed, the surface of the bone may present no irregularity perceptible externally; yet, the filling up of the excavation has been effected only by means of a dense fibrous tissue; and, in these cases, if the bone be macerated, the excavation, which the exfoliation had produced, will be clearly shown, and it will be found that no reproduction has taken place.

[This is most frequently seen in the bones of the skull, where the reparative process is less active than in those of the limbs: after removal of the soft parts, depressions may often be found in the cranium, resulting from a superficial necrosis, in which the lost bone has not been restored.]

Mr. Mayo's view, however, is different; he represents the surface, from which a thin exfoliation has separated, as becoming covered with granulations, the growth and ossification of which replace, in some degree, the substance lost. (*Human Pathology*, p. 34.)

[Miescher's experiments prove that this may sometimes take place, and that the exfoliated piece of bone may be partly reproduced by the ossification of the deeper granulations, which are in contact with the living bone (*De inflammatione Ossium*, 1836); but, as Rokitsky well remarks, the scar is usually depressed, since only a thin layer of the granulations is ossified, whilst a deposit of new bone beneath the periosteum, which surrounds the necrosed piece, renders this depression of the cicatrix still more apparent.

When, however, the external surface of the bone suffers necrosis, and the periosteum remains uninjured, this membrane inflames and pours out lymph, which becomes ossified, and forms a bony covering to the sequestrum, often necessitating an operation for its removal. This effort to restore the dead plate of bone, which sometimes accompanies a superficial necrosis, is seldom, if ever, met with in the skull, although it is very common in the bones of the extremities.]

It has been remarked that the power of reproduction in the bones is particularly active in the early periods of life, and in healthy subjects; and that it is languid or even annihilated in old persons, pregnant women (*Bonn's Thes.* p. 174.), and in venereal, cancerous, and ricketty patients. (*Callisen, Syst. Chir. Modicæ*, pars. i. p. 636.)



[Two circumstances may be specified as having an important influence upon the process of regeneration, viz. the structural peculiarities of the bone effected, and the manner in which the necrosis has occurred. The cases of necrosis most favourable to the reproduction of bone, are those in which it rapidly and completely perishes, without the occurrence of anything calculated to interfere with the inflammatory action in the periosteum and adjacent soft parts, since a due amount of inflammation in these tissues constitutes the first step in the process of regeneration. "When the bone has perished very slowly, or when its death has been preceded, or is accompanied by morbid changes in its tissue, or in the surrounding soft parts, the reproductive process will probably fail." (*Stanley. op. cit. p. 113.*) Again, the structure of the bone, whether it be light and cancellated, or solid and compact, determines very materially the amount of reparative action.]

For instance, a portion of the cranium dies, and exfoliates, but is rarely or never regenerated. This may be, according to Mr. Stanley, because the pericranium perishes, and leaves no cellular tissue as a matrix for the reproductive vessels. But, there are other instances, where no repair takes place, and in which such an explanation cannot be admitted. Why is the upper jaw never reproduced, while, in the lower, the process constantly succeeds?

[And why are the extremities of the long bones rarely attacked by necrosis, and, when so, never reproduced; whilst their shafts are frequently the subjects of this disease, and almost as constantly renewed?

It will be observed that it is in the flat, short, and irregular bones, whose structure is mostly cancellous—and with these must be included the epiphysal ends of the long bones—that this comparative freedom from necrosis exists, and in which, when it does occur, the process of regeneration fails. The greater vascularity of the cancellated tissue will account for its partial exemption from this disease, as also for the slow and gradual progress of necrosis in a bone of this variety. It therefore happens, that the inflammatory action in the periosteum—the principal agent in the reproduction of bone—is not sufficiently acute to promote the free exudation of lymph, and the quantity effused from this membrane is very limited; the structures again, which surround the short and flat bones, are, with few exceptions, entirely of a fibrous character, and these tissues, being highly unvascular, are incapable of contributing much to the regenerative process in which ordinarily the soft parts take so large part. These circumstances, together with others of minor importance, are unfavourable to the formation of bone, and osseous tissue is very sparingly developed in these cases.

The flat bones most frequently attacked by necrosis, are those of the cranium and the inferior maxilla, but the phenomena presented are very different in each. The course of the disease in the lower jaw is precisely similar to that observed in the shaft of a long bone. Its destruction is generally rapid, whilst being invested by periosteum, and surrounded by muscles, favours its complete restoration. In the cranial bones, on the contrary, necrosis proceeds very slowly, and there is but little attempt to renew the lost bone: the dura mater and the pericranium, which here substitute the periosteum, are insufficient for the purpose, whilst the thin covering of soft

parts can aid but little in the reproductive process. The length of time required for the complete destruction of a cranial bone, no doubt depends greatly upon the presence of the diplœ; this structure, being extremely vascular, long resists the extension of the morbid action.]

In order that a new bone may form, Weidmann thought that the periosteum and other membranes, concerned in the nutrition of the original bone, must be spared from destruction. In fact, he says that, in cases where the shaft of a long bone has suffered necrosis, the bone is never reproduced, if the periosteum has been destroyed by inflammation, or other causes.

[When the innermost layers of a long bone perish, while those which compose the outer walls are preserved, the latter become consolidated and thickened by the deposit of osseous matter between their layers, and upon their surface, so as to resemble a new bone.]

Several round apertures are observable upon the surface, which serve for the transmission of vessels, and are larger than those which perform this office in the natural state. Large openings, or fistulæ, are likewise formed, which, as in a new bone, lead to the medullary canal, and afford an outlet for the matter. Here it would be erroneous to conclude, that an entirely new bone has been produced; and a very little attention will discover, that all is limited to some changes in the external part of the bone, which the necrosis has not affected. [When, therefore, the internal lamellæ of a long bone are destroyed by a necrosis, which does not extend to the external layers, the osseous case, or *involutum*, as it is termed, enclosing them is not altogether a production of new bone.]

If, however, we find a cylinder of dead bone included in a sort of osseous shell, and its surface smooth, like that of a bone in the natural state, we may be certain that it has been detached directly from the periosteum, and that its bony investment is a new production. On the contrary, if the surface of the dead bone be rough, we may infer, that the separation has taken place between the innermost layers of the bone, and those which are superficial, the latter composing now the osseous shell, in which the sequestrum is included. (*Weidmann de Necrosi Ossium, p. 31.*)

This last theory, concerning the production of the involutum in necroses of long cylindrical bones, is adopted by Richerand as the true one, not only in the instances specified by Weidmann, but, in every other example, where the old bone forms a sequestrum, and is surrounded by an osseous case, which has the appearance of being a new production, and which was supposed by Troja, David, &c. to be formed by the vessels of the periosteum. (See *Nosographie Chir. t. iii. p. 158. 161. edit. 4.*)

The short or cuboid bones are very imperfectly reproduced; in some of them no attempt at repair has been seen after necrosis. (*Duverney, Maladies des Os. p. 450.*)

Weidmann never witnessed a reproduction of the spongy substance, such as it was before its destruction, round the medulla. He always found the newly formed bone dense and compact, at least, for some time after its formation.

It is now admitted that in process of time, the inner surface of the new bone becomes cellular, and is lined with a membrane containing medulla. The regeneration of the medulla was

first observed by Koehler, and afterwards by Dr. J. Thomson, in an extensive series of experiments, which he made with Dr. Alexander McDonald, and which were published in the latter gentleman's inaugural dissertation in 1799. (See *Thomson on Inflammation*, p. 393.) Mr. Russell was not aware of the regeneration of the medulla; for, he states, that, after the absorption, or removal of the sequestrum, the cavity of the new bone becomes filled up with granulations, which are at length converted into bony matter. Thus, he says, the new bone differs from the original one, in being solid, instead of hollow.

[Hunter also was unacquainted with the fact, that the medullary canal may be restored. (*Works by Palmer*, vol. i. p. 526.) Authorities are now agreed that newly formed bone, which at first is solid, becomes cellular in its interior—according to Rokitsansky, by a gradual enlargement of the Haversian canals—and, after the lapse of a considerable time, a cavity is formed; this is lined by a delicate membrane, and is filled with medulla. This process has been observed in the osseous deposit, which usually is found occupying the medullary canal of a long bone after fracture, and the continuity of which is thus slowly restored: it has also been seen in bones that have been reproduced.]

In the case, mentioned in the fifth volume of the *Mém. de l'Acad. de Chir.*, of a man whose clavicle was removed, and who died shortly afterwards, a new bone had been formed, which differed from the original one neither in length nor solidity, but only in shape, being flatter and not so round.

Mr. Mayo believes, however, that, in the ordinary course of a necrosis of the shaft of a cylindrical bone, the external layers alone are destroyed. "At all events (he observes) the cortex alone comes away as a sequestrum. The cancellous structure, which it contained, whether dead or living, is absorbed before the sequestrum becomes detached. One may suppose, that it does not die, for two reasons: first, the cancellous structure has more vascularity and vitality than the cortex, and might be expected to resist an influence, which would destroy the latter; secondly, if the cancellous structure dies with the cortical part, where is the agent which removes it?" (*Pathology*, p. 30.) It cannot be doubted, however, that when necrosis affects the whole thickness of a bone, it usually includes at once the walls and the medullary texture; and it is difficult to conceive how the cancellated tissue can possibly live within the sequestrum itself: whilst its not being found within a sequestrum, that comprises the whole shaft of a cylindrical bone, must be received, I think, as an unequivocal proof that it is not spared.

At the Royal College of Surgeons, in 1837, Mr. Stanley exhibited a drawing of a remarkable exception to the general rule of destruction of the medullary texture, when the walls of a cylindrical bone perish. It was a case, in which, in consequence of the application of nitric acid to a phagedenic ulcer of the leg, the whole of the periosteum, covering the tibia, became inflamed. Here the walls had become necrosed, but the medullary texture had retained its vitality. (*Op. cit.* p. 92.)

The reparative process in bone, after its removal by disease or injury, is merely a modification of that which takes place in the union of fractures, and the sources of reproduction are the same in each. (See *Fractures*.) Weidmann remarks,

that the power which effects this reproduction is the same that nourishes and supports the bones in health.

Many able men have ascribed the whole work of the regeneration of bone to the periosteum. (*C. Havers*; *Duhamel*, *Mém. de l'Acad. des Sciences*, 1739. 1741, 1742. 1747. *Fougeroux*, *Mém. sur les Os*; Paris, 1760. *Swencke*, *Harlemer Abhandlungen*, i. th. p. 39. *Bertin*, *Ostéologie*. *Mariques*, *Abhandlung von der Natur und Erzeugung der Callus*, p. 199.)

[Haller, (*Elém. Physiol.* t. viii. p. 352.) and Dethlefs, (*Diss. exhibens Ossium Calli generationem*, Göett. 1753.) thought that the material of repair was lymph and fibrine effused from the medullary tissue of the bone; whilst, according to Duhamel, the new bone was formed by ossification of the deeper layers of the periosteum. Bordenave (*Mém. sur les Os*, p. 227.) considered that the regeneration of bone was effected by a plastic exudation from its own vessels, as is the case with the soft parts; this becoming organized by an extension of the primitive vessels of the bone into it, was ultimately converted into osseous tissue.]

Callisen (*Collect. Hafn.* t. ii. p. 187), Tenon (*Mém. de l'Acad. des Sciences*, 1758, p. 415), and many others, have seen a part of the new production spring up from the substance of the old bone; a thing, says Weidmann, which one is also led to believe by the fact, that, when the whole shaft of a long bone is affected with necrosis, the epiphyses, which remain sound and untouched, unite and grow to the new bone, though no periosteum exists in the situation of the union.

[Bichat is of the same opinion, that the old bone plays an important part in the formation of the new, and Larrey also, who cites the bony union of the patella—a bone only partially covered by periosteum—after fracture, as a proof of this theory, which is further substantiated by the injection of callus by Sæmmering through the vessels of the bone. (*Journ. Complém. du Dict. des Sciences Méd.* vol. viii, 1820.)

Liston disputes the reparative power of the periosteum, urging that the newly formed osseous substance is never found adhering to that membrane, but always to the old bone. (*Edin. Med. and Surg. Journ.* No. 78.)]

Paletta records a case, in which five inches of the tibia were regenerated; and he concludes that the new osseous substance was not formed from the periosteum, which had been destroyed, but from the remaining portion of healthy bone. (See *Exercitationes Pathologicae*, 4to. Mediolani.) Dr. R. Knox has also seen an instance of caries of the trochanter major, where nature had attempted to repair the injury by a secretion of new bony matter round the ulcerated part of the bone, and where the new osseous substance appeared to be formed by the vessels of the old bone, the periosteum remaining perfectly sound and unchanged. His remarks are all in favour of the doctrine, which refers the production of new bone to the vessels of the remaining portion of living bone. (See *Edinb. Med. and Surg. Journ.* vol. xviii.)

[Some attribute the apparent regeneration of bone by the periosteum, not to that membrane, but to minute particles of the old bone which, they affirm, are always detached with the periosteum from the original shaft—whether the separation



take place by disease, injury, or experiment—and from these osseous granules the new bone is developed. (*Müller's Elements of Physiology, by Baly. — Goodsir's Anatomical and Pathological Observations. Edin. 1834.*)

Rokitansky (*op. cit.* p. 168) states that new osseous matter is “furnished chiefly by the outer surface of the bone,” where it is deposited beneath the periosteum; but he also admits that the periosteum, the surrounding soft parts, and “even newly formed vascular tissue,” are capable of contributing to the formation of bone.]

That, however, the periosteum is frequently the sole organ of the reproduction of bone, seems proved by the experiments of Troja, Blumenbach, Desault, Koehler, and Stanley, since in these the bones were invariably regenerated, though there was nothing left by which they could be furnished, except the periosteum.

[Charmeil's beautiful series of experiments upon pigeons, seem to be conclusive on this point, that if the periosteum be not the sole reparative agent in bone, it can, unaided, reproduce the lost piece entirely. (*Recherches sur les Metastases, 1821.*) He admits, however, that the soft parts around contribute, though much more feebly, to the osseous re-formation.]

Mr. Stanley repeated Troja's experiment, which consisted in destroying the medullary texture, and thus producing death in the walls of a bone to the extent of the injury done to its medullary texture. The periosteum, quitting its hold of the dead bone, now became the formative organ of the new, the osseous matter of which was secreted by the internal surface of that membrane; “and in this way, the same periosteum which had covered the old bone, was become the periosteum of the new.” (See *Lond. Med. Gaz.* vol. xx. p. 578.)

Dr. Macartney's observations nearly agree with those of Troja and Weidmann, respecting the formation of new bone by the periosteum, with this difference, however, that he does not describe the original periosteum as becoming afterwards attached to the new bone, but as disappearing. Dr. Macartney remarks, “that the first and most important circumstance is the change which takes place in the organization of the periosteum: this membrane acquires the highest degree of vascularity, becomes considerably thickened, soft, spongy, and loosely adherent to the bone. The cellular substance, also, which is immediately connected with the periosteum suffers a similar alteration: it puts on the appearance of being inflamed, its vessels enlarge, lymph is shed into its interstices, and it becomes consolidated with the periosteum. These changes are preparatory to the absorption of the old bone, and the secretion of the new osseous matter, and even previous to the death of the bone, which is to be removed. In one instance, I found the periosteum vascular and pulpy, when the only affection was a small abscess of the medulla, the bone still retaining its connexion with the neighbouring parts as it readily received injection. The newly organized periosteum, &c., separates entirely from the bone, after which it begins to remove the latter by absorption;” and while this is going on, its inner surface becomes covered with little eminences, resembling granulations. “In proportion as the old bone is removed, new osseous matter is dispersed in the substance of the granulations, whilst they continue to grow upon

the old bone, until the whole, or a part of it, is completely absorbed, according to the circumstances of the case. What remains of the investment, after the absorption of the old bone and the formation of the osseous tube which is to replace it, degenerates, loses its vascularity, and appears like a lacerated membrane. I have never had an opportunity of examining a limb, a sufficient time after the termination of the disease, to ascertain, whether the investment be at last totally absorbed, but, in some instances, I have seen very little remaining. During the progress of the disease, the thickened cellular substance, which surrounded the original periosteum, becomes gradually thinner; its vessels diminish, and it adheres strictly to the new-formed bone, to which it ultimately serves as a periosteum.” (See *Crowther on White Swelling*, p. 183, ed. 2.)

However, Mr. Stanley showed me a preparation, which tends to confirm the accuracy of Troja's account of the old periosteum becoming adherent to the new bone. In this example, the periosteum is perfectly continuous with that covering the epiphyses. If this were not the fact, we should have to explain in what way the periosteum of the new bone is formed. We know that the vessels of the original periosteum enter the new bone, in order to complete its formation; and it seems more consonant with the uniform simplicity of nature's operations, to suppose that this connexion is kept up, than that the old periosteum should be totally removed, after the production of the new bone, and another membrane of the same kind be then generated.

An interesting example of necrosis of the thigh-bone, published by my friend Mr. Copland Hutchison, tends also to prove, that the new osseous shell is commonly formed by the periosteum, as, in this case, the medullary tissue was found completely ossified (*Practical Obs. in Surgery*, p. 135), and could not therefore be supposed to be capable of the work. Dr. M'Donald deserves to be mentioned as one of the most distinguished advocates for the truth of Troja's explanation of this subject. (See *M'Donald's Thesis de Necrosi ac Callo*; Edinb. 1799.) Another writer has adduced many arguments to prove that the pulpy mass, which extends from one epiphysis to the other, and is itself at last converted into bone, is formed quite independently both of the original bone and of the periosteum. (See *Russell's Practical Essay on Necrosis*, p. 27. Edinb. 1795.) This account, however, is contrary to the observations of Troja, David, Weidmann, M'Donald, Macartney, and numerous other observers. Indeed, Mr. Hutchison seems to think the periosteum so essential to the formation of a new bone, that he attempts to explain the cause of fractures of the patella not becoming united by a bony substance, by adverting to the deficiency of periosteum upon it; a circumstance, which he deems also a strong argument against Mr. Russell's doctrine. (See *Practical Obs. in Surgery*, p. 141, 142.)

These very same cases, however, fractures of the patella, do sometimes unite by bone, and, therefore, while Mr. Hutchison is urging them as facts against Mr. Russell's opinion—that the periosteum takes no part in the regeneration of bone—Baron Larrey is actually adducing them in support of this very theory. (See *Journ. Complém. du Dict. des Sciences Méd.* t. viii.) The experiments of

Breschet, Villermé, Dupuytren, and Cruveilhier, in relation to the formation of callus (see *Fracture*), are decidedly against the periosteum being the sole organ of ossification.

Boyer does not refer all the work of reproducing bones exclusively to the periosteum in every instance; but joins Weidmann in believing, that what seems a new bone is sometimes only a separation and thickening of the external layers of the original bone, which have escaped destruction. He notices the modifications, to which the phenomena of necrosis are subject when the disorder affects the whole thickness, and the whole, or the greater part of the circumference of a long cylindrical bone. When the periosteum is destroyed together with the bone, while the medullary membrane, which does the office of an internal periosteum, is preserved, Boyer represents the latter membrane as undergoing similar changes to those which we have mentioned as taking place, under other circumstances, in the external periosteum, and he describes it as becoming the organ by which the new bone is formed. (See *Traité des Mal. Chir.* t. iii. p. 432.) The foregoing account is corroborated by Mr. Stanley. "If, in a living animal, (says he) a portion of one side of the walls of a bone be removed, without much injury to the medullary texture, the lost bone will be reproduced by the vessels of the medullary membrane." This he ascertained by an experiment made on the tibia of a dog. He had seen also an illustration of a similar circumstance in the ulna of the human subject. (See *Lond. Med. Gaz.* vol. xx. p. 501.) Mr. Mayo also states, that, if the integuments, and one aspect of the cortex of a cylindrical bone perish in consequence of an injury, the cancellous structure granulates, and reproduces what has been lost. (*Human Pathology*, p. 35.) But when the whole thickness and circumference of a long bone are destroyed, together with the medullary membrane, while the periosteum survives, Boyer agrees with Troja, &c., in believing the latter membrane to be the means by which the new bone is generated.

[Dupuytren, (*Clin. Chir.* vol. iv.), agrees very much with Duhamel as to the reproductive function of the periosteum, but his experiments lead him to assign some portion of this process to the medullary membrane and adjacent tissues. (See also *Syd. Soc.* 1847. Dupuytren on *Injuries and Diseases of Bone*, translated by Le Gros Clark.) Brodie fully confirms the opinion of Dupuytren. (*London Med. Gaz.* 1833-34, p. 54.) Bransby Cooper also lends his sanction to the formative properties of the same structures. (*Guy's Hospital Reports*, part 4.)]

But, according to Mr. Stanley's investigations, when the necrosis is attended with destruction of the walls of the bone and the medullary texture, the bone may be regenerated from three sources. 1. The articular ends of the original bone, which are very rarely implicated. 2. The periosteum, which invested the dead bone. 3. The soft parts, indifferently, whatever their nature may be, which surround the periosteum, supposing this to have been destroyed. Of these agents in the reproduction of bone, Mr. Stanley joins several of the foregoing pathologists in regarding the periosteum as the most important. Although he is far from maintaining that this membrane is the only tissue capable of forming bone, and gives several examples to the

contrary, yet he considers that the influence which the periosteum exercises in the regeneration of bone is so great, in consequence of its being perhaps more prone to form osseous matter than any other fibrous tissue, that, in all cases in which bone has been lost, whether by necrosis, or external violence, the chance of its reproduction, and the perfection of the process, are materially influenced by the condition of this membrane. With reference to this point, the same observer performed the following experiment. A portion of the radius, in its whole thickness, and with its periosteum, had been removed from the fore leg of one dog; and from the fore leg of another, a similar piece of the radius, but with the periosteum carefully spared; this membrane was merely slit, separated from the bone, and turned aside, so that the required portion of bone could be removed. The result proved the influence of the periosteum in the reproduction of bone; for, on killing both dogs, ten weeks after the operation, it was found, that, in the dog, whose periosteum had been left, the reproduction was so perfect, that scarcely any vestige of the injury remained. But, in the other dog, whose periosteum had been removed, the regeneration was incomplete, and a false joint had formed between the divided ends of the bone. (*Lond. Med. Gaz.* vol. xx. p. 578.)

[Mr. Syme had originally performed an analogous experiment with the same result, and his investigations all tend to show that the periosteum is the principal reparative agent for bone. (*On the powers of the Periosteum to form new Bone*, 1848, in *Contributions to the Pathology and Practice of Surgery*.)]

The experiments of Villermé, Breschet, (*Recherches Historiques et Expérimentales sur la formation du Cal*, 1818.) Sanson (*De la Carie et Nécrose comparées entre elles*, 1813.) Cruveilhier and others left no doubt about the power of the vessels of other textures, besides those of the periosteum and bone, to take a share in the work of ossification; and, as Mr. Stanley correctly observes, important as the periosteum is, as an organ for this purpose, the conclusion must not be made, that it is essential to the reproduction of bone. He removed the periosteum from a dog's tibia and destroyed the medullary texture; yet reproduction ensued, and this evidently by the vessels of the surrounding cellular tissue, which had become exceedingly condensed, and adhered to the surface of the new bone, forming, in fact, its periosteum. The same thing undoubtedly often happens in the human subject.

In cases of deep-seated necrosis, where there are large abscesses, and much destruction of the soft parts around the bone, there must often be more or less complete destruction of the periosteum, which had invested the old bone, and yet the formation of the new bone may be perfectly, though tardily, accomplished.

Besides the periosteum and surrounding soft parts, the articular ends of a bone, whose shaft has perished, contribute also to its reproduction; for luxuriant granulations will arise from their surfaces, and, becoming ossified, will at length unite them to the new bone, which has been produced either by the periosteum, or by other structures.

Many investigations have been made of late years to determine the sources whence the material, which regenerates bone, is derived, and the changes



it undergoes during its conversion into ossific matter. It is now ascertained that the tissues engaged in this process are: 1st, the periosteum; 2nd, the medullary structure of the long bones, and the diplœ of the flat ones; 3rd, the muscles and other soft parts surrounding the affected bone; 4th, the substance of the bone itself. The periosteum is the chief agent in the reproduction of bone, and alone is sufficient to restore the lost part. The experiments of Syme and Stanley, illustrative of this fact, have been already alluded to.

Flourens (*Théorie expérimentale de la formation des Os*, 1847) resected portions of the ribs, and found that, when the periosteum was preserved, deposition of bony matter commenced upon that membrane at the part farthest removed from the cut ends of the bone, and that it gradually extended towards them. Upon one occasion he placed a tube in a hole which was drilled into the medullary cavity of a long bone, and upon a piece of the periosteum which bulged up into the tube, bone was formed. Heine's experiments (*Graefe and Wallther's Journ.* Bd. xxiv.) are equally conclusive: he inserted a piece of linen between the periosteum and the femur of a dog, so as completely to separate them, and after the lapse of a few days, an osseous capsule enveloped the piece of linen, and adhered to the shaft of the bone above and below it, whilst no ossific matter was formed on the surface of the denuded bone. Syme has performed a similar experiment with the same result. (See also *Troja, De novorum Ossium regen. Experimenta*, 1775, and a monograph by Weding, 1823. *Diss de regen. Ossium*.)

The beautiful experiments of Ollier, of Lyons (*Brit. Med. Journ.* 1860), confirm the activity of the periosteum in the reproduction of bone. When portions of it were detached and transplanted into other parts of the same, or even of another animal, new bone was generated. He states that a *subperiosteal blastema* always exists between this membrane and the bone, and it is in this exudation that the osseous formation takes place. Mr. Jordan has attempted to utilize the well-known osteogenic properties of the periosteum in the treatment of ununited fractures.

The regeneration of bone by the medullary tissue has been shown by the experiments of Troja and Charneil upon birds and animals; and later by Stanley, Wagner, and others. It may be observed in the human subject after amputations, resections, and fractures, in the form of an osseous plug, filling up the medullary canal; also in certain cases of necrosis, where the sequestrum is contained in a cavity formed between the thickened external lamellæ, and the medullary tissue, which has been consolidated by osseous deposit into its cancelli. And again, in the obliteration of the medullary canal by bone, which generally takes place when the external layers have suffered necrosis. That the diplœ also takes part in the formative process may be seen sometimes in the cranial bones, where the reticular arrangement of the diplœ has entirely disappeared, in consequence of osseous deposit within its cancelli.

Hunter was the first to recognise the share taken by the surrounding soft parts in the repair of bone (*Op. cit.* vol. i. p. 526) and it is now generally acknowledged. Charneil removed portions of bones in pigeons, together with the periosteum and medulla, and the restoration was complete, al-

though more tedious than when the periosteum was preserved. Stanley destroyed the medullary tissue in the tibia of a dog, after removing the periosteum from it, and in six weeks he found new bone in course of formation round the necrosed shaft. The same author has observed cases of partial regeneration of bone in the human subject, by the soft tissues which surround it; but, to favour this mode of repair, it is necessary that there should be a thick layer of soft parts about the bone, and the inflammatory action preliminary to this process not too severe. (*Op. cit.* p. 108.) The experiments of Syme, Heine, Wagner, &c., show, however, that when the whole thickness of a bone is removed, together with its medulla and periosteum, the reparative process takes place very slowly and imperfectly. In most of their cases the cut ends of the bones were rounded off, and connected only by a dense fibrous cord, in which ossific nodules were occasionally found deposited.

Wagner denies that the bone itself assists in the formation of new osseous tissue. Rokitsansky, on the contrary, attributes to that portion of the old bone which remains healthy after necrosis, the principal share in the reproductive process. Müller does not admit that the periosteum possesses the function of regenerating bone, but considers the new ossific formation is entirely due to an exudation from the inflamed bone, or to minute osseous particles which are detached with the periosteum. Klencke agrees with Rokitsansky as to the reparative power of sound bone, but to a limited extent only; and most other observers are of his opinion.

As illustrations of repair, by the agency of bone, may be given the union of compound fractures by means of granulations which arise from the surface of the bone; the partial or complete restoration of bone in the same manner after an exfoliation; the obliteration of the fistulous sinuses and cavities in bone after expulsion of the sequestrum; the osseous union which takes place after necrosis between the newly formed shaft of a long bone and the epiphyses; bony ankylosis after disease or resection of the articular ends of a bone; and the healing of ulcers of bone, which is affected, chiefly by layers of granulations, devised from the osseous surface.]

If we examine the new bone, at different periods of its development, it appears in the earliest state in the form of a reddish fluid, as has been observed by Duhamel, Fougereux, Bordenave, Haller, Callisen, and others. If we also attend to the progressive changes which this fluid undergoes, we cannot but believe, that, as in the embryo, an organic and fixed arrangement of parts takes place. Indeed, it would be erroneous to consider such fluid destitute of organization and extravasated at random. Thin and little in quantity on its first appearance, its consistence and quantity afterwards gradually increase (*Troja*, p. 42, 44), so that what at first appeared like a liquid, soon becomes a gelatinous substance, in which are developed bony fibres which incessantly become more and more numerous. These fibres in a short time form little layers and cells, and extend themselves everywhere, so that at length all which was fluid disappears, and the new bone is produced. While young, however, it is still spongy and reddish (*Troja*, p. 44), but soon becomes denser, harder, and more solid than that which it substitutes, and it acquires the ordinary colour of the rest of the bones.

[According to more recent observers, the first step towards the reproduction of bone consists in an increased vascularity of the periosteum, which becomes swollen and intimately adherent to the surrounding tissues, then thickened, soft, and pulpy; a copious exudation of yellowish viscid fluid takes place from this membrane, between it and the surface of the bone, so as to separate them; in this fluid are seen small bloody streaks or specks, and when placed under the microscope, nuclei, granular matter, and oil vesicles are found. This blastema gradually condenses, becomes of a gelatinous consistence, then firm and cartilaginous; and in this stage it presents, on examination, nucleated cells and nuclei in large quantity, connected by an intercellular material, which is somewhat fibrillated.]

The process of ossification commences very early. Wagner has seen bone formed in the medullary canal as early as the sixth day. It takes place in the cartilaginous substance, above mentioned, by the deposition of osseous particles in several places at once. These increase in size and number, and assume the form of needles, which spread out over the mass, and, by their coalescence, enclose large spaces—thus causing the open porous surface which is a characteristic of new bone. This spongy condition disappears as ossification proceeds, and, in time, the new bone becomes equally dense with the old; a section of it under the microscope presents precisely the same arrangement as a piece of original bone.]

The external surface of the new bone, which, during the period of its formation, was irregular, and studded with several excrescences of various sizes, and pierced with apertures of different dimensions, becomes in the course of time smooth and regular, especially after the expulsion of the sequestrum.

The sides, or walls of the new bone, which at first were of considerable thickness, grow thinner (*Troja*, p. 21); and its interior becomes hollowed out, so as to form a more or less perfect medullary canal. When the entire necrosed shaft remains enclosed in the sheath formed by the new bone, this is neither shorter nor longer than the original. But, should one of the ends of the dead shaft protrude from the cavity, while, by the side of the affected bone, there is not another one capable of resisting the action of the muscles, the new bone will be shortened, and undergoes some change in its shape and direction. Indeed, says Weidmann, the new bone in its early state, from want of consistence, must yield to the efforts of the muscles.

[Muscular action, aided by the weight of the body when the necrosis is in the lower extremity, will sometimes occasion considerable shortening and deformity of the limb, in consequence of the yielding of the newly formed osseous tissue. Very serious results have ensued from this cause, such as fracture; or a sudden movement of the limb has been known to force the point of a sequestrum into a neighbouring joint, or to lacerate a large blood vessel. (*Stanley*, *op. cit.* p. 111. *Poland on Injured Arteries*. *Guy's Hospital Reports*. Series iii. vol. v. p. 332.)]

The periosteum, which swells as soon as the separation of the old bone commences, shrinks, and is not at all thickened, when the exfoliation is finished. *Troja*, having destroyed the medullary structure of a long bone, found the periosteum swelled at the end of 36 hours; but he observed,

that the whole of such swelling disappeared before the 25th day. (*P.* 43, 67.)

The periosteum, which thus survives, adheres to the new bone, as it did to the old one; its vessels are increased in diameter, and convey a larger quantity of blood; they dive into large apertures in the regenerated bone, ramify everywhere in its substance, and nourish it.

[When the periosteum is destroyed by injury, or by the violence of the inflammatory process, according to *Stanley* (p. 110,) the cellular tissue around the bone becomes dense and thickened; it adheres to the newly formed osseous structure, and forms its investing membrane, fulfilling all the functions of the periosteum. *Wagner*, however, (*op. cit.* p. 171) states that this new covering is formed by the plastic exudation, which takes place to regenerate bone. According to him, about the sixth day a change, perceptible to the eye, has occurred in this material. It then presents two different substances; that nearest to the bone is of a bluish white colour, resembles cartilage in its density, and is converted into bone; the more superficial layers are yellowish or reddish in colour, and, consisting "of the elements of immature cellular tissue," are gradually perfected into true areolar tissue, which blends with and thickens the periosteum, or, when that membrane is destroyed, forms a fibrous covering to the new bone.]

How admirable is the process, by which the muscles, detached from a bone affected with necrosis, have other insertions given to them, and are thus rendered capable of performing their functions! (*Troja*, p. 27.)

[When the periosteum is preserved, the muscles and tendons retain their connexion with it, and are inserted into the new bone through its medium; but, if that membrane be destroyed, their attachment to the skeleton is effected by means of the lymph effused during the inflammatory process which has taken place; this, infiltrating the surrounding parts, causes their adhesion to each other, as well as to the thickened layer of cellular tissue, which forms the immediate covering of the bone. *Rokitansky* states, on the authority of *Meckel*, that the muscles remain connected with the dead bone for some time, reaching it through the openings left in the new; but that they gradually become detached from it, and implanted in the newly formed bone. The manner, however, in which this is accomplished, is not described.]

The internal surface of new bone is lined by a new membrane, which serves as a periosteum to the inner lamellæ, and is at first hardly distinguishable. (*Troja*, p. 56.) In the early state, it is soft and pulpy (*ibid.* p. 22); but by degrees, it grows thicker and firmer, and is at length converted into a true membrane, which sends a great number of vessels into the substance of the bone. When this membrane is torn off, the surface, which it covered, is found somewhat smooth, the edges of the bony layers and projections of the fibres being blunt and rounded.

[The cavities which are gradually developed in the interior of a new bone, are also lined by this membrane, and, in course of time, marrow is formed within them.]

Necrosis may attack the whole shaft of a bone, but this is not usually the case; it is much more common to find only a part of one affected: it may also vary in intensity from the slightest loss of sub-



stance from the surface of a bone (see EXFOLIATION), to destruction of the whole thickness of its shaft.

In *external* or *superficial* necrosis, only the outer layers are involved, and it does not usually extend deeply into the substance of the bone; it is often the result of periostitis or of an injury, and varies very considerably in its extent. If the periosteum be destroyed, the dead piece of bone, when detached from the living, comes away of itself, or is readily removed, and the reparative process is very imperfect, or altogether absent. This form of the disease is frequently met with in the skull, in the bones of which there is seldom much attempt at reproduction.

When the periosteum is left intact, it pours out plastic lymph, which becomes ossified and forms a bony case for the sequestrum: this is then said to be *invaginated*, and requires the aid of surgery for its removal. In these cases the loss of substance is entirely restored.

In *internal* or *central* necrosis, destruction of the inner lamellæ of the bone takes place, whilst the outer part or cortex is not involved in the disease. Here new osseous tissue is formed by the periosteum upon the surface of the bone, whilst the external layers become indurated from deposition of ossific matter between them; the medullary structure may also become consolidated by bony deposit, and the sequestrum will then be contained in a cavity, formed by the thickened outer walls and the ossified medullary tissue. If the medullary texture perish, together with the inner layers of the bone, the whole will be detached as a sequestrum, in the form of a cylinder, leaving the solidified external lamellæ covered on their inner aspect by granulations. This latter form of the disease is most commonly seen in the stumps of long bones after amputation.

When the whole thickness of a bone dies, the medullary tissue generally perishes with it; the periosteum inflames, separates from the dead bone, and pours out plastic lymph, which ossifies and forms a bony sheath around the necrosed shaft, and, when this is removed, more or less perfectly replaces it. This cylinder of new bone, which is termed the *involutum*, is white, rough, spongy, and porous; it is perforated with openings of varying size and shape, they are called *cloacæ*, and lead into the interior of the bone.]

The cavity of the new bone includes, and almost entirely conceals, the dead fragments. Sometimes, however, the new bone forms a sort of bridge over the sequestrum, in such a manner that the cavity is open above and below, in both which situations the sequestrum can be felt. (*Hunter, in Med. Obs. and Inquiries*, vol. ii. p. 418.)

Sometimes, it is only a narrow cross piece, which forms the bridge retaining the sequestrum. (*Weidmann*, vid. tab. 5. fig. 1. a.)

The new bone may also have an opening in it, out of which the dead portion protrudes. (*Ibid.* p. 35.)

Sometimes the cavity of the new bone is single: while, in other instances, there are several successive cavities in the direction of the length of the bone, with transverse interspaces between them; or else the cavities are situated laterally with respect to each other, and divided by partitions. (*Weidmann*, tab. 7. fig. 2.) [In the Musée Dupuytren may be seen a tibia with nine distinct cavities, containing as many sequestra.]

These cavities are proportioned in size and shape to the fragments of dead bone, which lodge in them. It occasionally happens, that they open into some neighbouring joint, and bring on suppuration there; a very unfavourable complication. (*Ibid.* p. 34. and tab. 6. fig. 3. Also, *Boyer, Mul. Chir.* tom. iii. p. 435.)

Let me take notice of the holes, by which the cavities, including the dead pieces of bone, open externally, which Troja denominated the *foramina grandia*, and which the preceding excellent writer preferred calling the *cloacæ*, because they serve to convey outward the matter and any separated pieces of bone. In the beginning they are not observable, a certain space of time appearing to be requisite for their formation. They are noticed in long cylindrical bones, whether original, or of new production, whose cavities contain dead fragments.

These openings vary in number; when the sequestrum is small, only one is found; but, when the piece of dead bone is extensive, there may be two, three, or four. Weidmann never saw more than five. But Troja met with eight. (P. 58.) Weidmann possessed a small portion of the diplœ of the os innominatum, which was affected with necrosis, and contained in a bony cavity, that had no external opening whatever.

When there are several distinct cavities in the same bone, containing dead fragments, each cavity has at least one external opening.

These *cloacæ*, or apertures, are commonly situated at the lower and lateral parts of the cavities; they pass obliquely outwards, and communicate with fistulous sinuses, which open on the surface of the skin. (*David*, p. 186.) Some of the *cloacæ*, however, form at the middle, or (what is exceedingly rare) at the upper part of the cavities, and proceeding outward, without any oblique track, go to the front, back, or lateral parts of the limb. They are of a round or oval shape, or nearly so. Their usual size is such, that it will just admit a quill or a probe. They terminate internally by converging edges in the manner of a funnel; while, on the contrary, the margins of their outer extremity expand somewhat. The canal, between these two orifices, is sometimes long, sometimes short, and in certain cases, of scarcely any extent.

Different opinions have been broached, respecting the causes which produce the apertures in the new bone, termed by Weidmann the *cloacæ*. M. David says that the pus, collecting in an early stage of the disease between the bone and the periosteum, distends and corrodes this membrane, and that the openings which form in it become afterwards a cause of fistulæ in the new bone. (P. 186.) But it is observed by Weidmann, that this explanation is inadmissible, since the existence of the collection of pus mentioned by M. David, is not proved by observation: in fact, it was never met with by Troja, Blumenbach, Desault, Koehler, and many others in repeated experiments on the subject. (*Troja*, p. 56 and 66; *Weidmann*, p. 36.)

Koehler thought he had seen the new bone itself destroyed by the pus, and *cloacæ* thus produced. (P. 68-72.) Weidmann, however, deems this opinion quite as improbable as the preceding, for the fact of the surface of these bony apertures being always smooth, always formed in one manner, and constantly lined by the periosteum, decidedly proves, that they cannot arise from the action of pus on the bone.

Troja, in his third experiment upon the regeneration of bones, remarked, that forty-two hours after the destruction of the medulla, there took place, between the bone and the periosteum, an effusion of lymph, which was at first thin and in small quantity, but afterwards became thicker. He noticed, in the midst of this gelatinous substance, some small spaces, where it was deficient, and which had, instead of it, a subtile, whitish, dry incrustation, which, though tolerably adherent, could be rubbed off. These small spaces, according to Troja, produce the apertures called the *cloacæ*. (Troja, p. 45.)

In another experiment, he had an opportunity of examining the above little spaces at the end of forty-eight hours: he affirms, that they were replaced by the large apertures, or *cloacæ*, of the new bone (P. 47.), and that such openings were invariably formed in the place of the small incrustated spaces already described. (P. 58.) As Troja took notice, that no lymph was effused at these particular points, he was inclined to impute the circumstance to a defect in the ossification, and, perhaps, to the death of some parts of the periosteum. Weidmann acknowledges, that the mode in which the formation of the *cloacæ* happens is exceedingly obscure; and expresses his belief, that Troja's account of it is the nearest to the truth. But, says he, one thing is certain, namely, that these openings have no other use but that of conveying outward the pus, which collects in the cavity, and the small bony fragments, since, as soon as every atom of dead bone has passed out, they diminish, and, at length, are totally obliterated. (Weidmann, *De Necrosi Ossium*, p. 36.)

[Stanley considers that these openings are formed in consequence of the destruction of portions of the periosteum during the course of the inflammation which accompanies a necrosis: at these points no deposit of bone takes place, and it is uncertain whether the apertures ever close. Nélaton (vol. i. p. 617, op. cit.) agrees with Troja, that small pieces of the periosteal investment remain adherent to the necrosed bone and perish with it, and consequently there is an absence of ossification: but he states that, when the sequestrum is expelled, the openings are filled up by ossification of the granulations lining the cavity and fistulous sinuses. Gerdy (op. cit. p. 229.) is of opinion that they are formed by the mechanical action of the pent-up matter, which finds its way to the surface, after the manner of an abscess in the soft parts, and that they close ultimately.]

It is a remarkable circumstance in the history of necrosis that, in favourable instances of the disease, the inflexibility and firmness of the limb are preserved during the whole of the process by which the new bone is formed. Consequently, the new bone must have begun to grow, and have acquired firmness before the old bone separated, or was absorbed. Were this not the case, the limb must become flexible and useless, the moment the dead bone is removed. Another consequence of the new bone being formed, before the removal of the old one, is that the former must surround and include the latter. For, since the lifeless portion of bone completely occupies the space between the two living ends, these cannot be immediately connected by the new bony matter. The connexion

can alone be completed by the new bone being deposited on the outside of the old one, from one end to the other, and attaching itself to the portions which still remain alive. The new bone must also be necessarily larger than the old one, because it is externally situated; and hence the affected limb, after the cure is complete, will often continue larger, clumsier, and less shapely than the other. The length of it, however, may remain unaltered, because the old bone retains its attachment, while the rudiments of the new bone are lying on its outside, and connect the living ends of the old one, by an inflexible mass, equal in length to the portion which is destroyed.

When the loss of bone has been very extensive it is seldom completely restored, and, if it be reproduced, its shape is not exactly like that of the original bone: the sides are flatter; the usual angles, depressions, and eminences are not observable, and sometimes others are formed.

[Occasionally the shaft of a long bone is reproduced, equal in size and shape to that which it replaces; and, in rare instances, it may even exceed its original in length. Cloquet has recorded an example of this in a girl, 13 years old, where, after necrosis of the tibia, the new bone was an inch and a half longer than that of the other leg.]

We see that, in the process which nature follows in the formation of the new osseous shell, the old bone serves as a mould for the new one, and the first step of the process is to surround the old bone with an effusion of coagulating lymph. (See Russell on Necrosis, p. 2—7.)

When the sequestrum is thrown off slowly, the inflammation is moderate; but when it separates quickly, while the new bone is in a soft state, the detachment is generally preceded by severe inflammatory symptoms, and followed by a temporary loss of the natural firmness of the limb. This premature separation of the sequestrum often occurs in necrosis of the lower jaw, and the chin consequently falls down on the neck. In certain cases, the sequestrum separates at each end from the living portions of the old bone, before the new osseous shell has acquired firmness, so that the limb is, as it were, broken in two places. (Russell.) I have known cases of this description require amputation.

[The length of time required for the separation of a sequestrum is most uncertain: in some cases it proceeds with great rapidity, whilst in others, many years elapse without its detachment from the living bone. Stanley (p. 96. op. cit.) relates one instance where a portion of the femur was still in process of exfoliation thirty-five years after the injury which caused the necrosis; according to the same author, no explanation can be offered for the varying periods of time met with in different cases. Mr. Paget considers, that when the dead and living portions remain continuous for a long time, it is owing to a want of vital force to detach them; and, until the general health is improved, no separation takes place. (Op. cit. vol. i. p. 471.) This view receives confirmation in those cases of necrosis which proceed from constitutional causes, such as syphilis: here the process of exfoliation may take place very slowly, or even be entirely arrested, until the proper remedies for the disease be administered, and the patient's health improved: the eliminating action is then expedited, and the



piece of bone, which has been a source of discomfort for months or years, is cast off. In cases of necrosis from general causes, there is seldom much attempt at repair, and this circumstance is observed in traumatic cases occurring in unhealthy persons: also when there is much destruction of the soft parts, whether resulting from the injury, or from the violence of the inflammation succeeding to it; and again, when followed by very slight inflammatory action, the necrosis may assume a chronic form, and give rise to morbid changes in the bone itself and the tissues about it. In such instances, large portions of bone may be lost without further attempt at repair than is afforded by means of a fibrocellular structure, or even without any at all.

In some cases of acute necrosis, the disease follows a very rapid course, necessitating amputation of the limb within a few days of its commencement, or else the patient succumbs to its violence. In most of these instances, the whole shaft of the bone is implicated, and is found denuded of its periosteum, and bathed in pus: here there is no attempt at repair, and even when sufficient time has elapsed for the reproductive process to have established itself, the severity of the inflammation has usually prevented any formation of bone. Although the destruction of the shaft is so complete and rapid, the articular extremities are very rarely attacked, showing well the power possessed by the cancellated structure of bone to resist the invasion of disease.

Occasionally these acute cases of necrosis have given rise to pyæmia, and thus destroyed life (*Path. Soc. Trans.* vol. xiii.), but purulent infection is not a frequent consequence of diseased bone. The new bone which replaces the old, after a necrosis, may itself be attacked by the same disease. Where this has happened very little, if any, attempt at repair has been observed.]

Let us next consider the states and circumstances of necrosis, in which surgery may be advantageously exerted in the assistance of nature, and the means which may be employed for the purpose.

In some instances, the shaft of a cylindrical bone may have perished, and become completely separated from the living ends, and yet the process of reproduction may take place to only a limited extent, or it may entirely fail. In some other cases, and under whatever circumstances the death of the bone has occurred, whether from constitutional or local cause, from external violence or otherwise, the necrosed portion may still retain its connexion with the living bone, and no exfoliation ensue. In University College Hospital I lately had a patient with necrosis of the thigh bone, which had continued fourteen years, without any sequestrum having become loose. In many examples, the cause of this failure of separation seems inexplicable: "In some, (says Mr. Stanley,) it may arise from simple debility, or a peculiar derangement of the system; or it may be the effect of a diseased condition of the soft parts surrounding the dead bone. This is perhaps capable of illustration by those cases in which necrosis takes place from the influence of the venereal disease. In these, a portion of the front of the tibia, for example, having perished, and the skin covering it ulcerated, dead bone is exposed, and becomes perfectly black; but it undergoes no further change, till mercury is exhibited." (*See Lond. Med. Gaz.* vol. xx. p. 579.)

Weidmann strongly advocated the plan of confiding the process of separation, or exfoliation, to nature. In what other manner, he asks, could it be more safely accomplished, without hæmorrhage, or pain to the patient—without any risk of a recurrence of inflammation, or of a fresh necrosis? He admits, however, that the process frequently requires a considerable time; and that it would be desirable to accelerate it, if possible.

"Will any topical applications have this effect? They are put upon the inert surface of a dead piece of bone, in which no vital power or action can be again excited. When acrid, they prove irritating, inflaming, and destructive of the neighbouring flesh, without any utility—and cause pain to the patient, which is compensated by no good. Would the perforations recommended by Celsus, Belloste, and many others, have the desired effect? If, says Weidmann, they are confined to the dead bone, they cannot have more effect than the scarifications which were formerly practised in cases of gangrene; and, if they extend to the living bone, this will be injured. Lastly, Weidmann inquires, whether the separation can be accelerated by the actual cautery, which cannot act upon every point of the necrosis, and which, unless applied with the greatest precautions, will burn the subjacent parts, and bring on a new attack of inflammation, without forwarding the exfoliation in the smallest degree. Of what use, says he, can rasping and scraping instruments be, which act merely upon the dead part? Or will the gouge, and other cutting instruments, do more good? They cannot take away the whole of the dead portion, without injuring the adjacent living bone, and causing a risk of another necrosis. And, if they leave any piece of the old dead bone behind, nature will be as long in effecting the separation of these, as she would have been in detaching the entire necrosis."

A certain degree of irritation in the soft parts around a necrosis is set down by Mr. Stanley as a necessary condition for exfoliation. I believe that the process is frequently expedited by it; and that it is on this principle that perpetual blisters, issues, setons, mineral acids, the cautery, and some other plans above specified, have occasionally proved serviceable.

"In cases of slight superficial necrosis, surgeons have frequent opportunities of trying every kind of topical application; and when the cure takes place, during the use of any of them, the benefit is ascribed to whatever happens to be in use. But in numerous and far more serious examples of necrosis, it is impossible to make these applications reach the whole surface of the dead bone; yet notwithstanding this circumstance, the separation is not impeded. Some exfoliations happen, without our knowing of their occurrence, and without a thought having been entertained of promoting them by any vaunted applications. We even see necroses separate, whose situation rendered them inaccessible to our remedies: such are the necroses which occur within the long bones, and comprehend the whole of their cylindrical shaft or body. What surgeon can boast of having effected, by topical applications, the separation of the whole lower jaw-bone; a thing which nature has very frequently accomplished? And when, as often happens, the entire diaphysis of the thigh-bone, or other long bone comes away or splits longitudinally, and such bone loses a half of its cylinder, how is it possible

for any topical applications to reach every point at which the separation occurs?" (*Weidmann.*)

The same author justly condemns the practice of making incisions, for the purpose of exposing the whole surface of a necrosis, immediately the existence of the disorder is known. As such incisions soon close up again, so as to leave only a small outlet for the matter, they must be repeatedly practised before the dead bone becomes loose. The avowed design of them is to make room for the topical remedies, which are to render the exfoliation quicker; but, as these remedies possess no real efficacy, it follows that making incisions, before the dead bone is loose, only torments the patient without producing the least benefit. The orifices of the ulcers, then, which allow the discharge to escape freely, are sufficient, and so long as the fragments of bone are not entirely detached, the surgeon should abstain from the use of the knife.

It appears to Weidmann, that *the indications are limited to removing the original cause of the disease; to alleviating the symptoms; to supporting the patient's strength, and improving the state of the constitution, in whatever state it may be bad; and, lastly, in removing the dead portions of bone, when they become loose.*

Above all things, the surgeon must not regard every piece of exposed bone as necessarily affected with necrosis, and, in consequence of such idea, have recourse to acrid, drying, caustic applications. Such means are not only useless, but absolutely pernicious; because they may actually cause a necrosis, which did not exist before they were used, and which would not have taken place at all, if only mild simple dressings had been employed.

When the disease presents itself with violent symptoms, the inflammation and fever being intense, the severity of the case is to be assuaged by low diet, mild antiphlogistic remedies, emollient applications, and narcotics to alleviate the pain; if this be very severe, with swelling and tension of the part, and the irritative fever high, local bleeding by leeches may be of service, but general depletion by venesection can scarcely ever be required.

[Perfect quietude to the limb is essential, and must be insured: if suppuration take place—and this will be ushered in by rigors—incisions must be made, in the most suitable positions, to facilitate the escape of the matter, and the strength of the patient supported. When the disease assumes a chronic form, the soft parts about the bone may become greatly thickened from effusion of lymph and serum into them, giving rise to constitutional disturbance from repeated inflammatory attacks: mild counter-irritants, in the intervals of these attacks, will often relieve the pain and discomfort, and, by slightly stimulating the parts, hasten the separation of the dead bone and promote the reproduction of new. In certain cases gentle exercise of the limb will, in the same way, favour these processes: tonics and mild alteratives may also be given internally.]

When the necrosis has arisen from syphilis, scrofula, or scurvy, &c. the medicines calculated to remedy these states of the constitution should be employed. I cannot say, however, that my experience has taught me to believe, that, in necrosis from syphilis, mercury is generally useful. On the contrary, in necrosis of the bones of the palate and nose from this cause, I have mostly

found it hurtful to the constitution, and at least useless in relation to the dead bone itself. At the same time, I must confess, that some examples of necrosis of the tibia from syphilis have fallen under my notice, where the ulcers never assumed a healthy character, and exfoliation made no progress, till mercury had been administered. Similar facts are adverted to by Mr. Stanley. Here, as he conjectures, mercury may quicken the action of the absorbents, independently of their influence on the constitutional affection. Instead of mercury, the iodide of potassium, combined with decoct. sarsæ, or some bitter infusion, is far preferable: it rapidly improves the health, and quickens the action of the absorbents, or, as Velpeau terms it, the molecular action, by which exfoliation is accomplished. This is an excellent medicine, not only in necrosis from syphilis, but in that from scrofula and other causes.

Lastly, it is the duty of the practitioner to extract the fragments of dead bone, in order that the deficiencies produced by them may be filled up, and the ulcers of the soft parts heal.

Nature, who succeeds by herself in detaching the dead pieces of bone, can do very little in promoting their passage outward. Frequently, indeed, she has no power at all in this process, and it is only from surgery that assistance can be derived. When a dead piece of bone is still adherent at some points, its extraction should be postponed, until it has become completely loose. If it were forcibly pulled away, there would be danger of leaving a part of it behind, which must have time to separate ere the cure can be accomplished.

But, when a fragment is entirely detached, and the orifices of the sinuses are sufficiently large, it is to be taken hold of with a pair of forceps, and extracted. If the cavity has only a narrow opening, suitable incisions must be practised, in order to facilitate the removal.

Sometimes, the dead fragment protrudes from the opening and projects externally, so that, if loose, it admits of being taken hold of with the fingers and removed. In this way, Weidmann took away a large dead piece of the humerus, which protruded nearly two inches out of an ulcer in the middle of the arm. The patient was a young lad, fourteen years of age; and the limb became again a useful one, although somewhat misshapen, being concave within, convex externally, thicker, and one inch shorter than its fellow. He got quite well three weeks after the removal of the dead bone.

I have already adverted to the example, recorded by Weidmann, in which a shoemaker removed by himself nearly the whole body of the tibia. Doubtless the projection of the bone, and its looseness, enabled the man to do this easily with his fingers. But there are cases which present more difficulty: such are those in which the sequestrum is included in a cavity, either of the original or new bone.

The old surgeons were in the habit of amputating limbs which were in this state, although instances were not wanting in their days to prove the possibility of relieving the disease without amputation. This blameable custom of removing every limb, thus affected, is justly exploded from modern surgery. Albucasis was the first who attempted to cure such a necrosis by the judicious employment of the knife and saw. (*Lib. ii.*)



cap. 38.) The same kind of practice was successfully adopted in two instances by Scultetus. (See *Armament. Chirurg.* tab. xlv. and obs. 81.) This commendable method, however, afterwards fell into disuse, until M. David, by twenty examples of success, refuted all the objections which had been urged against it. (P. 197.) Since the period of this distinguished author, the practice has been imitated by all enlightened surgeons, so that the case is no longer regarded as a disease necessarily requiring amputation. M. Bousselin cut out the sequestrum eight times from the tibia, and four times from the thigh-bone, with perfect success. (Vid. *Mém. de la Société Royale de Médecine*, t. iv.)

The method consists in exposing the bone, and making in it an opening of sufficient size for the removal of the loose dead fragments. Experience proves, not only that patients affected with necrosis bear this operation well, but that, after its performance, the ulcers commonly heal favourably, the health becomes re-established, and the functions of the limb are hardly at all impaired.

Surgeons, however, are not indiscriminately to choose any period for performing this operation. If they are too hasty, they will run the risk of finding the dead portion of bone still adherent to the adjacent parts: and if they delay too long, the patient may be irrecoverably reduced; while there is much greater difficulty experienced in opening the investing case of new bone, on account of the density which it has now acquired.

Patients are met with who have been afflicted with necrosis several years. In such cases, great circumspection is necessary, and the practitioner should carefully endeavour to ascertain that the dead pieces of bone have not been absorbed or come away piecemeal in the discharge, lest a useless operation should be performed, as once happened in the practice of M. Bousselin. (*Mém. de la Société Royale de Médecine*, t. iv. p. 304.) Therefore, when the disease is of long continuance; when the discharge is much less than it was at the commencement; when small pieces of bone have at times been voided; and the sequestrum cannot be felt with a probe; it may be most prudent to abandon all idea of operating, and allow nature to finish what she has so well begun. In short, when the sequestra are undergoing a gradual absorption, without ever making their appearance externally, or giving any considerable disturbance to the constitution; or, when the dead bone is making its way outward without occasioning much suffering or inconvenience; the surgeon should interfere but little with the natural progress of the case. When the dead bone does not tend to make its way to the surface, but lies quietly concealed in the new osseous shell, a gentle stimulant, such as a blister, has sometimes seemed to promote the process of exfoliation, and thus hastened the cure; but soothing applications are in general more suited to all cases of necrosis.

[As soon, however, as the sequestrum is detached, which may generally be ascertained by examination with a probe, it should be cut down upon and removed.]

The dead bone, although separated from the living, may be held firmly by means of the granulations projecting into the holes and irregularities on its surface, which prevent its moving when pressed upon by a probe; if there be another

fistulous opening into the cavity, a second probe should be introduced until it touches the dead piece, and then by making pressure alternately with the probes any movement can readily be detected.

As a rule, an operation for necrosis should not be practised until the dead portion is detached from the rest of the bone; but in some cases, where the exfoliation progresses very slowly, an attempt may be made to remove the diseased piece, for, even if all of it be not taken away, the stimulus of the operation to the parts surrounding it will accelerate the process of separation.]

If the surgeon operate as soon as the sequestrum becomes loose, he will often find the new bone so soft that it can be divided with a knife; a circumstance which materially facilitates and shortens the operation.

Excepting in very young children, Mr. Mayo considers it generally right to remove the sequestrum by an operation, several months perhaps before it would spontaneously come away, because "the confinement of the patient to his bed, or couch, may produce sloughing of the integuments, or contraction of the limbs. The long confinement, or continued discharge, may exhaust the constitution. The protracted continuance of the sequestrum in the new bone may give rise to caries, or even involve the neighbouring joint in the disease." (*On Human Pathology*, p. 30.)

Keeping in mind the foregoing precepts, the surgeon is to begin with exposing the bone, in which the sequestrum is contained. When the bone lies immediately under the skin, Weidmann recommends making such incisions as will lay bare the whole of its surface; and when its situation is deeper beneath the muscles, he even sanctions cutting away as much of the flesh as may be necessary to allow the instruments to be freely worked upon the bone. I cannot, however, see the propriety of this advice: exposing the whole surface of the bone in the first instance, before it is known whether the saw need be so extensively used as to require such a denudation, certainly appears irrational. And, as for cutting away any portions of muscle, this can be no more necessary here than it is in the operation of trephining. But it is unquestionably proper to make, with the bistoury, sufficient space for the use of whatever instrument is employed for the division of the bone. Yet it is only necessary to make this exposure in the first instance in one place. The surgeon can afterwards enlarge the incision, or practise others, as circumstances may indicate. The surface of the bone being brought into view, if the cavities, in which the dead fragments lodge, present apertures which are too narrow, these apertures must be rendered larger by means of a small trephine, or with a saw constructed on the principle of those described by Mr. Hey, of Leeds, or else with a pair of cutting forceps, with which the removal of the requisite portion of bone can be very expeditiously accomplished. In University College Hospital, I have employed for this purpose a curved pair of bone forceps, and found them convenient. The perpendicularly acting wheel-like saw, turned by machinery, and invented by Mr. Macheil, here promises also to be of important assistance. It has been used by Sir A. Cooper, who has given an engraving of it in his *Surgical Essays*, part i. pl. 8, fig. 7. Another saw, constructed on some-

what similar principles, has been employed by Graefe of Berlin with great advantage for several years. A tract by Schwalb (*De Serra Orbiculari*, 4to Berol. 1819.), giving an account of it, was sent to me by the late Dr. Albers, a little before his death: it is turned by means of a handle, which projects horizontally from the cutting part of the instrument, and it has a frame or fulcrum, on which it works. Professor Thal's rotation-saw may also prove of service. (See *Edinb. Med. Journ.* No. lxxviii.) Messrs. Weiss, of the Strand, lately lent me a most perfect kind of wheel-saw, worked by machinery, and calculated to act through a narrow space, on bone deeply placed.

If the cutting forceps are used, the point of one blade is introduced into a cloaca, and a portion of the new bony case divided. In this way, the bridge of bone between one cloaca and another may often be cut with great facility, and the aperture then enlarged to the necessary extent.

When the sequestrum is found to be very large, it will be necessary to expose more of the surface of the bone by incisions. In such a case, Weidmann recommends applying a trephine to the upper and lower parts of the cavity, and then cutting away the intervening portion of bone with the saw or gouge. But, there can be no doubt, that a more prudent way would be to go on with the enlargement of the aperture in the bone, at the place where the first perforation took place, if the sequestrum presented itself equally well there; because, by proceeding in this manner, the surgeon might discover that the dead fragment could be taken out, without so great a destruction of bone as is caused in the other mode; and, if this were not to be the case, no harm is done, as the necessary removal of bone can be continued.

[In all operations for necrosis, great care should be taken to avoid removing more of the new bone than is absolutely necessary, as it is not reproduced; and, if the bone operated on be one of the lower extremity, the limb may be so much weakened as to be incapable of supporting the weight of the body.]

When the bone, which includes the sequestrum, is a recent production, its soft state may sometimes enable the operator to perform the needful excisions with the bistoury alone.

When several sinuses exist in the limb, each may be dilated, in the manner which seems most advantageous.

Sufficient openings having been made into the cavities including the sequestra, the next object is to extract these dead portions of bone. In accomplishing this part of the operation, Weidmann particularly advises two things: first, that no piece of the sequestrum be left behind; secondly, that no injury be done to the membrane, which lines the cavity in which the dead bone is lodged.

This author observes, that there are examples in which the vicinity of certain parts impedes the surgeon from making an opening in the bone, large enough for the extraction of a voluminous sequestrum in an entire state. In this circumstance, he recommends the sequestrum to be broken in pieces, or, as I should prefer, divided with any convenient means, and the fragments separately removed.

The cutting of the sequestrum in its centre, so as to make two pieces of it, is here right, on the principle of not destroying too much of the new

bony case. Sometimes, when neither end of the sequestrum is uncovered, it may be disengaged and extracted, by pushing it downwards or upwards, so as to enable the surgeon to get at one extremity of it, which may then be raised with an elevator, or the finger. When neither end can thus be reached, the opening may be enlarged upwards or downwards, and the sequestrum divided with a trephine, small saw, or cutting forceps. If necessary, a central piece of it may be thus removed, so as to make room for the extraction of each extreme portion of it separately.

[Where incisions into the soft parts cannot safely be made for the extraction of necrosed bone, in consequence of the vicinity of a joint, a blood-vessel, or other important structure, dilatation of the fistulous sinuses may be attempted by means of sponge tents, &c., and occasionally the bone may be withdrawn through them without necessitating an operation.]

It is not to be dissembled, however, that cases present themselves in which amputation affords the only chance of saving life. In fact, it sometimes happens, that the cavities, in which the sequestra are contained, communicate with those of the neighbouring joints, which then become filled with matter, and caries attacks parts of the bones to which the necrosis does not extend. On some occasions, the dead pieces of bone are very numerous, and each has a separate cavity; while, in other instances, the sequestra lie so deeply, that a passage for their extraction cannot be prudently attempted. Sometimes, nature fails to carry the reproduction of bone to the extent necessary for the cure, or the new osseous covering gives way, and immense deformity and vast irritation, followed by profuse abscesses, are the consequences. Sometimes, also, a necrosis is complicated with another disease in its vicinity. Lastly, such may be the reduced state of the patient's health and the particular condition of the necrosis itself, that the constitution cannot hold out during the whole time, which would be requisite for the detachment of the sequestrum. Under circumstances like these, amputation is necessary and ought not to be delayed.

Dr. Mott had a case, in which the head of the femur was so involved in a necrosis, that amputation at the hip-joint was necessary. As Mr. Mayo observes, "When the articular end of a cylindrical bone is necrosed, it excites disease of the joint, which precludes restoration. In a knee, which I amputated, half of the outer condyle was necrosed, and in process of separating into the articular cavity." (*Human Pathology*, p. 35.)

[Necrosis of the cancellated tissue of the head of the tibia is occasionally met with, and should be operated upon early, before the knee-joint becomes affected. The trephine must be used to perforate the bone, but many difficulties attend its successful performance.]

The wound made for the removal of a sequestrum should, immediately after operation, be thoroughly plugged with oiled lint, care being taken that the cavity in the bone is also filled by it; the lint should be left until loosened by suppuration, when a poultice may be applied, and this method of dressing the wound must be daily practised. By filling the wound with lint, the bleeding after operation is controlled; it prevents the cut edges of the integument from uniting, and thus insures a



free outlet for the matter formed, as well as for any small fragments of bone that may be left: it also compels the wound to granulate from the bottom, and thus the cavity becomes effectually closed.

The sequestra which are occasionally met with in the stumps of bones after amputation vary much in size and shape; sometimes, when the periosteum has been detached, a shell consisting of the external layers of the bone will exfoliate; at others, a small ring of bone, comprising the entire thickness of the shaft, will separate; this form is commonly met with when the soft parts have retracted or sloughed, leaving the end of the bone exposed. But a much more extensive loss of substance may take place from inflammation of the medullary tissue, when it has sustained injury from the action of the saw during the operation, or from the accident which necessitated amputation. In these cases the sequester is of a conical shape, comprising the whole thickness of the stump of the bone at its extremity, and gradually tapering away to a thin shell, which is formed by the internal lamellae of the shaft: these deeper layers have suffered necrosis in consequence of inflammation of the medulla, and are ensheathed in the cortex of the bone, which has become consolidated and thickened by deposit of osseous matter upon its surface and between its layers.

When completely detached, one of these sequestra may be drawn out of its bony sheath in the form of a cylinder, which consists of the entire walls of the medullary canal, and may extend the whole length of the stump. In the museum of St. Mary's Hospital is a specimen fully nine inches long, extracted from the femur of a person after amputation. The external surface of these sequestra is very rough and irregular, as is also, but to a less extent, the interior of the bones from which they have been withdrawn: on removing one of these necrosed pieces, the inner surface of the shaft from which it has separated is seen to be lined with granulations which ultimately form the medullary membrane.

In such cases, chronic inflammation is kept up in the stump, and a free discharge of matter will often continue for several months; the strength of the patient must be maintained until the sequester becomes loose, when it can be readily withdrawn by means of forceps, and the wound quickly heals; sometimes, however, an incision may be required to facilitate its extraction. This form of necrosis used to be very common when caustics and escharotics were applied to the stump after amputation, but since this practice has been discontinued, and early union of the flaps promoted, it is rarely met with, or only to a very slight extent.

Louis (*Mém. sur la saillie de l'os après l'amputation des memb.*), Veyrat (*Mém. sur la resection après l'amput. de la cuisse*), and others advocated, before the Academy of Surgery of Paris, amputation of the necrosed bone above the level of the soft parts: but Leveillé (*Sur la Maladie qui affecte les bouts des os après l'amput. des memb.*) and Desruelles (*Nécrose des os amputés*) recommended delay in operative proceedings until the dead portion of bone had separated, and this practice is now followed almost universally. In certain cases, where the surface of the bone has perished from inflammation or destruction of the periosteum, it has been proposed to destroy the medulla as

high as the necrosed external layers, and thus ensure the separation of the whole thickness of the bone, but the very obvious dangers attending such a procedure have prevented its adoption.

It sometimes happens that the dead bone may be separated from its articular ends, or removed by operation, before the new bone has acquired sufficient strength to resist the action of the muscles, and splints must then be applied to the limb to prevent shortening or distortion. After a necrosis, the patient must not be allowed to use the lower extremity until the new bone is consolidated and able to support the weight of the body: in consequence of neglecting this precaution, fractures have occurred through the newly-formed bone; and, although union has generally taken place, yet the recovery is slow and tedious, and in some few instances it has been imperfect, so that a false joint has resulted, necessitating amputation of the limb.] (*G. G. Gascoyen.*)

*Albucasis*, lib. ii. cap. 88. *Scultetus*, *Armament. Chir.* tab. 46. and obs. 81. *Bellosté*, *Le Chirurgien d'Hôpital*, part i. chap. 12. *J. Louis Petit*, *Traité des Maladies des Os*, tom. ii. chap. 16. *Monro's Works* by his Son. *Tenon*, in *Mém. de l'Acad. des Sciences*, 1758. *Aitken*, *Systematic Elements of the Theory and Practice of Surgery*, Edinb. 1779, p. 288. Some interesting cases and remarks, chiefly about the question of amputation, are contained in *Schmucker's Vermischte Chir. Schriften*, b. i. p. 17, &c. ed. 2. *Callisen*, *Systema Chirurgiæ Hodiernæ*, vol. ii. p. 893. *Gött.* 1800. *C. White*, *Cases in Surgery*, London, 1770. p. 57, &c. *Wrisberg*, *Comment. Soc. Reg. Gött.* vol. ix. p. 136, &c. *Louis*, in *Mém. de l'Acad. de Chirurgie*, tom. v. *Chopart*, *Dissert. de Necrosi Ossium*, Paris, 1776. *David*, *Obs. sur une Maladie connue sous le nom de Nécrose*, Paris, 1782. *Pott's* *Chirurgical Works*, Lond. 1779, vol. i. p. 32. *Bromfield's* *Chir. Cases and Obs.* vol. ii. p. 9. *C. G. Kortum*, *Comment. de Vitio Scrofuloso*; *Lemgoviz*, 1789. t. ii. part 3. cap. 11. *Knöll*, *Dissert. de Carie Ossium venerea*; *Lips.* 1763. *S. G. Raderer*, *Progr. de Ossium Vitis Observationes continens*; *Goettingæ*, 1760. *Lind*, on the *Scurvy*. *Fabre*, in *Mém. de l'Acad. de Chir.* t. iv. p. 91. *Bonn's* *Thesaurus Ossium Morbos.* *Bonnet*, *Méd. Septentr.* i. ii. sec. 4. cap. 25. *Ephemer. Acad. Nat. Cur. Ann.* 7 et 8. obs. 4. *Guernsey*, in *Mém. de l'Acad. de Chir.* t. v. in 4to. p. 355—368. *Belmain*, *ibid.* p. 363. *Aerel*, *Chirurgische Vorfälle*, ucbers. *Von Murray*, vol. i. p. 194. *Van Wy*, *Vermischte Chirurgische Schriften*, Nuremberg, 1786. p. 192. *Trioen*, *Observat. Méd. Chir. Fascic. L. B.* 1743, p. 46. *Replein*, in *Richter's Chirurgische Bibliothek*, t. vii. p. 569. *Henkel*, *ibid.* t. ii. p. 42. *Dussaussoir*, *ibid.* t. viii. p. 71. *Meekren*, *Obs. Méd. Chir.* cap. 69. *Taconi*, *De Nonnullis Cranii Ossiumque Fracturis*, &c. *Bononiæ*, 1751. p. 17. *Blancard*, *Inst. Chir.* p. 549. *Duhamel*, *Mém. de l'Acad. des Sciences*, 1741. *Boehmer*, *Diss. de Ossium Callo*; *Lips.* 1748, p. 17 and 18. *Cheselden*, *Osteographia*, or *Anat. of the Human Bones*, London, 1733, tab. 49, fig. 4. *Morand*, in *Platner's Vermischte Chirurgische Schriften*, p. 447. *Ruysch*, *Thesaur.* 10. No. 176. *Duverney*, *Traité des Maladies des Os*, p. 457. *Paris*, 1751. *Phil. Trans.* No. 312. *Wedel*, in *Ephem. Natur. Cur.* dec. 2. ann. 2. p. 396. *C. Battus*, in *Chir. Tract.* 4. cap. 8. p. 275. *Koschius*, in *Roonhuysen's Historische Heilkuren*, b. i. p. 217; *Nuremberg*, 1674. *Hofmann*, in *Eph. Nat. Cur.* dec. 3. ann. 9 et 10. p. 310. *Diemerbroeck*, *vid. Wolf* (obs. *Chir. Med. Lib.* ii. obs. 18. p. 212. *Wright*, in *Phil. Trans.* abridged, vol. xi. p. 252. *Fabricius Hildanus*, *Obs. Chir.* cent. 4. obs. 91. *Raw*, *Supellex Anatom.* edit. à *B. S. Albino*; *Lugd. Batav.* 1725. p. 13. *Dobyns*, in *Cheselden's Osteographia*, tab. 49, fig. 4. *Mackenzie*, in *Med. Obs. and Inquiries*, vol. ii. p. 299. *Ludwig*, *Advers. Med. Pract.* vol. iii. p. 60. *Bousselin*, in *Hist. de la Soc. Royale de Médecine*, 1780, 1781. *Paris*, p. 121—297—305. *Statpart Van der Wiel*, cent. 1. obs. 96. *Muralto*, in *Schriften von der Wundarzn.* *Bale*, 1711. obs. 202. p. 655. *De la Motte*, *Traité Complet de la Chirurgie*, t. iv. p. 284. *Ellinckhuys*, in *Trioen's Obs. Med. Chir. fasc.* *Lugd.* 1743. p. 115. *Ruysch*, *Opera Omnia Anat. Med. Chir.* *Amst.* 1721. tom. 1. p. 94. *Laing*, in *Med. Essays*

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Moore for *Syd. Soc.* 1850. *Arch. Gén. de Méd.* 1853. vol. ii. *Fergusson*, *Med. Times and Gaz.* 1851.]

**NEURALGIA.** (Syn. Fr. *Neuralgie*. Ger. *Nervenschmerz*. It. *Neuralgia*. Sp. *Neuralgia*. Definition. Violent pain [not due to inflammation] in the trunk or branch of a nerve, occurring in paroxysms of irregular duration, and after either irregular or regular intervals.—*Copland*. Neuralgia (derived from *νεῦρον*, a nerve, and *ἄλγος*, pain), a term signifying pain in a nerve, but first employed, I believe, by *Chaussier* as the name of a class of diseases, the chief character of which is excruciating pain in the trunk or filaments of some particular nerve, or in the nerves of some part of the body, independent of any inflammation or apparent disease in it. As *Sir Benjamin Brodie* remarks, the natural sensations of a part may be increased, diminished, or otherwise perverted, although no disease exists in it which our senses are able to detect, either before or after death. There are, says he, other cases, in which the nerves of motion are affected, instead of those of sensation. Here there is involuntary contraction, or spasm of a particular set of muscles, or certain muscles lose their power of action altogether; and yet, after death, the most minute dissection will demonstrate nothing in them different from what would have been noticed if no spasm nor paralysis had ever existed. These facts are not difficult of explanation. "Every part to which a nervous filament can be traced, may be said to have its corresponding point in the brain or spinal marrow, and an impression, made either at its origin, or anywhere in the course of the trunk of a nerve, will produce effects, which are rendered manifest where the nerve terminates, or at that extremity which is most remote from the brain." (See *Brodie On Local Nervous Affections*, p. 2.) In every case of neuralgia, therefore, one important indication always presents itself—namely, that of inquiring whether there is any cause of irritation, affecting the trunk of the nerve, sufficient to account for the symptoms in the part, to which its ultimate filaments are distributed. Thus in one case, recorded by *Sir Benjamin Brodie*, the pressure of a femoral aneurism against some branches of the anterior crural nerve, which were kept on the stretch by the tumour, accounted for severe pain experienced at the inner side of the knee. In another case, a neuralgia, in the course of the peroneal nerve during life, was discovered after death to depend on a tumour on the left side of the lumbar vertebræ, and extending into the pelvis, which had occasioned pressure on the origin of the sciatic nerve. Sometimes, as *Sir Benjamin Brodie* has likewise explained, similar effects take place, where the actual seat of disease is in the brain or spinal marrow. "Thus (says he) caries of the dorsal vertebræ, irritating the spinal marrow, produces pains and muscular spasms of the lower limbs; and the same disease, affecting the superior cervical vertebræ, produces corresponding symptoms in the upper limbs." A gentleman complained of severe pains, referred to one side of the abdomen. After having been fixed in one situation, they attacked another. No disease could be detected in the part apparently affected, and the pains were therefore regarded as nervous. It was observed, at the same time, that his powers of articulation were affected, and that he spoke in an indistinct and drawing manner. This seemed



to indicate that there was some disease in the brain, and the suspicion was confirmed soon afterwards by the occurrence of epileptic fits, from which the patient continued to suffer during the few remaining years of his life." (Op. cit. p. 6.)

[In such cases, however, the neuralgia is due to direct pressure, or irritation about the roots or origins of the nerves. But should no cause of irritation manifest itself in the course of the affected nerve, it is very probable that a careful examination in the neighbourhood of other nerves, prone to neuralgic affections when irritated, will result in the discovery of the cause of the pain. The neuralgia is then called *reflex*, indirect, or remote, to distinguish it from the *direct* or peripheral neuralgia first described.] Caries of a tooth may give rise to direct neuralgia, that is of the dental nerve implicated; or the impression may, as it so often is, be reflected to one or other of the superficial branches of the fifth pair of nerves. The same cause, dental caries, may give rise to still more remote neuralgia. Two cases are, for instance, given by Parsons,\* of pain in the arm resulting from a decayed tooth. Sciatica has been found due to the same cause, by Dr. Castle, of New York.† The teeth when decayed are indeed most fruitful sources of neuralgia, so that oftentimes patients have sacrificed many sound teeth to get rid of the pain really due to some other cause.

Thus, pressure from a small tumour on the scalp may give rise to tic douloureux,‡ and the writer has found sciatica due to simple pressure from a small tumour imbedded in the flexor muscles behind the femur; a neuroma of one nerve may cause indirect neuralgia of another nerve. (Gay.)

Neuralgia may affect different nerves *alternately*. Thus Sir B. Brodie (who had also observed neuralgic affections to *alternate* with insanity) gives the case of a gentleman who laboured under severe pains in the left side of the face, a kind of tic douloureux. While under the influence of this pain, he was suddenly seized with a pain in the calf of the left leg, having precisely the character of that in the face. When the pain in the leg attacked him, that in the face abated, so as to cause little or no inconvenience; but in a few days, when the pain quitted the leg, that of the face returned with its usual severity.

[Neuralgia of a sharp tic-tic nature may alternate with headache of a severe kind. The writer has had a case of this kind, in which the facial neuralgia or tic douloureux would last for twelve or more hours at a time, and occasionally be replaced by a dull heavy pain or aching within the cranium. The patient was a lady, whose nervous system had been functionally weakened through repeated attacks of fever some time before.]

Sometimes an impression made on one part of the body will produce a nervous affection in a distant situation, where no explanation of the fact can be afforded on the principle of the trunk of the nerves supplying such part being compressed or irritated. Thus disease in the liver produces a pain in the right shoulder, a disease in the heart pains in the back. Acidity of the stomach, or indigestible articles in it, have been known to cause pain in the foot, which subsided directly the

cause was obviated. In one case a similar symptom appeared to depend upon a stricture, and yielded as the latter gave way. (Brodie, *ib.*) A curious form of neuralgia of the ulnar nerve is mentioned by Dr. Putégnat, of Lunéville, the attacks having for their exciting cause the act of micturition, as well as the desire to pass water. (Gaz. Hebdom. de Méd. et Chir. 1864.) One remarkable feature of these neuralgic diseases, adverted to by the same experienced surgeon, is that they seem to be suspended during sleep. A patient suffering from the pains of tic douloureux in the face may, for a time, be prevented from falling asleep; but if once asleep, his sleep is likely to be sound for many hours. [In severe cases, the pain will often wake the patient many nights in succession at the same hour.] Even when the patient is awake, the pains usually have intermissions, and occur in paroxysms. The intervals of cessation, or abatement, vary in different cases from a few minutes to several hours, or even to several days. The pains in neuralgic affections are sometimes dull and wearying, but more frequently sharp, darting, or stabbing. Occasionally they are periodical, and then, as Sir B. Brodie notices, quinine and arsenic, which would cure the intermitting fever, will also cure the intermitting pain. Neuralgia of the face, from being often attended with twitches of the small muscles of the part, has received the name of tic douloureux; which consists in severe attacks of pain, affecting the nerves of the face; most frequently, the filaments of that branch of the fifth pair, which comes out of the infra-orbital foramen; but sometimes the other branches of the fifth pair, and occasionally the numerous filaments of the portio-dura, which are distributed upon the face. Some doubt its ever being felt in the portio-dura. "An hospital patient of ours complained of it not only in the cheek, but in the course of the portio-dura from the stylo-mastoid foramen. We do not see why the disease should be confined to nerves of sensation. Two or even all the three branches (of the fifth pair) are sometimes affected, and the pain may extend even to the other side of the face. We have known it extend down the neck to the shoulder, and all along the inside of the arm to the ends of all the fingers and the thumb. Various nerves of the legs, arms, fingers, or toes are occasionally the seat of the disease; and an intercostal, a lumbar, and even the spermatic nerve has been attacked. The pain may be confined to one nerve, or to it and its branches, may extend to other nerves in the neighbourhood, or at a distance; or it may affect nerves at a distance from each other, simultaneously or successively, and change its seat backwards or forwards. The pain does not always shoot in the course of the nerve, but frequently in the opposite direction." (J. Elliotson, in *Cyclop. of Pract. Med.*, art. *Neuralgia*.)

[Neuralgia affects certain nerves, as well as certain localities, more than it does others; it likewise affects certain parts of nerves more than other parts. The superficial nerves of the body, as perhaps first pointed out by Valleix, are more affected than those of deeper parts: this may be in part explained, in that the cutaneous nerves are more exposed to heat and cold, to atmospheric changes, to the vicissitudes of weather, &c.

M. Valleix considers that there are four points

\* *American Jour. of Med. Science*, 1854.

† *Lancet*, 1846.

‡ Dr. Hunt *On the Treatment of Tic Douloureux*, 1854.

in the course of nerves more liable than others to pain. These are—1. The point where the nerve emerges from the long canal through which it passes; 2. Where it traverses the muscle to ramify in the skin; 3. The point where the terminal branches expand in the integument; and 4. The point where a nervous trunk becomes superficial in its course. Pressure upon these points will, he believes, during the intervals re-excite a paroxysm of the pain; and thus, if *local* measures are deemed advisable, they can be had recourse to at the part affected during the induced pain. The pain of neuralgia must not be confounded with the pain due to inflammation. In true neuralgia there is a morbidly increased amount of sensibility of the nerve, with pain of a sharp, stabbing or plunging, or acute nature; but there is no local or general inflammation. "When the pain is due to inflammatory action, there is always palpable evidence of the bloodvessels being implicated." (*Billing.*) There is, moreover, local heat of the part, tenderness distinct from pain, and fullness of the bloodvessels, and usually of the surrounding tissue from exudation. This fullness and tension of the tissues may help to account for the pain, upon the principle of direct pressure and irritation of the nervous filaments, even though they may not themselves partake of the inflammatory condition. It is true in urgent or violent paroxysms of facial tic, and sometimes of hemicrania, that swelling of the cheek and forehead, with throbbing and fullness of the veins, occasionally happen. I have lately had a case in which this happened on the right side of the face, to such an extent as to prevent the patient from keeping her eye open: an atropine injection removed all the pain in the course of half an hour; and the next day the pain was as severe on the left side of the face, and the swelling now shut this eye up: a second injection again removed the pain and swelling, neither of which returned. But the swelling, the heat and tenderness, if due to inflammation, will remain, even although an anodyne might at once check the pain. Rheumatism and gout constantly predispose to neuralgia, which often attacks parts in which effusion from the bloodvessels, by exudation, had taken place some time previously; more heat and swelling will often accompany these attacks than in people not disposed to rheumatism.]

Neuralgic affections are more frequently met with in some parts than in others. They are less common "in the viscera, which are supplied by the great sympathetic nerve, than other parts. Nervous pains are more severe and perhaps, on the whole, more common in those parts which receive their nerves from the fifth pair—as the face, the eye, the tongue—than in any other individual part." (*See Brodie, On Local Nervous Affections, p. 20.*)

[*The Varieties of Neuralgia.*—Neuralgia may be general, affecting no one spot in particular, or for any length of time, seldom recurring at the same place; in fact, constantly shifting its locality: the nature of the pain is, however, the same wherever it occurs. Patients say, they have the tic in the leg, or the shoulder, &c. This *erratic* form, especially if of long standing, is often of most obscure origin. I have observed it more frequently in males than females (if we except erratic hysterical neuralgia), and think it must, in most cases, be referred to some lesion or serious irritation about a nervous centre. The

*localities* more particularly affected by neuralgia are:—

1. The head, face, and neck: tic douloureux.
2. The chest: by intercostal neuralgia, infammammary pain, and neuralgia of the breast.
3. The abdominal walls: by pain, chiefly over the liver, and in the groins.
4. Of the joints: articular neuralgia.
5. Of internal organs: calculous nephralgia; neuralgia of the spine, the testicle, the bladder, and the rectum; the stomach (gastralgia), the intestines (neuralgic colic), of the heart (angina pectoris), &c.
6. Of the extremities (see SCIATICA).
7. Traumatic neuralgia.

1. *Neuralgia of the head and face.*—These are the most frequent seats of neuralgia, which may vary greatly in its exact locality, the nature of the pain, the duration of the paroxysm, &c. It may exist in a single spot, or extend over one-half of the scalp; it is then called *hemicrania*; when directly due to derangement of the stomach, then called sick-headache. Hemicrania is at times exceedingly painful, and may last for weeks with little or no cessation. *Otalgia*, or ear-ache, is another depressing form of this complaint.

In tic douloureux, the pain is of a ticking, shooting, or throbbing character; it is not continual, like many of the other forms of neuralgia, but comes in paroxysms more or less acute, which start from some one or more points, or neuralgic foci: pressure upon these points will usually produce a paroxysm.

Tic douloureux, or *Neuralgia faciei*, is the *Trismus dolorificus* of Sauvages; the *Faciei morbus nervorum crucians* of Dr. S. Fothergill; and of that order of diseases which Professor Chaussier has so aptly denominated *Neuralgies*.

*Diagnosis of Tic Douloureux.*—From rheumatic pain it may be known by the absence of local swelling or redness between any paroxysms of pain, by the pain in tic being induced by the least pressure, and often by talking, by the act of eating or drinking &c., by its temporary violence, and complete cessation until the next attack; the pain of rheumatism is more continuous, accompanied usually by swelling, and often worse at night.

In some cases of severe facial and frontal neuralgia, I have observed not only general turgescence of the part, but great tension of the veins—in one case "almost like whiplcords," from the severity of the pain; but relief being afforded, the turgescence and the accompanying increase of temperature of the part rapidly subside.

It is known from the toothache by the comparative shortness of the paroxysms; the quickness of their succession; the intervals of entire ease; the darting of the pain in the track of the particular nerve affected; the more superficial and lancinating kind of pain; and the convulsive twitches which sometimes accompany the complaint.

Dr. Copland appears to think that in true neuralgia, *ease* is caused by pressure both in the internal and external forms, and that where pressure gives ease, or is well borne, the neuralgic character is thereby indicated.\* This is far from being the case in the majority of the forms of

\* Copland's *Dict. of Med.* vol. ii. p. 883.



facial neuralgia, although it is the case frequently in sciatica and other instances.]

The first excellent description of tic douloureux was published in the year 1776, by the late Dr. Fothergill. (See *Med. Obs. and Inq.*, vol. v.) It is not true, however, as is generally stated, that he was the first author who noticed the complaint. This, indeed, is so far from being correct, that we even find an account of an operation done long ago by Louis, for the relief of this disease (see No. xxxvi. *De la Gazette Salulaire*, 1766); and this identical case actually became a subject of hot dispute between the physicians and surgeons of the French metropolis. (See a thesis, entitled "*Utrum in pertinacibus capitis et faciei doloribus aliquid prodesse possit sectio ramorum nervi quinti paris?*" *Proponebat Viellart*, 1768, *conclusio negativa*.)

Neuralgia was in fact first described at a still earlier period, namely in 1756, by André of Versailles, in his work on diseases of the urethra. He met with it more frequently in women than men, but never in persons much under forty.

Tic douloureux conveniently admits of being divided into four species, called by the French *frontal*, *infra-orbital*, and *maxillary neuralgia*, and *the neuralgia of the facial nerve*.

In the frontal neuralgia, the pain usually begins in the situation of the supra-orbital foramen, extending at first along the branches and ramifications of the frontal nerve, distributed to the soft parts upon the cranium, and afterwards shooting in the direction of the trunk of the nerve towards the bottom of the orbit. In a more advanced stage, the conjunctivæ and all the surface of the eye participate in the effects of the disorder, and become affected with chronic inflammation, which is described as a particular species of ophthalmia. At length the pain passes beyond the distribution of the branches of the frontal nerve, and affects all the corresponding side of the face and head. It seems as if it extended itself to the facial, infra-orbital, maxillary, and even to the temporal and occipital nerves, through the communications naturally existing between their filaments. Each paroxysm produces a spasmodic contraction of the eyelids, and a copious effusion of tears.

In infra-orbital neuralgia the pain is usually first felt about the infra-orbital foramen. The seat is probably in the nerve of this name, and the pain extends to the lower eyelid, the inner canthus of the eye, the muscles about the zygoma, the buccinator, cheek in general, ala of the nose, and the upper lip. At a later period, the pain appears to extend backward to the trunk of the nerve, and those branches which are given off in its passage through the infra-orbital canal. Hence pains are then experienced in the upper teeth, the zygomatic fossa, the palate, tongue, and within the cavity of the nose. As the disorder advances, it may extend, like other neuralgiæ of the face, to all the same side of the head. During the paroxysms, when the disease is fully formed, an abundant salivation usually takes place. In general, the attendant toothache deceives the practitioner, who, in the belief that the pain arises from another cause, may uselessly extract several of the teeth.

Tic douloureux of the lower jaw, or maxillary neuralgia, is usually first felt about the situation of the anterior orifice of the canalis mentalis, and it

extends to the lower lip, cheek, neck, teeth, and temple. This form of the complaint is more uncommon than the preceding; but, after it has prevailed some time, is equally remarkable for its intensity.

With respect to the neuralgia of the facial nerve, or portio-dura of the auditory nerve, it is a case which very soon cannot easily be distinguished from the other species of tic douloureux. The pains at an early period are no longer confined to the passage of the principal branches of this nerve between the parotid gland and ramus of the jaw. The numerous communications of the portio-dura with the rest of the nerves of the face seem to facilitate the extension of the disease, so that the agony is soon felt over the whole side of the head. The original source of the disorder can only be detected by attentively considering the progress of the complaint in all its stages. (See Delpech, *Traité des Maladies réputées Chirurgicales*, t. iii. sect. 7, p. 214, &c.).

2. *Neuralgia of the breast, and intercostal spaces.*—These forms of the disease occur mostly in females, and more particularly when there is some derangement of the catamenia. The intercostal neuralgia (pleurodynia) has been mistaken for pleurisy, but the pain is not persistent as in pleurisy; it can be awakened by pressure; and there is no sign of local inflammation in the part.

Neuralgia of the breast has all the features of neuralgia elsewhere: it may be intense at one time, suddenly disappear, only to reappear, perhaps in the other breast. There may be also great sensibility of the part, *Hyperæsthesia* of the breast; there is then swelling and tension of the part, which disappear when the pain does. Todd and others have drawn attention to the almost invariable coexistence of leucorrhœa with this form of neuralgia; and it has often been observed that as soon as the healthy condition of the uterine organs is restored, the neuralgia disappears. Dr. Todd believes that in cases of this kind, there is not only an irritable state of the uterus, but also of one or both ovaries; and the pain is more immediately associated with the irritable ovary, the nerves of which, implanted as many of them are in the spinal cord, reflect the irritable state to the nerves of the infra-mammary region. (Todd's *Clinical Lectures on Paralysis*, &c., p. 445.)

Neuralgia of the abdominal parietes may occur at any part, chiefly perhaps about the region of the liver and the groin (Wood), or over the region of the bladder. It may be mistaken for pain attending disease of the internal organs: but a careful examination and absence of swelling of the part, and of febrile symptoms, will with the general history point to the nature of the case.

The diagnosis of hysterical pains of the abdomen, from those due to peritoneal inflammation, is not very difficult. The patient will complain as much of a light touch as of a firm or heavy pressure; a slight touch in other parts of the body will likewise make the patient shrink, as if in pain; there will be no signs of inflammation in the pulse, tongue, &c.; which in peritonitis is small, tense, and rapid, nor will the respiration be so short and guarded; but there will be, especially in the female, in many cases the *facies hysterica* (Todd), and derangement of the catamenia. These points of distinction will also occur in cases of hysterical spine, &c.

The treatment in this class of cases will of course be directed to the restoration of healthy action of the uterine organs, to checking the leucorrhœa if it exists, or the re-establishment of the catamenia if they are suppressed. The pain may however, if severe, be at once met by local measures, the most effectual of which will be found the subcutaneous injection of about a quarter of a grain of morphia.

3. *Articular Neuralgia*.—This must not be confounded with rheumatic, inflammatory, or gouty pains of the joints; there is no appreciable or material lesion to account for the pain,—still it may occur in people who have, or may have had, rheumatic or gouty joints.

Disease of the hip will constantly cause even severe pain in the knee-joint,—such pain may be explained by the pressure upon or irritation of the nerve; but the true articular neuralgia is more frequently due to a neuralgic or hysterical condition of the body. These pains may be *emotional*, due to or augmented by a concentration of the patient's mind upon the part.

The distinctions between this affection and pain from local mischief, are the lesser amount (if any) of swelling and deep tenderness—for there may be both in articular neuralgia, whilst superficial tenderness is exaggerated; and the complication of spasmodic movements of the joint, except during sleep. The patient is most likely a female whose catamenia are irregular or deficient.

4. *Calculus Nephralgia*.—Here there is a direct cause for the pain, often of an agonizing nature. It is due to the passage of a calculus along the ureter. The severe pain, the vomiting, and other symptoms subside as soon as the calculus has reached the bladder.

*Neuralgia of the testes* is usually due to a disordered state of some of the viscera; it may alternate or coexist with neuralgia of other parts. The hypodermic injection of morphia will rapidly remove the pain, and also greatly relieve the patient during the passage of calculi. Tonics, antacids, and alteratives may then be employed.

The same remarks apply to neuralgia about the neck of the bladder.

*Neuralgia of the rectum* is severe shooting or other pain affecting the lower bowel, but not due to fissure, to piles, or any discoverable cause. I have seen it last for years, alternating with neuralgia and spasm of the bladder, defying all treatment. Mild forms will yield to tonic and alterative treatment, with occasional anodynes.

*Neuralgia of the spine* is a nervous affection, chiefly occurring in women having an hysterical diathesis. No actual lesion of the spine will be found, no thickening of the spine as in caries. If it is complicated with hysterical paraplegia, which is not uncommon, the diagnosis between it and caries is more difficult. The treatment is the same as for other affections of an hysterical nature.

*Traumatic Neuralgia* may arise from local injury, or occur in the course of surgical operations.

It may be due to—1, pressure on the nerve; 2, partial or entire division of it; 3, a foreign body in the substance of it. When following amputation of a limb, the pain is often as distressing as it is difficult to subdue. Downing thinks the pain may arise "from a fixed half-cut nervous fibril, which is excited to action by the motion of the limb; from a nervous trunk or fibril compressed

by the contracting cicatrix, or against the shaft of the bone; or by the hardening of the lymph in the bulbous extremity; and lastly, through spicula of bone running into, or osseous deposit taking place in, a nervous branch."

The treatment most successful is that of anodynes or sedatives, as by lotions and poultices to the part. It is seldom that medicines given by the mouth afford more than very temporary relief. The most effectual relief is afforded by injecting morphia into the neighbourhood of the cicatrix. Atropine will sometimes be even more effectual, quickly removing the morbid sensibility. When nothing else succeeds, the reopening of the cicatrix has been had recourse to. For further remarks on this head, see article STUMP.

*Causes*.—Neuralgia may be produced by causes operating from within or from without the body.

The chief predisposing causes are a nervous or melancholic temperament; an hysterical, rheumatic, or gouty diathesis; irregularity in females of the catamenia; damp and cold atmosphere, exhaustion of the system from fever or long illness, prolonged lactation, excess of mental application, or excesses of any kind producing a drain upon the system, mental anxiety, &c.

The exciting causes may be general or local; the general are such as may produce neuralgia of any part of the body. Moral emotions of a powerful kind, such as anxiety, long watching, &c., *Malaria*, damp and cold, are I believe, however, far more frequent causes; frequent exposure to wet, sitting in damp clothes, being too thinly clad in cold weather, constantly passing from hot to cold rooms, are among the causes which most frequently excite neuralgic attacks.

Neuralgia may be due to centric or excentric causes. Local affections may be the cause. Thus severe pain in the testicle may arise from a calculus in the ureter. Diseases affecting the brain—such as tumours within the brain, or exostoses of the skull—are among the most serious centric causes; they may produce the most inveterate neuralgia, for which little can be done. Local injuries may cause neuralgia, either by wounding and so irritating a nerve, as by a spiculum of bone, or by pressure, or by stretching a nerve; such neuralgia has a direct cause. Or another distant nerve may be affected with reflex neuralgia: an instance of this kind is given, in which *tic douloureux* of the face resulted from the lodgment of a bit of a bullet in the radial nerve.

As regards the *pathological condition* of the nerves in neuralgia, there is little to be said. In by far the largest majority of cases the nerve has no actual disease in it. The pain in the nerve is a symptom of a real morbid or pathological condition, which the nerve manifests through the direct or indirect irritation it receives. These causes may be—1st, *local*, as above described, in which case actual irritation of or pressure upon nerve-matter exists; 2ndly, *inflammatory or congestive*—

a. Either the vessels or sheath of the nerves themselves, giving rise to effusion of inflammatory plasma, or of pus. These cases are the exceptions, as most neuralgic nerves show no morbid signs.

b. Of the cerebrum, as observed in certain cases which have terminated fatally in palsy and apoplexy. (*Copland*.)

c. Spinal, in which there is some local inflammatory action of the spinal chord and its membranes.



These cases may be complicated with partial, and terminate in complete paraplegia. They occur mostly in the male, about or over middle age. The pain is often intense, generally of a remittent or intermittent kind.

3. The *anæmic* condition of the blood is rather a predisposing than exciting cause of neuralgia. Anæmia may be connected with the cause engendering neuralgia in hysterical females, but there is no proof of its direct influence.

Let the diathesis or the temperament be what they may, neuralgia, if not due to local pressure, is due, in the majority of cases, to *irritation*, direct or reflected, of a nerve—the irritating cause being not inflammation, but still one leading to *debility* of the system generally.

*Treatment of Neuralgia.*—It has been shown how numerous are the causes, both predisposing and exciting, of neuralgia. It is therefore plain that no specific plan of treatment can be recommended for all cases, and that very different remedies will be required.

The indications of treatment are to relieve or cure the paroxysm, and to arrest, if possible, the tendency of the paroxysms to recur :

With either of these objects in view, the treatment required may be surgical or medical, local or general. It is of importance in every case to arrive, if possible, at a *first cause* for the neuralgia, to ascertain if the attacks can be traced to any *local exciting* cause, or whether due to some *general* morbid condition of the system.

If apparently due to an inflammatory state of the system, to derangement of the secretions—as of the liver, the stomach, the kidneys, or the bowels,—the indication will be to arrest such derangements as soon as possible, to act on the liver and bowels with a mercurial, unless contraindicated, and some cooling aperient, to correct the state of the stomach with antacids, &c.; to cool the blood with salines, such as the nitrate and bicarbonate of potass, with or without epsom-salts. If an inflammatory state of the blood is evident, Copland thinks blood-letting, cautiously employed, is often extremely beneficial, and renders such means as I have just described still more efficacious. I have never employed, or seen the necessity for, general bleeding in neuralgia, properly so called, nor do I think it desirable, unless in very exceptional cases.

As long as the attacks can be traced to any particular exciting cause, such as a decayed tooth, a neuroma, or a tumour pressing upon a nerve, constitutional treatment will be of little or no service; the exciting cause must, if possible, be removed. Anodynes may lull the pain, and even remove it for two or three weeks at a time, as happened in a case of sciatica in St. George's Hospital, produced by a small tumour; but no permanent good can be expected whilst the source of irritation remains. Tumours within the cranium, or imbedded in the cerebral substance itself, may produce the most distressing *tic douloureux*. Every kind of treatment will fail to give more than very temporary benefit in these cases; division of the nerve will do nothing. Such patients obtain most relief, as far as I have seen, from opium or morphia, of which, as a rule, they can take enormous doses with impunity; one patient of mine, for many years, took thirty grains of morphia daily.

When no local cause can be found, and the neuralgia is not of that unceasing nature, leading

to the supposition of its having an organic deep-seated origin, it will most probably be due to some one or other of the previously mentioned causes, affecting the system generally, and the nervous system in particular; the course of treatment to be adopted must depend upon the constitution of the patient, and general history of the case. Certain *modes* of treatment have been highly thought of from time to time for neuralgia: such as blood-letting, local and general, counter-irritation, as by blisters, the moxa, acupuncture, division of nerves, free purging, electricity, mercury, iron, arsenic, narcotics, &c.

As a rule, neuralgia does not require lowering treatment; it is so constantly produced by debilitating causes, that tonic and alterative treatment, with rest and good food, are indicated far more frequently than lowering measures. The application of one or two leeches to the neuralgic region may relieve the pain of the paroxysms; but as there is seldom any local heat, tenderness, or fullness of the part, much local depletion would do harm rather than good.

In neuralgia the treatment is to be directed, not so much to that particular part painful for the time, as to the general weakness and susceptibility of the nervous system generally, as indicated by that local painful attack.

Premising, that in most cases of neuralgia not due to obvious local causes, the secretions have been attended to, the treatment will be directed to—

1. The relief of the paroxysms.

2. The cure, if possible, of the neuralgic diatheses, or the causes predisposing to neuralgic repetitions.

1. The paroxysm may be relieved, cut short, or cured by local or general means. Should it be due to malaria, to debility, or to any weakening or depressing cause, a dose of quinine may relieve it, and even prevent an expected attack. Alcohol in some form, a glass of portwine or brandy, or an opiate, may likewise arrest or mitigate the paroxysm. When these fail, or the stomach refuses to retain the quinine, the iron, or the anodyne, or the pain is so excessive that he requires more instant relief, the hypodermic injection of morphia may be at once had recourse to.

Locally, great relief is often afforded by heat, in the form of hot fomentation, with or without anodynes; or by opiates, liniments, and lotions, or the local vapour of anodyne herbs; or by blistering, with or without the endermic use of morphia; the application of local irritants, as croton oil, &c. Dr. Sieveking thinks that, of "the various remedies, opium and its preparations, applied locally or given by the mouth, occupy the first rank." Next to opium, as a local application, comes belladonna, which may be used as the extract or ointment, or as a liniment; but oftentimes better than opium in any form, is the alkaloïd of belladonna injected into the subcutaneous cellular tissue. It will often completely remove a paroxysm of many hours in a few minutes. The mode of injection will be afterwards described. (See SUBCUTANEOUS INJECTIONS.)

Veratria and aconitina, both powerful poisons, have at times great effect upon the paroxysm. They may be used as ointments, one or two grains of aconitina to the drachm (*Pereira*) of lard; and of veratria, twenty to forty grains to an ounce of lard (*Turnbull*). Of these two local remedies, the

aconitina is by far the most powerful; I have seen great, though seldom permanent, benefit from it. Fleming's tincture of aconite may be painted over the nerve; it requires great care, nor should it be used if the skin is abraded. I have seen one patient nearly poisoned by painting too much of it upon the recently shaved chin.

Chloroform may be used locally in a liniment or by itself on lint under a watch-glass (*Little, Ranking's Abstract*, vol. xxxi.) by inhalation, or by the mouth: a case of long standing was cured after taking a single dose of chloroform, I believe only five minims, by the mouth (*C. H. Hawkins*). By inhalation: some patients inhale many ounces a day during the paroxysm, which the chloroform will arrest, often sending the patient to sleep. I have seen several cases, in which the skin was rendered very yellow, from the frequent repetition of the inhalation.

The local injection of chloroform beneath the skin will arrest the paroxysm, and cause sleep; it should not, however, be had recourse to, as it devitalizes the skin for many weeks. (*Medical Times and Gazette*, Sept. 10, 1859.)

Dr. Downing has great faith in the inhalation of medicated vapours, the drugs employed being henbane, hemlock, belladonna, aconite, Indian hemp, &c. (*Downing on Neuralgia*, Churchill, 1851.)

M. Bouchut has employed the tincture of iodine, locally as a counter-irritant, with success in several cases (*Medical Circular*, 1863). Occasionally some one of these local measures will do more than remove the paroxysm; it will even cure the neuralgia. From simple blistering I have seen but little benefit; in sciatica I have often seen no benefit at all from it. It may do more good when small blisters are applied, perhaps many of them in succession, over the tender neuralgic points of Valleix; but this mode of treatment is painful, tedious, and disagreeable to the patient, and much less successful than many other plans of treatment; nor have I ever seen much benefit from sprinkling the denuded derma with morphia. The amount thus used must be uncertain. Almost similar, but more likely to be effective, is the method of the French, called *l'inoculation de la morphine*. They dissolve morphia in water or creosote, and make a sufficient number of pricks with a lancet in the course of the nerve to take in all the morphine paste (*Nysten*). Acupuncture consists in introducing sharp-pointed needles into the subcutaneous tissues of the body, sometimes into the muscles themselves; they are allowed to remain a longer or shorter time, at the will of the operator. They are supposed to act either by counter-irritation (*Holmes' Surgery*, vol. iii.); or, if they are inserted into the nerve itself, by the mechanical assistance they afford towards the evacuation of fluid from the sheath of the nerve. Dr. Ogier Ward thinks highly of this plan in painful muscular rigidity. Electro-puncture is far more painful than simple acupuncture; it consists in passing a galvanic current into the tissues included between the acupuncture needles.

Dr. Ruppaner, who has lately written upon *Hypodermic Injections*, has injected *irritants* in five cases into the neuralgic parts, the principle being that of producing a small abscess as counter-irritation for the nerve: he injects the nitrate of silver and chloride of sodium. (*Antoine Ruppaner on Hypodermic Injections*, 1865, Boston). His

cases are chiefly neuralgia of spinal origin, affecting the limbs or trunk—a class of cases more likely to receive benefit from such counter-irritation, acting like a seton, than would cases of facial neuralgia.]

#### THE DIVISION AND REMOVAL OF PORTIONS OF NERVES.

The operation of dividing the trunk of the affected nerve, and even of dissecting out a portion of it, so as to prevent all chance of a relapse from the reunion of the ends of the nerve, is a plan which has sometimes been practised with permanent benefit. Thus, any one of the three branches of the fifth pair of nerves may be divided at the point where it comes out upon the face. But, before having recourse to this means, the surgeon should be sure that the particular nerve, which he is about to expose and divide, is really the principal seat of the disease; for when all the nerves of the face generally are affected, or when the branches of the portio-dura are especially concerned, there is little hope of success. In fact, it must be confessed that the operation has had many failures and relapses, either from the cases not having been duly discriminated, or from the neglect to remove a portion of the exposed nerve. Richerand, Delpech, and most of the leading surgeons in France, express their preference to the application of the moxa, or cautery, which they say proves more frequently successful than the knife. This should be done directly over the apertures from which the nerves emerge, on the forehead, cheek, or chin; and Richerand asserts that by such treatment, the pains may always be cured, or at all events rendered supportable. (*Nosogr. Chir.* t. ii. p. 218, edit. 4.) Delpech also affirms, that the section of the nerve very often fails, and that issues, and the repeated use of the cautery, have been attended with the greatest success. (See *Précis des Mal. Chir.* t. iii. p. 213.) The disfigurement of the countenance by burning applications must, however, be very objectionable; and as I think there is no positive evidence of the superiority of this method over the use of the knife, I consider what Richerand and Delpech have stated only as an instance of the extreme partiality of the French surgeons to the moxa and cauterization. Delpech confesses, however, that when the pain seems to be the consequence of a ganglion, or thickening of a part of a nerve, the excision of such part is indispensable. There can be little doubt that this would have been more proper than amputation, in Mr. Denmark's case, to which I have already referred. The theories of Dr. Parry, sen., who was generally inclined to refer the effects of disease to increased determination of blood to the parts affected, led him to believe, that the operation of cutting the nerve, as performed by Dr. Haighton and others, did good rather by the division of the arterial branch supplying the affected ramification of the trigeminus nerve, than by the division of that ramification itself. (*Parry, Elements of Pathology*, &c.)

There have been many examples of tic douloureux, which, after resisting all attempts to cure them, have been left to themselves, and, after a long time, spontaneously subsided. (*Delpech, Maladies Chir.* t. iii. pp. 212, 215.) This author has seen the operation of dividing the chief branches of the portio-dura, in front of the parotid



gland, undertaken, and even a portion of the soft parts cut away, but without any favourable consequences. (P. 218.)

When the infra-orbital nerve is to be divided, Sir A. Cooper recommends it to be done a quarter of an inch below the orbit. The supra-orbital nerve should be cut through just where it passes out of the supra-orbital foramen. An instance, in which this measure produced an immediate alteration in the seat of the pain, may be read in the 8th No. of the *Quarterly Journal of Foreign Medicine*; but the cure was not complete till the integuments had been divided from the root of the nose to the temple. The method of dividing the inferior maxillary nerve, advised by the same surgeon, is to cut down to the foramen mentale on the inside of the lip, directly under the bicuspid tooth. By the division of this nerve, M. Bouillard effectually cured one very severe case. (See *Lond. Med. Repository*, No. lxxix.)

I have already stated that the nerves of the extremities are subject to affections very analogous to tic douloureux. The following instance, related by Mr. Abernethy, will be found interesting:—

A lady became gradually affected with a painful state of the integuments, under and adjoining to the inner edge of the nail of the ring-finger of the left hand. No injury to the part was remembered which could have brought on this disease. The pain occurred at irregular intervals, and was extremely severe during the time of its continuance, which was for a day or two, when it usually abated. Accidental slight injuries always produced great pain, and frequently brought on the paroxysms, which, however, occasionally occurred spontaneously, or without any evident exciting cause—in all these particulars the disease correctly resembling tic douloureux. As the pain increased, the disorder seemed to extend up the nerves of the arm. After the patient had endured this painful affliction for seven years, she submitted to have the skin, which was the original seat of the disorder, burnt with caustic. This application gave her intense pain, and, on the healing of the wound, she found her sufferings rather augmented than diminished by the experiment. After four more years of suffering, she consulted Mr. Abernethy, when the circumstances of the case were such as to render an operation indispensably necessary. The pain of the part was intolerable, and it extended all up the nerves of the arm; and this general pain was so constant during the night, as to deprive the patient of rest. The muscles of the back of the neck were occasionally affected with spasms. The integuments of the affected arm were much hotter than those of the opposite arm, and sometimes the temperature was so increased as to cause a burning sensation in them. Under these circumstances, Mr. Abernethy did not hesitate to divide the nerve of the finger, from which all this disorder seemed to originate. He laid it bare by a longitudinal incision, of about three-quarters of an inch in length, from the second joint of the finger; and divided it opposite to that joint, by a curved sharp-pointed bistoury, which was conveyed under it. He then took hold of the nerve with a pair of forceps, and reflecting it downwards, removed a portion of it, half an inch in length, so that the possibility of a quick reunion might be prevented. The wound was brought

together with sticking-plaster, and it united by adhesion; but the upper part of the wound, opposite to the upper end of the nerves, became slightly inflamed, and was very painful. However, in the course of three weeks, the appearance of inflammation gradually went off. After the operation, Mr. Abernethy pinched the originally affected integuments sharply with his nails, without causing any sensation; but if in so doing he moved the finger, then pain was felt.

The result was, that nine months after the operation, the general pains in the nerves had become very trivial; but the sensation in the integuments at the end of the finger had gradually increased, and the skin had now its natural sensibility, so as accurately to distinguish the tangible properties of any body applied to it. If also the originally affected part was slightly compressed, painful sensations, resembling those which formerly occurred, took place. (*Abernethy's Surgical Works*, vol. ii. p. 203.) In a case resembling the former, but the consequence of a wound of the finger, Mr. Lawrence also cut down to the nerve, and removed a portion of it, with permanent success. In a case of severe pain in the thumb, extending up the arm to the neck, and causing a distortion of the neck, fits, &c., Sir A. Cooper cut down upon the radial nerve, by the side of the flexor carpi radialis, and cut out about five-eighths of an inch of it. The result was a complete cure.

Dr. Mott has adopted the practice of dividing the nerve in almost every case of neuralgia, where it is practicable. He has repeated this operation on the infra-orbital, mental, and other nerves so frequently, and with so great success, that he confidently recommends it. He sometimes insulates a portion of the nerve by repeated incisions through it, at small distances from each other, preferring this to a removal of a portion of the nerve. If these plans fail, Dr. Reese believes that the application of potassa fusa, or lapis infernalis, will almost always prove a remedy. (See *Amer. Ed. of this Dictionary*.)

Notwithstanding the occasional success of the knife and caustics, I concur with Dr. Hosack, Sir B. Brodie, and others, in the opinion that many forms of neuralgia depend upon constitutional or other causes, completely out of the reach of such expedients. "If the original disease operates immediately on the nerves of the affected part (says Sir Benjamin Brodie), producing in it pain, or muscular spasm, or paralysis, you will have first to consider how far it is within the reach of topical remedies. If a tumor presses on a nerve, or if some foreign body, as a musket-ball, or a piece of dead bone, irritates its surface, or is entangled in its substance, perhaps the tumor or the foreign body may be removed by a surgical operation, or the tumor may be reduced by other means. If this cannot be accomplished, or if the nerve itself be altered in structure, either from disease or injury, it will become a matter for consideration whether the limb should be amputated, or whether the nerve should be divided. It is only under these circumstances that any advantage can be expected to arise from the division of the nerve. In ordinary cases of neuralgia, where the disease on which it depends is in the brain, or in some other distant part of the body, or where it is connected with some derangement of the general health, it is evident that such an operation cannot

be recommended on any sound principle; and it need be a matter of no surprise that, where it is performed, it should so generally fail." (*On Local Nervous Affections*, p. 27.)

[Division of the nerves for neuralgia is not often performed, nor is it found at all more successful now than it was twenty years ago.

M. Nélaton has lately performed it upon two cases, apparently favourable for the operation; one succeeded, in the other it was of no effect; in both cases he inserted a little caustic paste, the chloride of zinc. Hooker has performed it with success for neuralgia of the leg. (*Lancet*, 1859.) Myani divided the dental nerve without success; he then divided the lingual nerve with success. Michel cured a case by it in 1859. Frank has succeeded with the operation in four cases out of five of neuralgia of the fifth nerve. (*Yearbook of Medicine and Surgery*, 1859.)

Brown-Séquard considers it the most important local means, and the sooner, if to be performed, the better; he thinks a piece of the nerve should always be removed, if for no other object than to examine microscopically for signs of inflammation. (Frank, contrary to many pathologists, believes that congestion of the trunk of the nerve is one of the most frequent causes of neuralgia. *Loc. cit.*) Brown-Séquard says, that if the nerve appear inflamed, another division of it ought to be performed, much higher up, and even as near the nervous centre as safe or possible. Sulphuric æther dropped upon the nerve, after simple division, will prevent it from transmitting irritation from the original wound for many days. (*Holmes' Surgery*, vol. iii.)

It may be concluded on this matter, that in very few cases will the operation be permanently successful. I have seen several patients upon whom it has been performed, but in none of them has any real benefit resulted.

Electricity in its various forms is esteemed curative in neuralgia by some physicians. This agent may be used in a mild form, as by a Pulvermacher chain, the power of which is increased according to the number of links; by powerful currents sent for a few minutes at a time through the neuralgic part, as found successful by Becquerel (*Med. Rev.* 1860); by Faradisation, the rapidly interrupted current being applied to the neuralgic nerves, and if muscular paralysis co-exists, to the muscles also (*Althaus*, 1861). Dr. Radcliffe thinks it best to insulate the patient on a stool, and keep him charged for some time with positive electricity; he also thinks a succession of shocks from an induction-coil likely to do good, "if continued long enough to bring on an artificial hot-stage by paralysing, to a certain extent, the vaso-motor nerves." (*Radcliffe on Pain, &c.*, 1864.)

General treatment will be required for neuralgia, if local measures fail to do more than simply mitigate the paroxysms. It will of course be modified in accordance with the characters the neuralgia may present, and the diathesis of the patient. In the distinctly intermittent form of neuralgia, no determination of blood to the head existing, or no active disease of the viscera, the medicines chiefly to be relied upon are the preparations of bark or quinine, combined if necessary with anodynes. In neuralgia more especially due to anxiety or nervous debility from any cause, or hysteria, the preparations of iron rather than of quinine might be

first tried. Belladonna and opium may be combined with the iron or quinine according to the severity of [the case, the frequency of the attacks, the nervous exhaustion induced, or the insomnia occasioned. In cases due to the effects of damp, or exposure to the atmosphere, I have found the injection of atropia to be one of the most valuable preventives of recurrent attacks, as well as a curative measure of the paroxysm. It also answers remarkably, in cases of neuralgia of a rheumatic or gouty origin, administered by the mouth; it may be given with alkalies, in doses of one-sixtieth of a grain, two or three times a day; or from that amount to a thirtieth, by hypodermic injection, once or, if repetition is required, two or three times a week.

The most valuable medicines are, upon the whole, iron, quinine, atropia, morphia, strychnia, arsenic, cod-liver oil, phosphorus, zinc, croton-oil, iodine, alcohol, &c.

The sulphate of quinine will succeed in a great number of cases of neuralgia, whether caused through debility, fever, malaria, or exposure to wet or cold. If employed alone, very large doses are sometimes found necessary, as from five to twenty grains, although two or three grain doses, every six or eight hours, will usually suffice. I have given as much as thirty grains, two or three times a day, in one very severe case; quinine may be advantageously combined in most cases with iron, the sulphate or sesquichloride would then be the most suitable. Schranz, in 195 cases of neuralgia of the fifth nerve, found quinine and iron combined the best treatment, arsenic the next most successful. (*Die Neuralgie des V. Nervenpaares*, 1859.) The carbonate of iron is a bulky remedy, although one which for many years has been held in great repute. In 1820, Mr. B. Hutchison recommended it in two-scruple or drachm doses, two or three times a day, for tic douloureux. Dr. Elliotson found, however, that far larger doses might be given without inconvenience, in doses, in fact, of half an ounce or six drachms every four hours; given in those doses, with twice its weight of treacle, it rarely constipated. But if this remedy is tried, a small purgative should every now and then be administered. There are, however, many other far less cumbersome and more elegant preparations of iron, which are equally beneficial and often more effectual remedies; such as the phosphates, the hypophosphates, and superphosphates of iron, the tincture of sesquichloride, the iodide, the lactate, &c.

*Arsenic*.—Its preparations have been much confided in by Nessettill, Barsedow, Bedingfield, Halliday, Rowland, &c.; it is more alterative than tonic, and is perhaps most useful in cases of neuralgia due to disordered secretions, to hysteria, or to uterine derangements.

Strychnia is sometimes successful in chronic cases of neuralgia—due either to non-inflammatory spinal disease, or to cases of neuralgia of nerves combined with loss of power. It is not well borne, as far as my observation goes, in cases of neuralgia of cerebral origin.

Phosphorus, first perhaps used by Loebenstein Loehel, has been much used lately by some physicians, in the form of the phosphate of iron, of soda, of ammonia, &c. Dr. Radcliffe thinks phosphorus adds to the nutrition and functional activity of the nerve-tissue; he gives it in cod-liver



oil, as a nutrient medicine for nervous tissue. The plan of treatment he proposes for neuralgia is as follows:—"To take care that the diet does not contain too much lean meat, and too little fatty and oily matter; to look on the properly regulated use of alcoholic drinks as essential to success in treatment; to avoid tea altogether; to be very chary in the use of sugar; to give some preparations of phosphorus, with or without cod-liver oil, as nutrients for a starved nerve-tissue; to avoid the habitual employment of aperients, and as a rule eschew the use of sedatives in sedative doses." (*Brit. Med. Journ.* 1863.)

Narcotics and sedatives are medicines of great value in the treatment of neuralgic affections, even when given in sedative doses, provided proper judgment is exercised as regards the repetition of them. Opium and its alkaloids, morphia, narceine, codeine, &c., belladonna and its alkaloid atropia, conium, aconitina, stramonium, &c., may be used locally to allay pain, or generally, to relieve the system from exhaustion, and to give sleep. When neuralgia occurs in people of a nervous or irritable temperament, it is often better to cut the gordian or neuralgic knot at once by a sedative, than to keep the patient lingering amid paroxysms, whilst we are hoping in time to untie or cure it by a course of iron or quinine.

I have indeed seen neuralgia, which had resisted all kinds of tonics, overcome by steadily keeping up narcotic or rather anodyne action, by hypodermic injection of morphia, until the patient was cured. The existence of neuralgia, as of phagedæna, seems at times to preserve the patient from a narcotic result from narcotics. A careful examination for some years of the action of what are called sedatives and narcotics, has convinced me that their action in neuralgia is often more tonic than narcotic, more stimulant than sedative. This is more particularly the case when they are administered by means of the

*Hypodermic or subcutaneous method.*—Under this name is implied the injection into the cellular tissue of medicinal agents. See article SUBCUTANEOUS INJECTION.

It may be employed in neuralgia locally, as practised by Dr. Wood, of Edinburgh, as long ago as 1843; by Mr. Rynd, of Dublin, in 1844, and by Dr. Kurzak, of Vienna, about the same time. Dr. Wood carried the morphine inoculation of the French to greater perfection, by injecting the alkaloid into the tender neuralgic spots indicated by Valleix.

He introduces the solution, we repeat (*Ran-king's Abstract*, vol. xxi. p. 40), as near as possible to the painful part of the affected nerve; where, as M. Valleix has pointed out, there is usually more or less tenderness on pressure, even in the interval between the paroxysms of pain. This he insists upon as an important point of practice.

Or the injection may be employed at a distance from the neuralgic part, and with equal success, as pointed out by myself in 1858. A number of cases were operated upon by me, both locally and at a distance, in St. George's Hospital, with equal effect.

A lady had severe tic douloureux for many months; the endermic method, with morphia applied upon the blistered surface, was tried without benefit; so likewise were internal stomachic medicines. This patient was cured by a single

morphine puncture in the arm. It is still an open question whether localization or the distant injection is preferable. I believe the chief benefit to be due to the mode of the introduction, that is by the cellular tissue, not to the agent being injected into the tender spot. I have over and over again found the effect of the distant injection upon the pain to be as rapidly effective as when localized. It may be an advantage to be able to get the same effect without localizing. It avoids the necessity for bringing on a paroxysm. It is less painful to inject the outer arm than the face or head; and, again, the neuralgia may be situated in parts difficult of access under ordinary circumstances.

The alkaloids most valuable for hypodermic injection are atropia, morphia, quinine, and strychnia. The acetate of morphia may be used,—strength, six or twelve grains to the drachm. The latter can be used free from acid enough to cause no subsequent irritation. The dose must vary from one-eighth to one-half or three-quarters of a grain for a first injection, according to the case.

Of atropine, the sulphate is the best form—one grain to fifty or sixty minims. I have found this alkaloid, which I first proposed for hypodermic injection, in 1858, to be of great value in cutting short the paroxysms; and it will usually, in ordinary cases, cure the neuralgia after two or three injections. Atropia thus employed acts as a sudden stimulant to the whole system. The first injection should not exceed the thirtieth of a grain; as a rule, morphia may be thus first used in cases of neuralgia of cerebral origin, atropia of spinal origin.

Out of eighty patients upon whom I have employed the atropine injection, thirty-four have been cases of neuralgia—twenty-one of the thirty-four were cases of facial tic-douloureux. The results of the treatment are as follows: twelve out of the thirteen cases of neuralgia were either cured or decidedly benefited; so also were eighteen out of the twenty-one cases of facial tic; the remaining four patients received no benefit at all.

Quinine may be injected when it has no effect by the mouth, or when stomachic irritability or headache attends its stomachic administration.

The advantages of this mode of dealing with neuralgia are:—

1. The great rapidity with which the paroxysm is subdued, and relief obtained.
2. The greater certainty of effect than by the stomach.
3. That it can be used when the stomach rejects all food and medicine.
4. That the curative effect is usually much greater than that which follows the repeated administration of the same alkaloid by the mouth, or by the endermic method.
5. That with carefully-regulated doses, the stomach and bowels suffer no derangement, as they usually do by stomachic anodynes.

Should the hypodermic injection of remedies fail to do more than arrest the paroxysm, it can be used still for that object, being the quickest method for relieving pain; and other measures may be had recourse to, to remove, if possible, the tendency of the pain to recur.

In conclusion, be it observed, that neuralgic patients should not tax their mental or bodily strength too much; any systemic causes exhaust-

ing the system should be stopped, if possible. Neuralgia is itself an exhausting disease, as indicated by the general aspect of the patient, the loss of sleep so often entailed, the severity and frequency of the attacks, &c. Such patients should, as a rule, live well; their meals should not be at long intervals—a small quantity of good nourishing food, repeated at short and regular intervals, being best. Eggs, bacon, meat, with wine, beer, or alcohol in some other form, help much to prevent the susceptibility to neuralgia, by keeping up strength and nerve-force. Outdoor exercise should daily be taken, rather than prolonged application to indoor occupation and amusements. Exceeding two hours at the piano always brought on neuralgia in one patient. In neuralgia due to rheumatic or gouty diathesis, the nature and amount of the stimulus allowed must be modified. In other cases, a glass of stout at bedtime will often carry a patient through the night free from paroxysms. Purgation should be of a mild nature, if required at all. Such is the general outline of treatment, combined with the measures above indicated, for arresting the paroxysm, for cases in which no cause of the neuralgia actually removeable can be discovered.]

Charles Hunter.

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NEUROMA (from νεῦρον, a nerve), a term originally employed by Odier, to signify a tumor formed in or upon a nervous trunk. This subject has been ably investigated by Mr. Wood, whose results are given in the *Edinb. Med. Chir. Trans.* vol. iii. part 2. Tumors connected with nerves are subject to much variety. Sometimes, though rarely, the swelling consists almost entirely of a cyst filled with a fluid, as exemplified in the case operated upon, and reported by Cheselden. In other instances, it is in part solid, and in part fluid; more frequently it is solid throughout.

[As a rule, however, and as usually seen, a neuroma is nothing more or less than a fibrous tumor, usually of small size, embedded in the nerve itself, or, at all events, enveloped in the neurilemma of the nerve. "Neuromas," says Brown-Séquard, "are almost always purely fibrous tumors on or between the fasciculi of a nerve. Sometimes, however, with purely fibrous elements, neuromas contain those nuclei, and fusiform, or caudate, or stellate nucleate cells, which are found in granulations." Paget regards them as usually fibrous by nature, with a thin investing capsule, the fibrous texture of which is in different specimens variously marked. But pathologists have at times discovered tumors of a very different nature to the purely fibrous, and which are neuromas in that they are clearly connected as to their origin with a nerve. Thus, Wedl mentions the dissection of a neuroma in the continuity of the ulnar nerve: it had a connective tissue-capsule, which was continuous with the upper and lower portions of the nerve, or section; it was of a dirty grey-red colour, and contained defined light-yellow speckled portions not unlike the usual reticulum of cancer. There were also blood-tinged spots and streaks.—Wedl, *Pathological Histology*.]

In one of the cases detailed by Mr. Wood, the tumor consisted almost entirely of a firm membranous cyst, containing a thick fluid; in three others it consisted partly of fluid and partly of a solid substance; and in twenty it was of a solid texture. The consistence, colour, and appearance of the solid part differ in different cases, and sometimes in different parts of the same tumor. In some instances, the whole mass is very firm and hard, of a whitish or yellowish colour, and of a fibro-cartilaginous appearance—harder than a nerve, and rather more shining.

The fibres run generally in a longitudinal direction, but are not always parallel, and the interstices of them were observed by Mr. Wood to be filled up by the substance of the tumor. ["In some," says Paget, "curved shining white bundles, of fibrous aspect, traverse a more homogeneous



basis-substance, of greyish, yellowish, or dull white colour; in some, such bundles effect a concentric plan; in some, the whole section looks nearly uniform, pale or white, very dense; and the fibrous structure, though discoverable with the microscope, is not visible to the naked eye.”]

In other cases one part of the mass is solid, of a reddish colour, and steatomatous appearance; and in another part there are cells of a larger or smaller size—some empty, others containing either fluid, or a softish medullary substance. Occasionally small lobes are met with, all distinct, but closely pressed together. In almost all cases, Mr. Wood observed a firm sac, more or less dense, and of a shining appearance, not unlike tendon, and seemingly formed in part or entirely of diseased neurilemma. In some cases the sac is loosely attached to the contained parts by a thin cellular substance; in others it is firmly incorporated with them, and sometimes it is attached to or partially covered with muscular fibres. The nerve itself is sometimes sound where it enters and comes out of the tumor, but according to Wood it is more frequently thickened, and now and then reddened.

[Copland seems to think the nerve itself is usually a little redder than usual, and thickened just above and below the tumor. This, if invariably confirmed by other surgeons, which is by no means the case, would lead to the idea of inflammation of the nerve (or *neuritis*) being at the bottom or origin of the neuroma. But such is not the case, for neuroma is seldom now considered a result of injury to the nerve, as will be mentioned in speaking of its causes.

The nerve may often be traced to the surface of the tumor, and some of its fasciculi even into the substance or sac of the tumor. When, however, the swelling is very large, none of the nervous fibres can be traced from the trunk above to that below the tumor.

According to Rokitsky, a neuroma is never deposited in the centre of a nerve, but at its side, so that a small part only of its fasciculi is displaced. He makes the observation that it occurs mostly in spinal nerves, or those cerebral nerves having both sensory and motor power. Bérard, however, has met with one instance of the disease upon a ganglionic nerve. (*Erichsen's Surgery*.)

Mr. Charles H. Moore has lately had a case of arterio-venous cyst produced in the popliteal nerve, from a blow with a pump-handle. A swelling the size of a hazel-nut existed at the end of a fortnight. In sixteen months the swelling had so increased that tapping was occasionally employed during the next three months—the tumor was then cut down upon and amputation found necessary. The tumor was found to be a cyst constituted by the expanded and hypertrophied textures of the nerve.

Mr. Sibley gives the particulars of an interesting case in which very numerous neuromata existed all about the nerves before issuing from the spinal canal; they were so numerous on some nerves as to resemble beads strung on a thread. Some of the neuromata were fibro-cellular only; others contained cysts filled with gelatinous fluid. The patient was paralysed both as to sensation and motor power in the legs, which were drawn up. (*Med. and Chir. Trans.* 1866.)]

The circumstance of the disease affecting only a certain number of the fibres of the nerve, seems to

Mr. Wood to account for the complete power of sensation and motion, often retained in the limb beyond the tumor. That part of the nerve does continue adequate to its functions, when another part of it is much diseased, is proved by the effect of dividing the nervous trunk in the operation for the removal of the tumor, when the cessation and power of motion, which had previously been little impaired, became instantly destroyed or much diminished.—(See *Wood* in *Edinb. Med. Chir. Trans.*, vol. iii.)

[The nerve-tissue is not immediately destroyed, unless it is by pressure from the size of the tumor; but the fasciculi are separated, stretched and expanded, and perhaps arrested in their function by the growth embedded in them. The *diagnosis* of a neuroma is usually easy. A small hard tumor is to be felt, either in or under the skin, firm to the touch, sometimes feeling elastic. The shape of it is usually oval or olive-shaped, the long diameter being from above downwards, that is, in the direction of the implicated nerve; it can be more easily moved from side to side, than from above downwards. It may be accompanied by no pain, but this is seldom the case; usually these tumors are excessively painful, even upon the slightest pressure. Smart attacks of pain will also occur at other times, darting chiefly towards the periphery of the nerve. It is curious that when an immense number of these neuromas occur in one individual, that they seldom, as observed by Rokitsky and others, give rise to or are accompanied by pain. One man, mentioned by Smith, had 450 of these painless tumors in the right lower extremity, and perhaps 2,000 of them altogether. The pain is usually in the neuroma itself, or the nerve implicated; but it may be reflected to other nerves, and is not unfrequently a cause of reflex neuralgia. In the neuroma of stumps the pain radiates upwards, often involving neighbouring nerves in the pain.

Among the reflex irritations to which a neuroma may give rise, Brown-Séquard enumerates chorea, epilepsy, hysterical symptoms, trembling, reflected neuralgia, anæsthesia, and paralysis. In several cases, epileptic fits have been traced to them, and upon the removal of the neuroma, the fits have ceased.—*Portal, Brown-Séquard, &c.*]

The generality of neuromatous swellings do not seem to be of a cancerous nature: “First, because, however large the diseased mass is, or however long it may have existed, the contiguous textures, and more particularly the skin, do not become affected with disease of a malignant kind; and, secondly, because there seems to be no tendency to a return of the complaint after it has once been removed by operation.” (*Wood, ib.*)

We know however from the history of medullary cancer, and especially from the history of this disease, as it presents itself in the eye, that the nerves may be the seat of it. Mr. Liston removed, from a middle-aged and healthy-looking man, a tumor which had occupied the popliteal space for a considerable period. It was growing rapidly, having attained the size of a cricket-ball when it was removed. On the dissection, the tibial nerve was found intimately connected with it, the fibrillæ stretched over its sheath, entering into and being mixed with the substance of its growth. The nerve was cut above and below, and the whole mass extirpated, unbroken and entire. During the stay of the man in the hospital, a tumor was

detected on the front of the thigh of the same limb; here an inflammatory swelling took place, and suppurated. It was opened, but the original lump did not disperse. Within six months after the healing of the wound in the ham, the patient returned with an enormously swollen limb, and a large elastic morbid mass in the back part of it. A bleeding fungus protruded, and the disease was soon fatal. The original tumor (in Mr. Liston's collection) is soft and bloody, but that on the forepart of the thigh was fibrinous, ovoid, larger than a hen's egg, and involving the anterior crural nerve. It seems extraordinary that in this case the removal of the tumor from the ham, with at least three inches of the tibial nerve, should not have been followed, even for an instant, by any loss of power or sensation in the limb or foot. (*Liston on Practical Surgery*, p. 294.)

[Romberg also speaks of neuromas of a fungous and scirrhus nature, in the interior of which tumors he observes that cavities and cysts not unfrequently occur, containing fluids of great variety. Dr. Remak is quoted by Romberg, concerning a neuroma of scirrhus nature, in which yellowish-green fluid filled up the fibrous trabeculae. The ordinary fibrous neuroma is looked on by Romberg as the painful or subcutaneous tubercle—by Wood as distinguished from neuromas of other origin. When these tumors are of a cystic nature, Rokitansky says it is at once clear, from the condition under which the cyst is developed, that it performs the office of a bursa. But such can hardly be called true neuromata, or painful tubercles, which are either fibrous or fibro-cartilaginous, and have, according to Paget, the following microscopical appearances:—One finds the fine stiff undulating filaments or filamentous appearance; with these nuclei or elongated cells, or other probably rudimentary or developing structures, are usually found some elastic fibres in them; some present mixtures of cartilage or of bone." (P. 483.)

*Causes of Neuroma.*—The causes of idiopathic neuroma are not known. When it occurs in a stump, or after an operation upon any part, the direct violence or irritation, either during the operation, or afterwards from the sutures, the discharge, &c., are believed sufficient to excite the production of a neuroma. In the case above alluded to, under the care of Mr. Moore, a blow from a pump-handle excited the neuroma, which was of a cystic nature.

Dr. Robert W. Smith clearly shows that neither neuritis nor rheumatism are ordinary causes of neuroma. On the other hand, there are those who think, with Copland, that it is undoubtedly a consequence of chronic inflammation of the tumefied part, inasmuch as the changes observed in it are similar to those which result from chronic inflammation in other parts of a like structure. "He looks on it as a result of chronic neuritis. But Paget thinks its origin usually appears to be spontaneous, that is it is unknown." (P. 484, *On Tumors*, *Holmes' Surgery*, vol. i.) Neuromata may sometimes be referable to an injury, but there is no general rule. When they occur in a stump, after amputation, they are usually of a fusiform shape, varying in size from that of a pea or cherrystone, to that of a pigeon's egg. In such cases the cause may be the division or tearing of the nerve-tissue by the knife, or irritation from the

discharge, or inflammatory products in contact with the nerve, or thrown out among its fibrillae. In many cases they are not attended by inconvenience or pain; at others they are productive of most severe suffering, even on the slightest pressure.]

This pain may, as Mr. Lawrence conceives, be due to the cicatrix involving the bulbous swellings of the nerves, or to their being pressed by the contraction of the cicatrix against the sawn end of the bone. For further remarks on this matter see STUMP.

[The cure for neuroma and subcutaneous tubercle is to remove it, when removal is possible. Brown-Séquard says there is no other treatment than extirpation of the tumor, or amputation, if the first operation is not possible. The operation of removal should be carefully performed, as it may not be necessary to divide the nerve, the swelling being usually on one side of the trunk, if not in the centre of the nerve. But even when the nerve is quite divided, the patient has a good chance of recovery of sensation and motor power, by reunion of the divided ends and regeneration of the portion of nerve excised. "There are many cases showing that after excision of one or several inches of the ulnar, the median, the radial, posterior tibial, and even sciatic nerves, reunion or regeneration has taken place, and sensibility and movement been recovered." (*Brown-Séquard*.)

If the neuroma gives rise to no irritation, or pain, of course no operation is required, unless disfigurement is produced by its bulk.] If completely implicated with the whole structure of the nerve, it should be removed, with the portion of the nerve involved in it. "If so implicated, and the nerve, the sciatic, and the tumor or cyst, the cyst might be punctured, and the fluid evacuated, and precaution taken to unite the wound by adhesion. In the last case, supposing the tumor to be solid," Mayo questions whether it is not better to divide the nerve between the neuroma and the brain before proceeding to remove it by dissection. (*Mayo's Human Pathology*, p. 146.)

In the neuromata of stump, the treatment must likewise be removal. For engravings of the appearances of the ends of the nerves in stumps, consult G. P. Van Hoorn, *De iis quæ in partibus membri præsertim ossis amputatione vulneratis, notanda sunt*. (Lugd. Batav. 1803. 4to.)

Charles Hunter.

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**NIPPLES.** In addition to what is stated upon the subject of sore nipples in the article MAMMA, I may observe that the nitrate of silver is an excellent application for the cure of this painful and sometimes obstinate complaint. Dr. Hannay, of Glasgow, strongly recommends its use in the following



manner. Having gently, but carefully dried the nipple, the part is to be freely touched with a sharp pencil of nitrate of silver, which is to be insinuated also into the chaps and chinks. The nipple is then to be washed with a little warm milk and water. The pain soon subsides, and the sore may then be healed with a little zinc ointment. Dr. Hannay occasionally washes the nipple with a saturated solution of borax, before and after suckling the infant. (See *Lond. Med. Gaz.* vol. xiv. p. 674.) Sir Astley Cooper's formula of borax for these cases is specified in the article MAMMA. Dr. Jewel adds his testimony in favour of nitrate of silver. (*Op. et vol. cit.* p. 753.) Pyroligneous acid, blended with white of egg, is another remedy sometimes preferred. (*Gaz. Medicale.*)

[Shields of ivory or wood perforated, of chamois leather, or prepared calves' teats, placed over the nipple to protect it during suckling will be found beneficial, provided the child can obtain nourishment through them. Dr. Simpson recommends the edges of the fissured nipple to be brought together and held in apposition by means of a solution of gun-cotton, which is not disturbed by the child's mouth in the act of sucking. A solution of tannin, five grains to the ounce, as suggested by Mr. Druitt, or of tincture of iodine, may be tried with advantage in excoriated nipples. (*Dr. Churchill's Theory and Practice of Midwifery*, p. 652.)]

**NITRIC ACID.** [Nitric acid is a remedy in frequent use in surgical diseases, both internally and externally. Internally the dilute acid of the pharmacopœia is very constantly prescribed as a tonic in doses of  $\mathfrak{m}\mathfrak{xv}$ . to  $\mathfrak{xxxv}$ . in combination with cinchona, cascarilla, or other remedies of that class. It is indicated in cachectic cases, in cases of hectic from profuse suppuration, in phagedænic ulcerations, in gangrene, &c. In former editions of this Dictionary, the writings of Scott, Cruikshank, Beddoes, Hammisch and others were quoted to show the value of nitric acid as a remedy for syphilis, both in its primary and secondary forms, and it was even thought that it might prove a substitute for mercury in the treatment of that disease. Subsequent experience has, however, conclusively shown that nitric acid internally possesses no specific influence whatever upon syphilis in any of its stages, though it may frequently be given with advantage as a tonic in cases of spreading ulceration, of suppurating buboes, or after a mercurial course. With this view, but without any belief in its specific action, it is still in constant use at the London Lock Hospital.]

As the nitric and other mineral acids decompose and destroy the teeth, the utmost care must be taken to prevent so serious an effect. Their being properly diluted, and blended with sugar, syrup, or mucilage, will materially tend to hinder the evil. But the safest way is always to drink the mixture through a glass tube, and wash the mouth well immediately afterwards with water or with a dilute solution of carbonate of soda or potash.

[Locally, nitric acid may be employed in the dilute form, ( $\mathfrak{3j}$ . of the dilute acid Ph. Lond. to  $\mathfrak{viiij}$ . of water) as a stimulant and antiseptic lotion to unhealthy or phagedænic ulcerations, from whatever cause arising. It is also beneficial as a gargle in syphilitic ulcerations of the mouth and throat, or in aphthous affections of the same parts.

When used as a gargle it should be not more than half the strength above recommended, for fear of its injurious effect upon the teeth.

But it is as an escharotic that nitric acid is especially valuable to the surgeon, and is perhaps superior to every other material; the actual cautery, under certain circumstances, alone excepted. When used as an escharotic the acid should be the strongest procurable, and its specific gravity should be 1.5. When of this strength it has a tendency, on exposure to light, to become of a yellow colour, from the evolution of oxygen and the development of nitrous acid, the latter being given off in yellow or orange-coloured fumes. The amount of the fumes, however, must not be taken as an index of the strength, for the acid is of course weakened *pro tanto* by their escape. The true test of its escharotic power is in its specific gravity.]

Strong nitric acid is a most valuable application in cases of hospital gangrene: and an interesting paper was published by Mr. R. Welbank, detailing its excellent effects as an application to diseases, which he has described under the name of sloughing phagedæna, and which he considers as identical with hospital gangrene. (See *Med. Chir. Trans.* vol. xi. p. 369, and HOSPITAL GANGRENE.) The cases, reported by this gentleman, are highly favourable to the practice, which, however, is not entirely new, for in speaking of Mortification, I have mentioned that it was Kirkland's practice sometimes even to dress certain gangrenous and phagedænic diseases with a solution of mercury in nitric acid. Still, I feel that Mr. Welbank has rendered a service to the profession by drawing their attention still more particularly to the use of undiluted nitric acid in the forms of phagedæna, which he has so well described.

[In the treatment of hospital gangrene or of sloughing phagedæna, cauterisation with the strong nitric acid is still regarded as the most reliable local treatment. The object in its application is to destroy the diseased surface completely, in the hope that when the eschar separates, a healthy granulating ulcer may be substituted for it; therefore, when the sloughs are thick, they should be removed with scissors before the acid is applied.

Vascular tumours, such as nævi, when superficial, may be effectually destroyed by nitric acid, but when they are of any considerable depth or thickness the ligature is usually to be preferred. It has been also much extolled in the treatment of hæmorrhoids of late years, though here again its use should be restricted to cases in which the tumours are small and superficial. When they are large, the ligature is a quicker and less painful remedy.

Strong nitric acid may also be used with signal benefit in the early stage of venereal sores. If applied within the first four or five days after the appearance of a chancre, it will usually destroy it effectually, and will substitute for it a sore which will quickly heal under simple local applications. By this early destruction of the primary sore, the risk of constitutional infection, if not absolutely avoided in all cases, is reduced to the lowest possible amount.]

**NODE.** A tumour of a bone or a swelling of the Periosteum depending upon Venereal disease. See VENEREAL DISEASE.

**NOLI ME TANGERE.** See LUPUS.

## NOSE, HYPERTROPHY, or LIPOMA OF THE

The growth, or enlargement, seems to be restricted to the skin and subjacent cellular tissue. These textures become thickened; and "the sebaceous crypts are enlarged and distended with their secretion, some of them to a considerable degree, and forming encysted tumors of the size of a garden pea; the cellular tissue is loaded with serosity, and, in some places, there is fibrinous deposit. The arterial capillaries are not much enlarged; but when the part is dependent, or the circulation much excited, or the return of blood prevented by violent exertion of the lungs, the veins are much enlarged, giving the tumor a more blue and distended appearance. Different parts become affected in succession, and the mass is made up of many growths from the point and sides, of various sizes, separated by fissures, in which the sebaceous secretion, often rancid and offensive, lodges. These swellings, though attached by pretty broad bases, are loose and pendulous." (See *Liston on Pract. Surgery*, p. 237.)

In some instances, the tumor has been known to extend over the mouth and nostrils so much, that the patient could not breathe well, especially during sleep, unless a tin tube was placed in one of the nostrils. If the tumor were not supported with the hand, it also became immersed in any liquid that was brought towards the mouth to be drunk. (See *Hey's Surgery*, ed. 2. p. 565.)

In one of the cases, under this last practitioner, the disease appeared to be nothing more than an enlargement of the common integuments of the nose. The bones and cartilages seemed to be in their natural state. For, though the latter were buried in the mass, yet, when the tumor was supported, Mr. Hey could distinctly trace, with his finger, the border of the cartilages. The tumor was divided in the middle; and, at the origin of this cleft, he could discern a small portion of the tip of the nose. The sebaceous crypts were so much enlarged, that some of them would admit the end of a crow's quill. Mr. Hey operated as follows:—Having felt, with his finger, the border of the cartilaginous part, which gives the nose its proper figure, he marked out this border upon the inferior surface of the tumor with a pencil moistened with Indian ink. Then, allowing for the thickness of the cartilage, and a proper covering of adipose membrane, he made his first incision parallel to the line marked out. He next pursued the dissection upwards, aiming at preserving the natural figure of the nose. When the principal mass had been removed, he reduced the remaining part of the adipose substance to an even surface by means of the tonsil scissors. The hemorrhage, which was considerable, was stopped during the operation by the pressure of the fingers of the assistants. The patient, though a stout man, nearly fainted from the loss of blood; but, after the completion of the operation, the bleeding did not return. The case succeeded perfectly.

I have seen the operation performed in one or two instances by Mr. Liston. The following is the method preferred by him. "An incision should be made through the diseased integument and cellular tissue in the mesial line upon the cartilage of the apex and columna, not however so as quite to reach them. An assistant places his forefinger in one nostril, and the surgeon, seizing the mass with his fingers, or with a small vul-

sellum, proceeds to dissect it off with a scalpel. The incisions must be carried pretty close to the cartilages of the ala, until the one side is cleared, the edge of the opening being well observed, and neither that, nor the cavity encroached upon. The assistant will give warning if the knife, at any stage of the proceeding, approaches his finger. The surface is trimmed a little, if occasion requires, with a pair of thin slightly curved or knife-edged scissors. A similar proceeding is observed on the opposite side, and they (the two sides) are to be made as symmetrical as possible. A few vessels may bleed; but the bleeding is easily restrained during the dissection, by placing the small spring forceps (Graefe's) upon their mouths, or they are compressed by the point of the finger. Ligatures are afterwards placed upon them if they still persist in bleeding. Should the ligatures not hold, the cut ends (of the vessel) not being readily drawn out from the condensed tissue, a fine cambric needle may be passed across the bleeding point, and a ligature tied under it, the ends of both the needle and thread being cut off. Any troublesome general oozing may be stopped by plugging the anterior nares, applying a compress of lint, and a double-headed roller. Difficulty and pain are experienced in removing this dressing, and, it is much better, if possible, to apply frequently and assiduously for a few hours, pledgets of lint, moistened with cold water, and after coloured discharge has ceased, to substitute the tepid dressing, and thus encourage suppuration as speedily as possible." The exposed surface having granulated, the zinc lotion may be used. Mr. Liston has removed many of these growths without any untoward accident. In only a single case, a repetition of the operation became necessary after an interval of nine or ten years. A tumor of large size had been removed from the apex of the nose, leaving the integuments of the alæ slightly thickened. These afterwards increased so as to form a bulky swelling on each side of the apex. (See *Liston's Practical Surgery*, p. 240.)

See also *Civadier*, in *Mém. de l'Acad. de Chir.* x. iii. p. 511. *Imbert Delonnes*, *New Progress of Surgery in France*; translated by T. Chavernac. 4to. Lond. 1801.

NOSE, HEMORRHAGE FROM. EPISTAXIS. In consequence of the bleeding being sometimes profuse, and incapable of being stopped by other means, it becomes necessary to plug up the nostril and corresponding posterior opening of the nasal fossa. A loop of wire, or a bougie, may be introduced along the floor of the nostril from before, backwards; and when it reaches the pharynx it may be taken hold of with a pair of forceps, and brought forwards in the mouth, so as to allow a strong ligature to be attached to it, which is next drawn into the nasal fossa, and out of the nostril by means of the wire, or bougie. This now becomes useless, and may be cut off. To the middle of the ligature, a dossil of lint is fastened, and the ligature being then drawn more out of the nostril, fixes the lint in the posterior aperture of the nares. The nostril itself is then to be closed with a plug of lint. The dossil of lint may easily be removed from the posterior opening, when no longer required, by displacing it with a probe introduced through the nostril, and the aid of the portion of the ligature in the mouth. This part of the ligature should be kept against the roof of



the mouth, by fastening it to the upper lip with a piece of adhesive plaster. A still more simple mode is to use a loop of catgut, which will pass to the back of the fauces as readily as wire, or a bougie, and one portion of it being then drawn forwards out of the mouth, will serve for the conveyance of the plug of lint to the posterior opening of the nasal fossa.

*NOSE, Operation for the Restoration of.* The Tagliacotian method, which consisted in employing a portion of the integuments of the forearm for the purpose, is now superseded by the oriental plan, in which the cicatrized remains of the former nose are converted into fresh-cut surfaces, and a flap of skin, duly shaped, is twisted, and brought down from the forehead, so as to admit of being united to them. This is the *rhinoplastic art*, as it is termed, from *ῥιν*, the [nose, and *πλάττειν*, to form, which has been practised in India time immemorial, and for many centuries in Italy, where cutting off the nose was a common punishment for certain offences, even as long ago as the period of the ancient Romans. The following is the mode adopted by Mr. Liston:—"A piece of soft leather, cut to the shape and size of the integument required to replace the apex and alæ, is placed flat upon the forehead. To secure accuracy in the line of incision, its boundaries are marked on the skin with ink, in case the patient prove unsteady. The flap being thus defined, is dissected down, and kept of uniform thickness, till near the lower angle, when the incisions should be carried deeply, so as to insure an abundant vascular supply. Care should be taken, however, to avoid the periosteum, for otherwise exfoliation may follow, which would increase the scar, and render the cure tedious. This narrow part of the flap, or attachment at the root of the nose, must be of some length, to allow of its being twisted, so as to bring the integument to the exterior, when the part is adapted to its new situation; and to facilitate this, the knife should be carried a little lower down on that side on which it is intended to make the turn. After the bleeding has ceased, the flap is retained in apposition with the raw edges of the truncated organ, by points of suture. A little oiled lint is placed in the nostrils to support the flap, but no other dressing should be applied. The surgeon should be in no hurry to fix the flap; for union is most likely to occur when bleeding has ceased, and the edges of the wounds have begun to assume the glazed appearance, which precedes secretion. The lower part of the wound in the forehead is brought together by suture. To the rest, lint moistened with warm water, and covered with oiled silk, is applied, the lint being rewetted from time to time." As for the nose itself, the lint may be removed in three or four days, and then too perhaps some of the stitches may be dispensed with. The flap will be found adherent, yet moveable with the breath. During the cure, contraction of the nostrils is prevented with tubes. When the nose is firmly consolidated, and a collateral circulation has been established, so as to become independent of the supply of blood through the twisted attachment, this is to be divided with a bistoury, so as to remove a wedge-like portion, and let the front of it be laid down smoothly over the root of the nose. With respect to the columna, the practice in India was to obtain

this by taking a slip from the forehead, along with the rest of the flap; but Mr. Liston has found it much better first to form the main portion of the nose, as already described; and, after this has become consolidated, to raise a columna from the upper lip. The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip, previously stretched and raised by an assistant, close to the remains of the former columna. The incision is continued down to the free margin of the lip; and a similar one, parallel to the former, is made on the opposite side of the central line, so as to make a flap about a quarter of an inch in breadth. The frænum is then divided, and the prolabium of the flap removed. The new columna is then fixed in its proper place with a sewing needle, which, after its head has been covered with sealing-wax, to facilitate its introduction, is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap. Then a few turns of thread suffice to keep the fresh-cut surfaces in contact. Twisting the flap is here unnecessary. Lastly, the edges of the wound in the lip are to be brought together with the twisted suture. (See HARELIP and Liston's *Practical Surgery*, p. 213.)

[*Calculus concretions* have been met with in the nostrils, but they are of very rare occurrence. It is not easy to account for their spontaneous formation, but foreign substances introduced by design or accidentally, have been known to become lodged in some of the intricacies of the nasal cavities, and to have formed the nucleus of a nasal calculus. The symptoms of irritation and obstruction caused by the presence of a nasal concretion or rhinolith would induce the surgeon to explore the nostril; the more common affection of polypus would of course be suspected by him as the cause of the malady, unless the patient himself had discovered the hard nature of the obstruction and had informed his medical attendant of the circumstance. When accessible to an instrument introduced into the nostril, the surgeon can assure himself of the presence of a hard resisting object, which he must carefully diagnose from a denuded portion of the bony boundary of the nostril, this he would be enabled to do by the position of the concretion and by the absence of fætor and other characteristic symptoms of carious or necrosed bone. The treatment consists of operative procedure for the removal of the concretion, but the surgeon may expect to meet with difficulties arising from its position and size. It may even be necessary to incise the nostril in order to obtain room for the application of the appropriate extracting instruments, whether forceps, levers, or scoops.

*Cartilaginous and fibrous* growths have also been observed to arise from the interior of the nostril. In St. Mary's Hospital, my late colleague, Mr. Ure, met with an instance of the former blocking up and greatly distorting the nostril. The growth was attached to the septum and floor of the nostril. Mr. Ure removed it by detaching the ala nasi from the cheek, and by gouging out the cartilaginous mass. (*Lancet*, April 27th, 1861.) I have myself met with two remarkable cases of fibrous growths springing from some portion of the interior of the nostril. In one case the growth extended along the lachrymal ducts into the orbits, producing protrusion of the globes of the eye, threatening the



destruction of vision, and also into the frontal sinuses, causing absorption of the outer table of the skull in this position. I have operated three separate times on this patient, at intervals of two or three years, removing the growth as far as possible from the orbits, frontal sinuses and nostrils. But as the whole of the disease could not be reached, it has always returned, and the man still suffers from the malady, and will probably have to submit to another operation. He shows himself occasionally at St. Mary's Hospital, with the intention when it becomes absolutely necessary to undergo further treatment by operation. The other case also occurred at St Mary's Hospital; a most remarkable one from the size the growth ultimately attained. It filled both nostrils completely, distended the antra of both superior maxillary bones, lifted the floors of the orbits, and so encroached on the buccal cavity as to endanger life, by the difficulty of deglutition and of respiration which it caused. A formidable operation was required to remove the diseased mass. Both superior maxillary bones, both palate bones, the vomer, turbinated bones, and a portion of the sphenoid and ethmoid were implicated in the disease, and required to be extirpated with it. The man recovered slowly after an attack of erysipelas, and is now living. A third case of fibrous tumor in the nostril extending up the lachrymal canal, occurring in a lady 35 years of age, was placed under my care by Mr. J. E. D. Rodgers. The nostril and lachrymal sac of the left side were distended by the disease. This, as well as the above case, was at first mistaken for ordinary polypus of the nostril. A London surgeon, however, whom the lady had consulted, informed her that it was a more serious ailment, and declined to perform any operation, considering it, I presume, to be of a malignant character. The whole of it was removed under chloroform, without the aid of cutting instruments, by forceps and scoop, aided by the finger introduced into the posterior nares; the portion of the growth which distended the lachrymal sac was easily displaced by pressure, and made to pass into the nostril. There has been no return of the disease, now six years from the date of the operation.

The interior of the nostrils is, of course, liable to all the diseases of bone, of cartilage, or of fibromucous membranes, whether of an innocent or malignant nature, whether arising from a specific constitutional taint, or from ordinary local irritations. These will be treated of under other heads. (See *SYPHILIS*, *LUPUS*, *OZENA*, *CANCER*.)

There are two other affections, however, that may require a short notice here. Every surgeon of experience must have met with cases of perforation of the cartilaginous septum of the nostril giving rise to great anxiety to the patient, though causing but little local pain or inconvenience. The description of one such case will explain the features and peculiarities of the rest. A surgeon, 45 years of age, a married man with a healthy family, who never had syphilis, discovered by a sort of whistling noise on sneezing, or blowing his nose, a small opening in the septum of his nostril through which he could pass a director. He consulted the late Mr. Pilcher and myself 15 years ago, and I have watched the case ever since. Throughout, there has been no increased vascularity or thickening of the mucous membrane covering the septum.

No symptom of any constitutional affection has manifested itself; he has been throughout, and is now, in good health. The edge of the opening has always presented an ulcerated surface, and notwithstanding that the thin layer of the cartilage alone intervenes between the mucous membrane of opposite sides, and which in each nostril is entire and apparently healthy, up to the very margin of the opening, they do not coalesce so as to heal over and cover the narrow ulcerated edge. The opening is now, after 15 years of continued slow ulceration, little larger than a sixpenny piece. The form of the nose is of late years very slightly altered, the bridge of the nose not being quite so well supported. Local applications and constitutional remedies of various kinds have been had recourse to, without avail, to arrest the ulceration. He has for years ceased to treat the affection, and all the inconvenience he suffers is an occasional stain of blood on his handkerchief on blowing his nose. I have seen three other similar cases, one in a married, and one in a single lady; the third was in a gentleman who formerly had syphilis, but from the absence of any other symptoms of that disease, I believe the ulceration in the cartilaginous septum to be independent of it.

The only other affection of the nostrils it appears to me necessary to notice, is a state of chronic inflammation of the Schneiderian membrane, accompanied by a very foetid discharge continuing for years, tainting the breath and rendering life miserable, of which I have met with two or three instances. One of these, a young female, a maid servant, was unable on account of this offensive complaint, to retain a situation. Her mother informed me that she had suffered for years as a child from the malady, that little notice had been taken of it by herself, till she became adult; but that now she felt it most acutely, had become sullen, avoided strangers, and had threatened to make away with herself. No foreign substance could be detected in the nostril, the mucous membrane was vascular and thickened, and secreted a thick muco-pus, which was very apt to concrete in some part of the nostril. There was no ulceration or caries of bone present. The treatment adopted, from which she derived considerable benefit, although a complete cure was not effected, was the local applications of ointments, simple and medicated; the free injection of antiseptic lotions, such as weak solutions of chloride of lime, of Condy's fluid, of carbolic acid, of lime water, of Goulard lotion, and the internal administration of cod liver oil, of iodide of potassium, of bark, steel, and other tonics. The other cases were not so severe, and were still more amenable to treatment.]

*Celsus* de Re Medica, lib. vii. cap. ix. *Manzano*, *Annales Mundi*, 1442. *J. G. Tagliacotii*, de curtorum *Chirurgia per Incisionem*, Venetiis, fol. 1597. *Nova Ed. cura M. Troschel*, 8vo. fig. Berlin, 1831. *Th. Findley* and *J. Cruso*, *Gentleman's Mag.* 1794. *J. C. Carpe*, an account of two successful operations for restoring a lost Nose, 8vo. Lond. 1816. *C. F. Graefe*, de Rhino-plastice, 4to. Berlin, 1818. *Delpech*, in *Chir. Clin. de Montpellier*, t. ii. 1828. *Dieffenbach*, *Chir. Erfahrungen*, &c. 8vo. Berlin, 1829-30. *A. A. Velpeau*, *Méd. Opératoire*, t. ii. 8vo. Paris, 1830. *J. Lisfranc*, sur la Rhino-plastie, in *Mem de l'Acad. de Med.* t. ii. 1832. *R. Liston* on Practical Surgery, 8vo. Lond. 1837.

Nose, *Polypi* of. (See *POLYPUS*.)

NYCTALOPIA. (from νύξ, night; and ὤψ, the eye; or ὄρω, to sec.) *Visus nocturnus*, or day-blindness, vulgarly called owl-sight, is an



affection, in which the patient either cannot see at all, or sees but very feebly, objects which are in the open day-light, or situations where there is a strong light: but discerns them very well when they are in a darkish place, or at sunset, or in the night-time, if not immoderately dark. (See *Lassus, Pathologie Chir.* t. ii. pp. 539, 540.)

According to Dr. Hillary, there are persons in Siam, in the East Indies, and also in Africa, who are all of this cat-eyed species, or subject to the disease of being blind in the day-time, and seeing well by night. (*Med. Univ. Hist.* vol. vii.) The same author notices the general rarity of the disorder, and mentions his having met with but two examples of it.

Dr. Pye mentions an intermittent or periodical nyctalopia, which begins regularly in the morning, and goes off in the evening, the patient continuing blind, whether he keeps himself in a dark or a light place. The cause of these instances, which, he observes, are very uncommon, is generally seated in the primæ viæ, and requires emetics, resolvents, purgatives, and bark. (See *Lassus, Pathologie*, t. ii. pp. 540—542. And *Richter Anfangsgr. der Wundarzn.* b. ii. p. 481.) Ramazzini frequently observed amongst the country people in Italy, and especially boys about ten years of age, in March, a great weakness of sight. Through the whole day, they saw little or nothing, but when night came on, they saw distinctly. The disorder ceased of itself by the middle of April. The pupils were noticed to be much enlarged. (*De Morb. Artificum*, cap. xxxviii. Lond. 1718.)

As Dr. Mackenzie has remarked, scrofulous intolerance of light, the photophobia of the albino, or that of a person long shut up in the dark, and suddenly brought out into the glare of the day, must not be confounded with this species of periodical amaurosis. Day-blindness is mentioned as a symptom both of mydriasis and myosis. In the former disease, the pupil admits too much light to enable the patient to see till after sunset. In the latter, the contraction of the pupil is supposed to relax in the obscurity of the night, and thus vision to be improved. On the same principle, the patient, who has an incipient cataract, sees little during the brightness of the day, but finds his sight in part restored by the dilatation of the pupil in the evening. (See *Mackenzie on Dis. of the Eye*, p. 885. ed. 2.) An instance, supposed to be syphilitic, and cured by mercury, is related by Mr. Isbell. (See *Edinb. Med. and Surg. Journ.* vol. ix. p. 260. 8vo. 1813.)

In an example, following scrofulous ophthalmia, and where blisters, tonics, opiates, belladonna, &c. had failed in diminishing the sensibility of the retina, M. Vassal constructed two cones of pasteboard, two inches and a half in length, and painted black internally. He fitted to one extremity of each cone a blue glass, and applied the other extremity, on each eyelid, so that the borders of the cone penetrated into the entrance of the orbit. A curtain of black taffeta applied to this extremity prevented the rays of light from reaching the eye otherwise than through the cone. From the third day of the use of this apparatus, the child could distinguish objects at the distance of three or four feet. Every week, the length of the cones was lessened, and, in three months, the child, with the protection of blue spectacles, could bear the light; and these she

continued the use of for a year. (See *Archives de Med.* Fevr. 1832.)

In 1787, Baron Larrey met with a case of day-blindness in an old man, one of the galley-slaves at Brest, who had been shut up incessantly for thirty-three years in a subterranean dungeon. His long residence in darkness had had such an effect on the organs of vision, that he could only see in the dark, and was completely blind in the daytime. (See *Mem. de Chir. Mil.* t. i. p. 17.)

Nyctalopia may sometimes depend on a peculiarity in the organisation of the eye; by reason of which, the quantity of light, which only suffices for vision in an eye of natural formation, proves too abundant for a nyctalops, and absolutely prevents him from seeing at all. We know that, in the eye, there is a black substance, named the *pigmentum nigrum*; one supposed use of which is to absorb the redundant rays of light, which enter the pupil. A deficiency of it may explain some forms of nyctalopia. (See *VISION*.)

**ŒDEMA.** (from *οἰδέω*, to swell.) A swelling, arising from the effusion of a serous fluid in the cellular tissue; the affection, when more extensive, and accompanied with a general dropsical tendency, receiving the name of *anasarca*. An œdematous part is usually cold, and of a pale colour; and, as it is little, or not at all elastic, it *pits*, as surgeons express themselves, or, in other words, it retains, for some time, the impression of the finger, after being handled or pressed. Œdematous and anasarcaous swellings are often connected with constitutional causes, or visceral diseases, and especially with circumstances causing obstruction to the free passage of blood through the heart. The fluid is disposed to gravitate to the lowest situations, and it is enabled to do so by reason of the free communications in the cells of the cellular tissue. In many cases, however, they seem to be entirely local affections, arising from such causes as only act upon the parts in which the disease is situated. Thus we observe, that after violent sprains of the wrist, or ankle-joint, the hands and feet often become œdematous: and limbs are frequently affected with œdema, in consequence of the return of blood through the veins being obstructed by the pressure of tumors on them, or that of splints, bandages, &c. Pregnant women are known to be particularly subject to œdema of the legs, owing to the pressure of the gravid uterus on the iliac veins. Persons who have been confined in bed, with fractured thighs, or legs, generally have more or less œdema in their feet and ankles, on first getting up again; and the affection in these cases is probably dependent on loss of tone in the vessels of the limb.

In the treatment of œdema, great attention must always be paid to the nature of the cause, in order to determine whether the disease originates from a mere local, or a general constitutional affection. When it depends on the pressure of a tumor on the veins, as we often see happen in cases of aneurisms, the effect cannot be got rid of till the cause is removed; and the aneurismal swelling must be lessened, before the œdematous one can admit of the same beneficial change. When œdema is the effect of vascular weakness in a limb, in consequence of sprains, contusions, &c., the best means of relief is, to support the parts affected with a laced stocking, or a flanne

roller, while they are also to be rubbed with liniments, and bathed with cold spring water, till they have perfectly recovered their tone.

With regard to the œdema attendant on the advanced stage of pregnancy, a complete cure cannot be expected till after delivery. The affection is generally more considerable in the afternoon than the morning, owing to the different effects of an erect and a recumbent position. Some relief may be obtained by the patient keeping as much as possible in a horizontal posture; and, when great inconvenience and pain are felt, the parts may be fomented with an aromatic or spirituous application.

Frequently, œdema is one of the symptoms of deeply seated suppuration.

There is a species of œdema, accompanied with a degree of heat, pain, &c. in the part, and which seems combined with phlegmon. In this case, fomentations, leeches, and saline purgatives are proper.

**ŒSOPHAGOTOMY.** See **ŒSOPHAGUS.**

**ŒSOPHAGUS, SURGICAL AFFECTIONS OF THE.**—[The œsophagus, extending from the termination of the pharynx, about the fifth cervical vertebra, or lower border of the cricoid cartilage, ends at the cardiac extremity of the stomach, opposite the ninth dorsal vertebra. It lies behind the trachea, and in the middle line at its upper part; but in its lower portion it usually slightly inclines to the left side, so as somewhat to project from behind the trachea,—a circumstance which is taken advantage of in certain operations on the canal.]

The œsophagus is liable to inflammation and its consequences,—softening, abscess, and ulceration. It is occasionally affected with spasm, malignant disease, stricture, paralysis, and morbid growths; while wounds and foreign bodies are at times the cause of the surgeon's attendance.

When caustic solutions have been swallowed, the œsophagus occasionally suffers severely. The effects will of course vary with the quantity and strength of the liquid. In most cases such solutions are taken through error, and in consequence of the spasm in the throat they give rise to, they are rejected before they reach the œsophagus,—the pharynx and buccal cavity alone suffering. Occasionally, however, the fluid traverses the œsophagus, and even enters the stomach; where, if the solution be concentrated and the stomach empty, the parietes may be at once destroyed, and death by collapse takes place with great rapidity. Even in less severe cases, violent inflammation leads to a more lingering but hardly less certain termination, either through its direct effects, or in consequence of the closure of the canal which it brings about. The œsophagus may be partially or wholly occluded, in consequence of the inflammation, effusion, ulceration, and cicatrization which follows the introduction into it of caustic solutions; while its mucous membrane will be found, in case of death at an earlier date, eroded, softened, or destroyed, to a greater or less extent. (See art. **PHARYNX.**)

It is by no means easy to obviate or remove the effects of such accidents as those above referred to. In the first instance, we try by chemical solutions, or by means of any mucilaginous fluid, to neutralize or mitigate the effects of the caustic which has been swallowed. It would be well to wash out

the stomach with the pump, if it were not for the danger attending the introduction of its tube along a canal, the walls of which may be partially or wholly destroyed. Our next object must be to subdue inflammation; and this we accomplish by local applications: ice to the throat, and introduced into the mouth,—leeches, perhaps, and the use of purgative enemata. The advantage which some allege they have obtained from mercury in such cases can hardly be sought, except the metal be introduced into the system by inunction. The food must be given in small quantities, and be of a soluble and concentrated kind. If it cannot be swallowed, it must be thrown into the rectum. After this acute stage, blisters may be applied to the neck and between the shoulders, and during the progress of cicatrization the passage of bougies should be had recourse to, in order, as far as possible, to retain the patency of the canal. If the tube gets entirely closed, the question of opening the stomach and thus introducing food (the deprivation of which is here alone the cause of death) becomes a fair one for consideration.]

**ŒSOPHAGUS, STRICTURE OF THE.**

[This may be either spasmodic or organic. *Spasmodic* stricture of the œsophagus attends various diseases, as tetanus and hydrophobia, and it is also caused by certain poisons; but it is as met with in hypochondriasis or in hysteria that the surgeon has chiefly to do with it. It is seen in nervous females for the most part, and either in youth or what is, perhaps, more common, in middle life. It depends on one or other of those many causes to which we attribute other nervous affections in the female, especially spinal irritation and gastric or uterine derangements. Occasionally it seems to be due chiefly to moral emotions, but various bodily irritations—as worms in the intestinal canal, the ingestion of acrid substances, long constipation, sudden and violent impressions of cold on the external or internal surfaces of the body, or the temporary impaction of a foreign body in the œsophagus itself—appear to exercise the greatest influence in producing it. The contraction of the canal in these cases lies high, and depends on spasm of the constrictor muscles.]

In cases of spasmodic stricture of the œsophagus, we have usually symptoms of the general nervous temperament on which it depends, over and above those effects which arise directly from the œsophageal spasm. A feeling of constriction, as if a ligature was tied round the upper part of the thorax, and embarrassed both the breathing and swallowing,—pain deep in the throat, and more or less dysphagia, are the common complaints of patients suffering from the affection under consideration. The periodic character of the attack in many cases,—the suddenness of its approach and departure,—the great and unaccountable violence of the symptoms at times, especially when the mind is directed to the subject,—the exaggerated expressions used with regard to the disease,—the ascription of the affection to an inadequate and often fanciful cause, and the absence of any attack from the application of other causes apparently as potent,—and finally, the absence of emaciation and early failure of the bodily vigour, will direct our judgment to an estimate of the true nature of the affection we are called on to deal with. If any further evidence was required of



the absence of all organic stricture, the ready passage of a bougie when the patient has been put under the influence of chloroform, or the passage of the instrument after only slight resistance without chloroform, would supply it.

As to the treatment of spasmodic stricture of the œsophagus, it is apparent that its removal must in most cases be sought by remedies addressed to the general system. The constitutional condition on which it so frequently depends must be corrected, and if the function of any special organ be deranged it must be set right. The uterine, digestive, or spinal functions must be carefully examined, and their healthy action insured. Such general measures as conduce to the establishment of vigorous health must be enjoined in all that relates to exercise, free country air, good and digestible food, and proper habits; while the regulation of the secretions and mental occupation will at the same time receive due attention. The use of aloetic purgatives and of assafoetida internally, and the administration of iron—either in the form supplied by some of the mineral spas of this or foreign countries, or the same valuable remedy in one of the many good and elegant pharmaceutical preparations now in use,—the cold shower-bath or sea-bathing, and change of scene, are means of restoration of the utmost importance in such cases as we are now considering.

During the attack, antispasmodics, sedatives, and stimulants, especially the foetid gums and camphor, may be of use, or chloroform may be administered. A full-sized bougie passed down the œsophagus is often highly beneficial, and should not be neglected. Cupping between the shoulders and the application of a belladonna plaister to the forepart of the throat has been sometimes thought serviceable. It need hardly be added that if the spasm is due to the impaction of any foreign body, such as a pin in the throat, it must be removed before any good can be expected from treatment.

*Organic Stricture* usually occupies either the highest or lowest portion of the canal, and may in its nature be simple or malignant. There are but a few cases of congenital stricture of the œsophagus on record, and folds of mucous membrane obstructing the canal are also very rare; but the more common causes of the complaint are injury, violent inflammation, ulceration, and malignant deposition. When inflammation has been for some time present, plastic exudation takes place, and the walls of the canal being thickened, and rendered more rigid, encroach on the tube and diminish its calibre; while when ulcerative action has existed, and the breach of surface heals, contraction attends the formation of the cicatrix. Malignant disease, again, is not uncommon in the œsophagus, and is the cause of a very unmanageable stricture. As compared with other portions of the alimentary canal, cancer is not frequent in the œsophagus, but even there it is by no means rare. It may be either of the hard or soft variety. It is commonly found at the period of death that the stricture consists of epithelial disease, but whether it has been of that character all along, or has become so during the progress of the case, it is not always easy to determine. It is, however, well known that strictures of long standing are very liable to become ultimately converted into epithelial disease.

The extent of an organic stricture varies much. Sometimes it consists of a mere line of constriction,

surrounding the canal like a ligature,—sometimes the contraction is limited to one side of the tube,—sometimes the change of tissue on which the stricture depends is quite superficial; while at other times it passes deeply, and involves the whole circumference of the canal. Occasionally the longitudinal space of the œsophagus constricted is very small—at other times it includes a considerable length. When the stricture is due to malignant disease, the involvement of the canal may be very extensive, and in such cases the œsophagus may be bound firmly to the vertebral column and the surrounding parts. It is much more common that the whole circumference of the œsophagus should be comprised than that it should implicate merely one side. The canal frequently undergoes a remarkable enlargement above the seat of stricture, while below it no change is in general met with. The dilatation may be uniform, or may present itself as a pouch of greater or less size, formed of all the coats of the canal or of a sort of hernia or protrusion of the mucous through the muscular coats. The food is arrested in these sacs, and a species of digestion may then go on. In some cases the parietes of these saccular enlargements are much thickened, while in other cases, on the contrary, they are greatly thinned. Ulcers are occasionally found both above and below the seat of stricture, and perforation is not of rare occurrence, especially in cases of malignant disease. A communication may thus be formed with the larynx or bronchial tubes, or pleura, and even through them with the surface of the chest; and thus long fistulous tracts may arise in the neck. Fatal hæmorrhage too may arise from the ulcerative action opening some of the great vessels of the neck, or even the aorta. The vertebral artery and the superior intercostal have also been thus perforated. Openings have in like manner been formed into the mediastinum and pericardium.

Traumatic stricture of the œsophagus may, of course, come on at any age and in either sex, while malignant stricture is usually met with in females beyond middle life. The symptoms gradually unfold themselves. The obstacle to deglutition being slowly formed in organic stricture, the signs by which it is recognised, though at first indistinct and liable to misconstruction, soon become sufficiently distinguishable. Considerable uneasiness generally attends the complaint, and that from an early period. This feeling of discomfort or actual pain is not always clearly referred to the throat, but pervades the chest and the region of the neck, and shoots to a point between the shoulders and to the xiphoid cartilage. Deglutition becomes more and more difficult, till probably at last a larger piece of food than usual sticks altogether, and is removed with difficulty. Solids become in time unmanageable, and the passage even of fluids is not unattended with difficulty. The ingesta often appear to the unhappy patient to reach a certain point which he indicates, and then either regurgitate or pass slowly and painfully on into the stomach. This process, though not always attended with suffering, is very painful to witness, and occasionally causes the utmost anxiety to the patient, as we often see portrayed in his countenance. The higher the constricted point the sooner, of course, will the regurgitation take place. Spasm frequently aggravates the difficulty, and as a sense of suffocation is occasionally urgent,

the distress is very great. The voice is often affected, and sounds as if a foreign body were present in the throat. The whole system ere long is influenced by the irritation, pain, and want of due nourishment. Emaciation, gastric derangement, want of sleep, prostration, high nervous excitement, and mental depression soon proclaim the danger and progress of the complaint. Death takes place by exhaustion, in consequence of the want of food, and before death mind and body are in general reduced to the last stage of exhaustion. In the case of malignant stricture a fatal termination is not uncommon, at a comparatively early stage, from pneumonia.

The history and symptoms of organic stricture of the œsophagus are in general sufficiently distinctive. It is apparent that embarrassment in deglutition must naturally be one of the earliest and throughout the leading symptom of the complaint, so that it is necessary clearly to recognise the various causes which may give rise to this symptom. These causes are various and numerous, and the dependence of the dysphagia on stricture is often to be decided by determining the absence of these other efficient causes. Any pressure exerted on the œsophagus, by a body within or without its walls, may embarrass the function of swallowing. In the upper part of the gullet we may find enlarged tonsils. These are easily recognised. Polypoid growths, foreign bodies, abscesses of the walls of the pharynx or in the soft parts of the neck; œdema or ulceration of the back part of the epiglottis or rima glottidis; that chronic inflammation of the pharynx which occasionally accompanies or follows chronic skin-diseases and abnormal dilatation of the œsophagus,—all these may occasion dysphagia. The presence of polypi or foreign bodies, or post-pharyngeal abscess, may in general be detected by inspection (the tongue being well depressed and drawn forwards) and digital examination; while the laryngoscope, or the sensation communicated to the finger, as well as the other symptoms present, and especially laryngeal cough and fits of suffocation in affections of the epiglottis and rima, will enable us to recognise ulceration of the epiglottis and chronic pharyngitis.

Exostosis of the vertebræ, or a malignant or other tumour growing from the spine and pressing upon the gullet, may also be the cause of the difficulty of swallowing. The finger will best recognise these sources of obstruction.

Tumors of all kinds situated in the mediastina, or in the lateral regions of the neck, may cause dysphagia by pressure. Cancerous or other growths springing from the spine, enlargement of the thyroid or thymus, or lymphatic glands, and aneurism of the great vessels, may come to press on and obstruct the œsophagus. Aneurismal enlargements in a backward direction of the carotids, innominate, or aorta may thus act, and be by no means easily recognised. Tumors of the posterior mediastinum give rise to wearing pain between the shoulders, flashing down the arms and often up the sides of the head; and if of cancerous origin, they will declare themselves before long by their influence on the general system. Percussion, too, and the history of their progress will assist us. The hand and eye can in general, especially in the later stages, when emaciation is present, detect tumors of the lateral regions of the neck; and auscultation and percussion, together with those

other symptoms occasioned by aneurism of the great arterial trunks of the neck, will enable us in general to make out these affections. Instrumental examination of the œsophagus must not be attempted in cases of suspected aneurism, as the rupture of the sac might follow any such ill-judged manipulation. The embarrassment of the respiration and of the venous circulation, which so commonly attends aneurism, will afford us useful information in most cases.

Further, dysphagia attends paralysis of the gullet, and is a common attendant on hydrophobia, tetanus, congestion of the brain, and apoplexy; and is occasionally seen in hysteria, low fevers, epilepsy, and mania. These sources are, however, easily discovered. The passage of a bougie will in cases of paralysis make the absence of organic stricture evident, and the fact that in cases of paralysis more difficulty is encountered in swallowing fluid than solid food (the very contrary to what is seen in organic strictures), will confirm the diagnosis. Dislocation of the sternal end of the clavicle, either from accident or in consequence of curvature of the spine, are also to be noted as rare but easily ascertained causes of dysphagia.

The obstruction, then, being from none of these causes, the question next arises, is it of a simple or malignant kind? and this is often very difficult to determine. The sensation communicated to the hand when passing a bougie often conveys to us important information on this point. If the instrument passes apparently over a rough surface, with a jerking and grating sensation,—if there is any enlargement discoverable at the root of the neck,—if the cervical glands are enlarged,—if blood or pus follow the withdrawal of the bougie, and if such expectoration continue, mixed or not with shreds of tissue, and if there is the sallow look of cancer and suspicious tumors elsewhere, then the most unfavourable view of the nature of the affection is forced upon us. The absence of these conditions would justify the contrary opinion, and lead us to believe that we had to do with a simple or fibrous stricture.

In thin persons, if a stricture, even of a simple kind, be attended with much deposition in the parietes of the canal, and be situated high up, it can occasionally be discovered by pressing the fingers behind the trachea while the patient makes an effort to swallow.

The treatment of organic stricture of the œsophagus is often very difficult and unsatisfactory, and demands much care and perseverance.

In fibrous stricture the main resource is instrumental dilatation, by which some hope to promote the absorption of the deposited lymph, and all expect to retain or increase the calibre of the passage. This dilatation of the canal may be attempted either rapidly or slowly. Various kinds of instruments are employed. Elastic bougies with well-rounded ends; whalebone instruments, with balls of ivory attached to their extremities; pieces of sponge, which being saturated with white of egg or oil are pressed through the constriction; instruments with blades, which, by means of screws in the handle or other contrivance, are separated the one from the other; catheters, with india-rubber sheaths, which are expanded by the pressure of water or air; hollow graduated instruments, which slip the one over the other, and all the various appliances which are employed in the



treatment of stricture of the urethra, have been here brought into use. Trousseau uses occasionally a catheter, to the extremity of which he daily adds a thin layer of wax, thus gradually increasing its size. Gradual dilatation is accomplished by the passage of an instrument every second, third, or fourth day, at first; the size of the bougie employed being each time slightly enlarged, and the repetition of the operation being regulated by the effects produced. The instrument should not be passed a second time till the irritation of the first introduction has passed off, and when being passed it should be done quickly and by a twisting motion, and only retained for a very short time, so as to avoid all danger of lighting up inflammatory action, and so augmenting the disease by causing further deposit and thickening. It is, however, proper to observe that some surgeons of repute prefer having the bougie within the grasp of the stricture so long as it can be borne, or even passing Switzer's instrument and leaving it *en permanence*. This instrument consists of a short ivory tube, which is introduced by means of a whalebone rod within the stricture and there left, the conducting-rod being withdrawn. A strong thread connected with the ivory tube enables the surgeon to remove it when he wishes to substitute a tube of larger size. The irritation and annoyance caused by these instruments appears, however, to be very great; and as even positive evil in the aggravation of the malady results, this mode of treatment is justly all but abandoned.

In those cases in which sacs exist in the œsophagus above the site of the stricture, much patience and address is required to introduce an instrument through the constricted portion; and in no instance of the kind should any force be applied, but the whole manœuvre should be conducted with the greatest gentleness. In the treatment of stricture by dilatation, the surgeon may be well content if he obtains such a diameter of the canal as will allow of the food passing with comparative ease into the stomach; and this calibre he should endeavour to retain, by the passage of a suitable instrument at intervals, till all fear of a relapse has passed.

Caustic is but little employed in the present day in the treatment of œsophageal stricture. It does not appear to have any advantage attending it, while much evil has been attributed to its employment. Scarification, too, has in a great measure been abandoned. Alphonse Guérin, however, has more recently recommended internal incision, as employed in stricture of the urethra, in preference to other methods of treating the similar affections of the œsophagus.

In all cases the general health must be attended to, and appropriate remedies used to correct any error therein. Iodine and mercury are still believed in by some to promote the absorption of the abnormal tissue at the seat of stricture. The food must be of the most nutritious kind, and given in a finely-divided form. It may be necessary to feed the patient by a tube introduced through the stricture; and if this cause too much irritation, or become impossible, then we must employ enemata or strong soup-baths, to obtain some respite to the inevitable doom. The hunger can in general be relieved with much greater ease than the thirst, which in such cases is intolerable.

If all the means we can devise for the support

of the system fail, and death is plainly inevitable, it becomes a just consideration whether gastrotomy, or the opening of the stomach through the abdominal walls, should not be performed. Œsophagotomy too may be taken into account, as, if the position and extent of the stricture permit of it, a way may thus be got for the introduction of food into the stomach. In such cases the œsophagus has been opened above, through, and beneath the seat of stricture. Taranget and Monod opened it below, Watson at, and Lavacherie above the constricted point. In opening the canal below the stricture, the temporary advantage of supplying food is attained; but in cutting into the stricture, or opening the tube above it, the surgeon may employ direct means of curing the disease itself. It is apparent that such an operation would only be contemplated in cases of stricture where there was no suspicion of malignant disease, and that while the exact seat and extent of the constriction would require to be carefully defined beforehand, the age and constitution of the patient should enter into our calculations.

Gastrotomy, again, could only be undertaken when we had reason to believe that the stomach was sound. If violent and constant pain was suffered in that organ,—if there was frequent vomiting after food, or other symptoms of the implication of the stomach in the injury or disease which caused the stricture, then no good but manifest harm would be done by attempting an operation, which in appropriate cases may be of great benefit, but which if undertaken in ill-selected cases can only sink into unmerited disrepute. This operation has as yet been in general confined to cases of malignant stricture, where, even if successful, it can only be of very temporary benefit, and thus its merits have not been fairly tested.

When malignant disease is the cause of the stricture, we can do little to prolong life. Opiates to allay pain, and as nourishing food as can be introduced, by the mouth or rectum, comprise nearly all our resources.]

#### ŒSOPHAGUS, CATHETERISM OF THE.

[Instruments may have to be passed along the canal in a variety of circumstances. It may be to explore the canal; to introduce food into the stomach; or to remove poisons from that cavity. It may be performed by the mouth or nostril, but the former is not only much more easy than the latter, but also much more safe; as rupture of the œsophagus has been many times caused in cases in which, from voluntary effort on the part of the patient (as in the case of lunatics), or from disease, the mouth could not be opened. Some surgeons prefer introducing the tube through the nostril, when it is to be left in place; and this Boyer managed by first passing it by the mouth, and then, by means of Belloc's canula, bringing one end out by the nostril. The ordinary œsophagus sound is an elastic tube, long enough to reach from the mouth to the stomach, and of a size to fill, without distending, the canal. When about to be passed, the patient's head should be well thrown back (so as to render the passage as straight as possible), and supported on the breast of an assistant. The left forefinger is then introduced into the mouth, and the tongue by it depressed and drawn forwards, while the point of the instrument (well-oiled) is quickly

passed over the back of the finger, and made to descend by gentle pressure close to the posterior wall of the pharynx. So soon as the instrument is fairly in the canal it should be moved slowly and gently on, the patient being encouraged to breathe as it is being passed. The bougie is frequently temporarily arrested on a level with the cricoid cartilage, but we are not on that account to conclude either that a foreign body is present, or that a stricture exists there. When any stoppage to the progress of the instrument takes place, the bougie should be gently withdrawn, and in again pushing it onwards we should turn it on its own axis. In general, catheterism of the œsophagus occasions but little discomfort to the patient, but occasionally the presence of the foreign body in the pharynx gives rise to retching, cough, and much struggling. In such cases the operation should, if possible, be delayed till, by education, the parts become more tolerant of such contact. It would be, under ordinary circumstances, an unpardonable error to pass the bougie into the larynx; but when it has to be introduced by the nostril, and the patient be an old or feeble lunatic, who fails to give any hint to the surgeon, such an accident may occur. The great embarrassment to the breathing which would result, and the escape of air by the tube, would warn the operator of what had taken place. The breathing and cough should in such cases be observed, and if any doubt exists, the escape or not of air should be tested by means of a lighted candle, or a few drops of water should be allowed to run along the tube, when, if it fall into the larynx, the effects will be at once fully apparent. In cases of disease of the œsophagus, very great gentleness in passing instruments is necessary. If any violence is employed there will be great risk of perforating the walls. When the mouth is closed by disease, so that a tube cannot be introduced, the last molar tooth may be removed so as to make room for its passage, or it may be introduced by the nostril. When the mouth is forcibly closed voluntarily, then chloroform may be employed, the mouth opened, and a perforated gag introduced.]

#### ŒSOPHAGUS, DILATATION OF THE.

[Independently of its combination, as before said, with stricture, the œsophagus is on rare occasions the seat of dilatation, and that occasionally to a very great degree. This, as has been already pointed out, may cause difficulty in deglutition. In some cases the whole circumference of the tube is found implicated, and the muscular coat atrophied, or on the contrary hypertrophied; while in other instances the dilatation is confined to one side of the canal, and then all the coats may be dilated so as to form a sac, or a sort of hernia of the mucous membrane through the muscular coat may occur, in a way similar to what is occasionally seen in the rectum and bladder. These sacs are most common near the division of the trachea, and attain the greatest size where the fibres of the inferior constrictor muscle run horizontally. Where a pouch exists a considerable amount of the food may fall into it, and there undergo partial digestion. This gives rise to a feeling of fullness and discomfort as a rule, followed by vomiting of the contents at an uncertain period. The patient continues to be feebly nourished, but the symptoms are not always consistent, varying with

the amount of the food which finds its way into the bag, and what passes on into the stomach.]

#### ŒSOPHAGUS, PARALYSIS OF THE,

[Is an occasional accompaniment of general palsy of an aggravated kind, or may arise from tumors situated at the base of the brain, or at the origin of the pneumogastric nerves, or injuries sustained by the same part. Dysphagia, more or less severe, results. The absence of any discoverable obstruction and the presence of general palsy will clearly define the malady. It must be treated according to its cause. If the patient be full-blooded, and it has come on suddenly, then active purgation and counter-irritation to the nape and spine will be required. In some cases strychnine will give good results; in others tonics, with cold or tepid shower-baths, good food (if necessary introduced through a tube), and attention to the secretions, will best fulfil the apparent indications of the case.]

#### ŒSOPHAGUS, FOREIGN BODIES IN THE.

Small pointed bodies are most apt to become impacted in the folds of the mucous membrane at the root of the tongue and back of the pharynx; but larger bodies are most frequently caught, either at the part of the canal where the pharynx ends in the œsophagus, i.e. just behind the cricoid cartilage, or at the lower end, where it passes through the diaphragm, and just before it enters the stomach. The pain and annoyance are greatest when such bodies are arrested on a level with the cricoid cartilage. The foreign bodies which may be found impacted in the œsophagus are of many varieties, both as to nature, shape, and size; and the effects they produce will, to a very considerable extent, be modified accordingly. Knives, forks, false teeth, needles and pins, articles of food, and such substances as may during its preparation be mixed with and concealed in the food by accident or design—bones, fruit stones, &c.—pieces of money, even the handle of a punch-ladle, and a gold watch and seals, have been found impacted in the gullet. The sharper and more angular in form, the more dangerous, for obvious reasons, such foreign bodies are, and the symptoms which their presence will produce will vary with their nature and the position they occupy. It is occasionally very difficult indeed to detect even considerable masses when they have been for some time impacted in some parts of the gullet, and have become embedded in its wall. Sets of false teeth have been thus so concealed and protected by their position, and the way in which the mucous membrane has overlapped them, that the most experienced surgeons have failed to detect their presence; while, on the other hand, it is to be remembered that the passage of an irregular body along the canal may, by the abrasion it creates, cause a sensation as if it still remained, long after it has in reality been removed. With a knowledge of these two facts, the surgeon is often much puzzled in his examination of such cases as are now being considered.

Foreign bodies, if large, may entirely obstruct the œsophagus, and by their pressure on the wind-pipe embarrass the respiration, or even cause suffocation. If small and sharp (as fish-bones, pins, &c.) pain and irritation, followed by a great or



less degree of inflammation, may alone result. The impaction of a considerable body, even though not attended by immediate danger, causes much distress at first, though in some cases a remarkable tolerance becomes established. A sense of constriction at the top of the sternum, and pain of a remittent or persistent character, a constant attempt to vomit, and a flow of saliva, which may be tinged with blood when the wall of the canal has been injured, are among the most common symptoms. The face and eyes are suffused, the breathing more or less impeded, and in thin persons with long necks, the foreign body, if of any size, may sometimes be felt by external examination.

The diagnosis of foreign bodies in the œsophagus is not in general difficult, though cases every now and then occur in which very considerable hesitation may be felt. The sensation produced by the presence of the foreign body is frequently of use in a diagnostic point of view, and yet, as we have seen, it is often deceptive. The embarrassment of the breathing and swallowing,—it may be the detection of the intruder from without by the hand, or the finding of it with the finger or with instruments introduced into the throat,—or discovering it by inspection of the gullet when the tongue is well drawn forwards and depressed, and lastly the account of the case as detailed to us, will in general suffice.

As to the removal of foreign bodies from the gullet, it may be remarked that when abandoned to the natural efforts they are got rid of in one of three ways. They are either brought up and ejected; passed downwards along the canal and expelled; or they work their way to the surface through the walls of the œsophagus by ulceration, and so escape. The surgeon imitates these efforts, and adopts one or other plan, according to the nature of the impacted body and its position in the canal.

*First:* Foreign bodies may be removed by producing or encouraging vomiting, or simply by withdrawing them (with or without the aid of instruments) through the mouth. Before considering these plans, however, it may be remarked that we should not lose time in employing measures to subdue any inflammation which may be present, but at once proceed to extract the foreign body, and thus remove the exciting cause of the inflammation.

In some cases an emetic has been found useful in getting rid of a foreign body, but such a remedy must be employed with caution; as, if the intruding body be sharp or angular, the efforts to vomit will be apt to drive it more deeply into the tissues, and will greatly increase the subsequent inflammation. If the body be firmly impacted, experience has shown that considerable danger of rupturing the canal arises from violent emesis. Tartar-emetic has been administered in such cases by the mouth and rectum, and has been even injected into a vein; but tickling the fauces will be found sufficient and more manageable, in the few cases in which it is desirable to produce vomiting. Striking the patient smartly between the shoulders or on the sternum has sometimes the effect of assisting expulsion.

Extraction by means of fitting instruments is the proper treatment when the body is within reach, and especially when it is hard and irregular. Many metallic bodies are peculiarly pernicious when impacted in the œsophagus, not only on ac-

count of their hardness, but also from their chemical action.

Pins and needles, sharp bones, &c., adhering to the walls of the upper part of the canal, can sometimes be removed with the nail of the finger; and an attempt to hook out any foreign body situated high in the tube should be made with the finger, if a proper instrument is not at hand. It has recently been well shown how by raising the windpipe, and holding it upwards and forwards with the left hand, the right can be greatly assisted in removing any obstruction, and how much easier and deeper an effort at extraction may thus be made.

Forceps of many forms have been invented for the extraction of foreign bodies from the throat. Some are varied as to the angle at which they are bent in the blade or limbs, so as to adapt themselves to the canal. The blades of some open longitudinally, and those of others laterally. The crane-billed forceps of Gensoul has a contrivance external to the grasping point, which keeps the mucous membrane from becoming entangled in the blades. Whatever kind of forceps are employed, the blades should be bevelled at the edges, so as not to injure the mucous membrane when they are used. When forceps are employed, the blades are introduced closed, the patient's head being thrown as far back as possible and supported; and when the offending body is found the blades are opened, and an attempt made to grasp what we wish to remove. The efforts of extraction are then to be made with care and gentleness. A hard foreign body which can be felt may sometimes be displaced when impacted by the application of the hand, and so the natural efforts at expulsion aided, or the action of the forceps supplemented by gentle manipulation with the hand on the sides of the neck.

Hooks of various kinds are occasionally employed to remove foreign bodies. The double blunt hook of Græff is probably the best of this kind. The whalebone stem, being attached to the double hook by a hinge, enables the instrument to adapt itself better to the body to be removed. Baudens has reintroduced an old instrument formed like a parasol, which was expanded by the action of a screw in the handle, or simply by the movement of withdrawal, so soon as the foreign body had been passed. All such instruments, however, must, for obvious reasons, be used with great caution. Fatal consequences have followed the careless employment of hooks.

Snares of many kinds are also resorted to for the removal of small and sharp bodies. They are formed of numerous loops of wire, or thread, or horsehair, or catgut, as in the various inventions of Petit, Marechal, Elliot, and others. Elliot's instrument is both ingenious and useful. It is composed of a whalebone stem inserted into a full-sized male catheter, the lower extremity of which has been removed. The whalebone is made to exceed the catheter in length by about an inch at the upper and about three inches at its lower end. The upper end is roughened, so as to enable it to be firmly grasped. To the lower extremity of the whalebone a piece of sponge is attached, and between this and the end of the catheter catgut or horse-hair is stretched all round the instrument, the one end of the layer of hairs being bound to the whalebone below the sponge, and the other end being firmly tied to the extremity of the catheter. It follows from this arrangement that

when the whalebone is drawn out of the catheter by grasping the handle, the strands of hair are made to project by their extremities being approximated, and thus a "sweeper," similar in appearance to that used for chimneys, is produced which is very useful and well adapted to catch in its folds or loops any sharp body with which it may meet.

Fish-hooks have on several occasions got access into the interior of the œsophagus, and they have exercised the ingenuity of the surgeon to get rid of them. It is an old manœuvre, though one frequently claimed as original in later times, to pass the line attached to the hook through a leaden bullet, which being allowed to run down over the hook, helped by its weight to remove the hook from its attachment and to guard its point when being withdrawn. The extraction of such unpleasant bodies may also be accomplished by passing the line through a hollow tube, which on being introduced into the throat over the line displaces and guards the hook as it is being removed.

*Secondly.* Foreign bodies, such as alimentary substances, which can do no harm when swallowed, and other objects, it may be, which have passed far down and cannot be extracted, have occasionally to be pushed onwards in order to remove them from the œsophagus. Swallowing thick fluids, such as soup, arrowroot, or dry bread, or pulpy fruits, such as an inverted fig or prune, will sometimes remove a small and pointed body, but such measures cannot be used when the obstruction is great, as then they will only serve to aggravate matters.

Probangs having a piece of sponge attached to their extremity, which is either saturated before introduction with white of egg, or butter, or oil, or glycerine, or, being passed in a dry state beyond the offending body, are then made to expand by the introduction of water into the throat, will often succeed either in pushing onwards, or entangling and withdrawing, the obstruction. Probangs with ivory balls are also employed to push the foreign body into the stomach. When the substance impacted is of a soft and easily disintegrated character, such as a potato, and is situated high up, Dupuytren's plan of crushing it by the pressure of the hand from without may succeed in freeing the canal of obstruction. If hard irritating bodies have been either accidentally or intentionally passed downwards, their passage along the intestinal canal should be assisted by the administration of mucilaginous fluids, and probably a dose of castor oil.

Dr. Hall, of Baltimore, proposes to soften, and so facilitate the removal of, bones impacted in the œsophagus by the administration of the mineral acids in small and frequent doses through a tube. He says he has thus succeeded in his object.

*Thirdly.* When a foreign body can neither be extracted nor pushed onwards, or when it is of such a nature that it is undesirable to attempt the latter procedure, the surgeon is called upon to remove it by operation. Doubtless a foreign body left to itself may occasionally, in consequence of suppuration becoming established, get loose and so come up or pass down without extraneous aid, but the risk attending such a process is very great, as Begin has well shown, and should not be voluntarily encountered. Violent inflammation abscess, sloughing, and even gangrene may result from the

continued lodgment of hard irregular bodies in the œsophagus, and thus perforation of the canal may follow, and fatal hemorrhage, disease of the spinal cord, effusion into the air passages or chest may be produced. Death may be caused by the irritation, and sometimes symptoms which before the employment of auscultation were taken to indicate phthisis pulmonalis,—emaciation,—hacking cough,—vomiting of pus and blood—arose from the continued impaction of such bodies.

Needles and such like bodies may pass through the walls of the œsophagus or intestine, after being swallowed, and travel a long way before finally escaping by the surface, which they do by the formation of an abscess. During such transit they may cause little or no inconvenience, but they have likewise been known to pierce important organs, such as the heart and liver, to work their way into the great blood-vessels and air passages, and either produce serious effects at once or set up dangerous and destructive inflammation. It becomes then a proper and anxious question when the operation of Œsophagotomy should be performed.]

#### ŒSOPHAGOTOMY.

[This operation is occasionally undertaken not merely in order to remove a foreign body, but also to cure a stricture of the œsophagus, or to introduce food into the stomach. In the case of the impaction of foreign bodies, the counsel of Bell and Boyer was at one time universally followed, of not operating unless the foreign body to be removed could be felt in the neck and used as a guide, but this limitation is no longer admitted, and the necessity for removal being recognised, and the impossibility of attaining this by any less serious means apparent, then the operation is performed. If a foreign body be impacted in the throat whose continued presence is calculated to be injurious, and if fair trials have been made for its removal, then œsophagotomy should be at once performed. It should not be delayed, and only undertaken as a last resource, but performed before mischief has been done. It is not a very difficult or dangerous operation, but requires care, and a clear knowledge of the anatomy of the region to be cut in.

If the foreign body to be removed can be felt from the outside, or accurately determined by the mouth, then its position determines the point of operation; but if no such adjudicating circumstance be present, then we operate in the space between the sterno-mastoid and the windpipe on the left side, and between the superior and inferior thyroid arteries as upper and lower boundaries.]

Though œsophagotomy was cursorily mentioned by Verduc in his "*Pathologie Chirurgicale*," Guattani, formerly a distinguished surgeon at Rome, published the first valuable observations on the subject. (*Mém. de l'Acad. de Chir.* t. iii. 4to.) He proved by experiments that the operation might be safely performed upon dogs, which recovered after it very well, and he demonstrated on the dead body that it was equally practicable on the human subject. Nay, what is still more to the point, he brought forward two instances in which the practice had been successfully adopted on living patients. "In May, 1738, Goursauld, a surgeon at Coussat-Bonneval, in Limousin, was called to a man in whose œsophagus a bone was lodged, an inch long and half an inch broad. Various ineffectual endeavours



had been made to force it down into the stomach. and, as it was perceptible on the left side of the neck, Goursauld made an incision for its extraction. The bone was thus easily taken out, no bad symptoms followed, and the wound soon healed. For six days the patient was not allowed to swallow any kind of food, but nourished entirely by clysters. According to Morand, a similar operation was performed, with equal success, by Roland." (*Mém. de l'Acad. de Chir.* t. iii. p. 94.) The practicable nature of the operation, and the tendency of wounds of the œsophagus to heal favourably, when not complicated with other mischief of too serious a description, are facts proved beyond all dispute. In attempts at suicide and murder, and in cases of gunshot injury, the œsophagus is sometimes wounded, together with other parts in the neck, and yet the patients frequently recover; and, when they die, their fate seems to depend rather upon other unfavourable circumstances in their cases, than upon the accidental injury of the gullet. Cures of wounds, involving the latter tube, as well as the trachea, are reported by numerous writers, B. Bell, Desault, Bohnius, &c., and several have fallen under my own observation. If it were necessary to substantiate this point further, I might cite the instance, recorded on the authority of Dr. James Johnson, where a man recovered after the larynx had been completely severed between the thyroid and cricoid cartilages, and one half of the calibre of the œsophagus divided. (See *Hennen's Military Surgery*, p. 364. ed. 2.) But, supposing a wound of the œsophagus, abstractedly considered, were more dangerous than it really is, the question of the propriety of œsophagotomy would not be materially affected by it, because the operation is never recommended except as a matter of necessity, and without which the patient would have no chance of preservation.

On the outer side of the trachea, its muscles, and the thyroid gland, there is on each side of the neck a triangular space, the apex of which is downwards, and which is bounded externally by the sterno-mastoid muscle. In the area of this triangle we find the skin, and superficial fascia, the platysma myoides, some cellular tissue, the layers of the cervical fascia, between which the omo-hyoideus plays, and lastly, the sheath enclosing the carotid artery and the jugular vein. If this sheath be drawn away from the trachea, we approach the organs situated in front of the bodies of the cervical vertebræ, and in tracing the parts from without inwards, we meet with the œsophagus, which is the first and only muscular texture that will present itself. No vessels, nor nerves of importance, need be injured. But the wound must not descend nearer to the sternum than one or two finger-breadths, lest the inferior thyroid artery be cut; nor be carried up above the hyoid bone, not only because the laryngeal nerve, and the lingual and superior thyroid arteries might be wounded, but because we should thus get to the pharynx, in which the foreign body is not lodged. (See *Malgaigne, Manuel de Méd. Oper.* p. 497. ed. 2.)

[A patient on whom the operation is about to be performed should be placed in the recumbent position, with the head and shoulders supported on pillows. The head should at the same time be thrown back, and the neck well exposed. The

left side is always chosen, unless the foreign body project on the right, on account of the slight deviation the œsophagus makes to that side. Our superficial incisions are limited above and below by the level of the thyroid cartilage and the sternum, and laterally by the trachea and anterior border of the sterno-mastoid. More deeply we work in a line midway between the sterno-mastoid and sterno-hyoid and thyroid towards the vertebral column.

Several modes of opening the œsophagus have been proposed. Let us shortly refer to these before detailing that most usually adopted.]

1. Guattani cut between the trachea and the sterno-hyoid and sterno-thyroid, on the left side. "The patient is to sit on a chair, with his head inclined backward, and steadily supported by an assistant. The skin having been pinched up into a transverse fold, an incision is to be made in the integuments from the upper part of the sternum. The cellular tissue, between the sterno-hyoid and sterno-thyroid muscles and trachea, is next to be divided. With two blunt hooks, the lips of the wound are to be kept open; and, on separating the cellular tissue at the side of the trachea with the aid of the finger and a few strokes of the knife, the œsophagus will be seen. The lower part of this tube is then to be opened, and the wound in it enlarged with a pair of curved blunt-pointed scissors, a director being employed if any difficulty arise. With a small pair of curved forceps, similar to those used for the extraction of polypi, the foreign body may then be removed. According to Guattani, the wound will serve for the extraction of the foreign body, whether this be situated above or below it, and he asserts that the opening will even be useful when the extraneous substance has passed so far down that it cannot be taken out, because it may now be easily pushed into the stomach. Guattani lays great stress on the usefulness of endeavouring to unite the wound, and adverts to his experiments, proving that, in animals, wounds of the œsophagus heal very favourably. If, says he, the vein which brings back the blood from the inferior parts of the thyroid gland, and runs into the subclavian, happen to be cut, the hemorrhage may be stopped with a dossil of lint held upon the aperture in the vein during the operation, and afterwards, if the bleeding continue, compression, or a ligature, is to be employed. The recurrent nerve, if likely to be touched with the knife, is to be cautiously drawn aside with a blunt tenaculum." (See *Mém. de l'Acad. Chir.* t. iii. 4to.)

2. [Eckholt made his incision between the two heads or portions of the sterno-mastoid.

3. Nélaton prefers the following. He makes his incision along the central line of neck, as in tracheotomy, only dividing the tissues more freely. The sterno-hyoid muscle is then so freed that it can be drawn aside with a blunt hook. This muscle may, if thought desirable, be divided. Two ligatures are next passed, by a blunt hook, under the isthmus of the thyroid body, and tied at a short distance apart and between the ligatures, the isthmus is divided. The trachea, which is now bare, is followed closely round—the left lobe of the thyroid and the overlying tissues being separated and drawn outwards, and the œsophagus is found with ease lying behind and to the left of the trachea. There is here no risk of wounding any of the great blood-vessels, or the inferior thy-

roid in particular, and as the space supplied is somewhat limited for the object we have in view, we have the trachea always as our guide. (*Éléments de Pathol. Chirurg.* t. iii. p. 407.)

4. Boyer recommended the incision to be made between the sterno-mastoid and sterno-hyoid.

The mode of operating most generally preferred in Great Britain is as follows: The position of the patient being such as was before described, an incision is made to the inner side of the sterno-mastoid, and between it and the trachea, from the upper border of the thyroid cartilage down to within an inch and a half of the sternum, and dividing the superficial tissues,—skin, platysma, and fasciæ. These, with any vein which appears, are to be drawn aside by an assistant, with broad copper spatulæ. The cervical fascia is to be divided along the outer border of the sterno-thyroid muscle, and the head bent somewhat forwards, so as to relax the tissues. Some operators divide both the omohyoid, sterno-hyoid and sterno-thyroid, in order to obtain more room, and though no positive harm may thereby be done, yet no greater division of muscular or other tissue should be made than is absolutely necessary. The assistant may, by the use of spatulæ, greatly increase the space for the operator. The wound should, at all the stages, and especially the deeper ones, be carefully sponged so as to afford a clear view of the parts lying before the knife. The carotid is to be carefully avoided, as it lies on the outside of the incision, and the thyroid gland drawn inwards, while the veins are to be held to whichever side is most convenient, and the inferior thyroid artery in the lower part of the wound carefully avoided. If an instrument is to be introduced into the canal, in order to facilitate its incision, as recommended first by Vacca-Berlinghieri (Græfe and Walters, Jour. Bv. p. 712), now is the proper time for the manœuvre. The object held in view in the use of an instrument is to supply the place of a projecting foreign body, without which the surgeons before Vacca's time would not operate. Vacca's instrument resembled that used by lithotomists in the supra-pubic operation, but a considerable variety in construction has since been suggested. In some an ivory ball is made to press outwards in the wound, in others a grooved staff. In some it is proposed to pierce the walls from within outwards, by means of a concealed blade. If any assistance is required, a male catheter is quite sufficient for the purpose. There can be little doubt but that such aid is often of great consequence, as the canal is very small when relaxed, very difficult to recognise, and not easy to open when found. Its walls lie in close contact, and thus it has happened that an operator has passed to the one side, or passed altogether through both its walls. The trachea will serve as a guide to the œsophagus, when no instrument is introduced by the mouth. The rings and colour will distinguish the trachea, and then, immediately behind and between it and the vertebral column, the œsophagus will be found. The contractions of the tube, and the hard feeling it imparts if the patient attempts to swallow, will also serve to distinguish it. The recurrent nerve, lying in the grooves between the trachea and œsophagus, must be avoided with care. A small opening is at first made into the œsophagus, over the foreign body if possible, and afterwards enlarged to the necessary extent by blunt-pointed scissors, or a probe-pointed

bistouri. When the foreign body has been removed by means of curved polypus forceps, or any other appropriate method which may present itself, the wound in the œsophagus is to be closed, but the external incision allowed to remain open. No instrument for feeding the patient should be introduced either by the mouth or wound, but enemata used, and ice milk sucked in small quantities for a day or two, care being at the same time taken not to allow the patient to be starved, but a tube at once passed, and strong beef tea thrown in, if he shows signs of exhaustion.

It may be remarked in conclusion, that if foreign bodies are firmly impacted in the œsophagus, so that they cannot at the moment be removed, and if the patient runs the risk of suffocation, tracheotomy must be performed, in order to preserve life in the first instance, and the vital functions be re-established before renewing our attempts at extraction.

*Polypi* of the œsophagus are rarely met with. When present they are usually of the cellulofibrous description, and attached by a long stalk. The symptoms which they produce develop themselves slowly, and are those of obstruction, with a sensation of a foreign body being the cause thereof. Sometimes we have emaciation, persistent nausea, and vomiting added. Frequently the symptoms are very obscure, and the cause difficult to verify, but occasionally a careful exploration with instruments will satisfy the surgeon that he has a polypus to deal with, in that some movable body is present, that the obstacle to the freedom of the passage is not due to stricture, and that there is no evidence of malignant disease.

Polypi thus situated should be removed if possible by means of forceps—the foot stalk being seized and twisted. Or they may be snared with wire, or a ligature applied to the stalk, and the growth then excised with the knife or galvanic cantery, or as a last resource, if the danger of suffocation be great, œsophagotomy may be performed.

A certain amount of obstruction may be caused in the œsophagus from an hypertrophy of the epithelial lining occurring in patches, and which has been mistaken for warts and cysts. This is a rare pathological condition, but is yet occasionally seen.

*Wounds of the œsophagus* may be of any description, incised, punctured, &c., and are liable to serious complications from the depth at which the tube lies, and the important parts which surround it. A wounding agent can hardly penetrate from the surface without injuring some blood-vessel or nerve of importance, though, in the case of wounds from within, the injury in the first instance may be confined to the walls of the canal. Gunshot wounds of the œsophagus are usually very serious, not only on account of the immediate destruction they cause, but also from the complications which are so apt to attend them. In cases of suicide, the œsophagus is occasionally partially or even wholly divided, and yet even in the latter case recovery has sometimes followed.

When a wound of the œsophagus opens freely on the surface, the ingesta will escape, but if the aperture in the soft parts be not free, then most troublesome abscesses and sinuses are liable to form, and even fatal inflammation or gangrene from



the irritation caused by the escape of matters into the tissues of the neck may result.

Transverse wounds of the cesophagus should be carefully closed if possible by suture, and the wound in the soft superficial parts kept open till adhesion has taken place in the deeper structures. All abscesses should be at once opened, and any inflammation which may arise subdued. If the canal be entirely severed, the patient must be fed through a tube introduced at intervals through the lower orifice. This step has in at least one case had to be continued daily for many years, the divided tube having failed to unite.

In longitudinal wounds, no sutures are required, but by position the sides of the wound may be kept in contact, and adhesive plaster used to approximate the sides of the external opening.

The cesophagus has been ruptured during violent and prolonged attempts to vomit, and that in some cases where no evidence of pre-existing disease existed. This is a fatal accident.]

Geo. H. B. Macleod.

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**OLEUM CAMPHORATUM.** R. Olei olivæ, ℥j. Camphoræ ʒiv. Misce ut solvatur camphora. Sometimes employed for promoting the suppuration of indolent, particularly scrofulous swellings, which are to be rubbed with it once, twice, or thrice a day, according to circumstances.

**OLEUM LINI.** In surgery, linseed oil is sometimes used as an application to burns, either alone, or mixed with an equal quantity of the liquor calcis.

**OLEUM MORRHUÆ.** Oleum Jecoris Aselli, Cod liver oil. This oil has been very largely used during the last fifteen or twenty years. Its reputation has arisen chiefly from its beneficial effect in case of phthisis, but in surgical diseases also, especially those of strumous character, it is a remedy of very great value. It is constantly prescribed with excellent effect in scrofulous affections of the bones and joints, in glandular enlargements, and in cachectic ulcerations. It may be given advantageously in combination with iron, either Tinct. Ferri Perchloridi, or for children the Vinum Ferri. The dose of the oil for an adult is ʒ ss. twice or thrice daily, for a child ʒj. to ʒij. according to age.

**OLEUM RICINI.** In surgical cases, requiring the bowels to be opened with the slightest degree of irritation possible, and yet with certainty, oleum ricini is one of the best and safest medicines. The usual dose is one or two table-spoonfuls, which may be repeated, every two or three hours, till the desired effect is produced. It may be taken, floating on a little peppermint-water, or milk.

**OLEUM TEREBINTHINÆ.** In the article LINIMENT may be seen a formula, in which turpentine is an active ingredient. It was also strongly recommended by Dr. Kentish, when mixed with the ung. resinæ flavæ, as an application to burns. It is sometimes given internally for the relief of gleet, and various affections of the bladder and its mucous membrane.

**OLEUM TEREBINTHINATUM.** R. Olei amygdalæ ʒ ss. Olei terebinthinæ gutt. xl. Misco. In deafness, occasioned by defective, or diseased action of the glandulæ ceruminosæ, Mr. Maule directs a little of this oil to be dropped into the patient's ear, or applied at the end of a small dossil of cotton. The meatus auditorius externus should be cleansed every day with a bit of soft cotton affixed to a probe. (See *Pharmacop. Chirurgica*.)

**OLEUM TIGLII.** Croton Oil. This medicine is well known for its active purgative qualities in minute doses, varying from m ss to ʒ iij. It may be given on a bit of sugar. Some times it is blended with extract. Colocynth. comp. and administered in the form of pills. It is prescribed in cases attended with great torpor of the bowels, as in those of tetanus, injuries of the spine, &c. It should not be employed when any inflammation is present in the abdomen.

**OMPHALOCELE.** (From *ὀμφαλός*, the navel, and *κήλη*, a tumor.) A rupture or hernia at the navel. (See *HERNIA*.)

**ONYCHIA.** (*ὄνυξ*, the nail.) An abscess near the nail of the finger. (See *WHITLOW*.)

**ONYX.** (From *ὄνυξ*, the nail.) A small collection of matter in the anterior chamber of the aqueous humour, and so named from its being shaped like a nail. Others, imply by the term *onyx*, a small abscess between the layers of the cornea. The term is now rarely used.

[**OPHTHALMOSCOPE.** (*Augenspiegel*.) The ophthalmoscope (abbrev. os.) is an instrument used for examination of those parts of the eye in the living, which are situated behind the pupil. This instrument was invented in 1851 by a German—Heinrich Helmholtz—at present (1867) Professor of Physiology at the University of Heidelberg. We do not propose to enlarge upon the merits of the instrument, which will readily be recognised by comparing the results of the examination of the optic nerve, retina, choroid, &c., of the eye of the living, and the changes produced by these examinations in our ideas and treatment of amaurosis, &c., with those which were current before the use of the ophthalmoscope. We shall enter however into the description of the various kinds of ophthalmoscopes which have come into use since the first one introduced by Helmholtz. This description will be followed by a few remarks upon the mode of examining the healthy living eye with that instrument.

The description of the morbid changes of the tunics of the eyeball, and their appearance in health

as derived from the os. examination, is included in the remarks upon these tunics and to be found under the articles retina, choroid, vitreous substance, &c.

An excellent book, "The Ophthalmoscope, its Varieties and its Use," translated from the German of Dr. Adolf Zander, by Robert Brudenell Carter, with notes and additions by the Translator, contains most that has been said regarding the various ophthalmoscopes in use, and their mode of application. The greater part of the following article is, with the permission of Dr. Carter, taken from his book. Slight alterations became necessary through the impossibility of inserting drawings of the different ophthalmoscopes.

"*The varieties of the Ophthalmoscope,*" and the *principles on which they depend.*—When we look at the eye of another person the pupillary space usually appears black, and the interior of the organ does not return to the spectator a single reflected ray. We have here, therefore, an apparent exception to the well-known physical law, that the passage of light from one medium to another is never complete, and that some of the rays that fall upon the new medium are in all cases bent back again or reflected.

The reasons of the dark appearance are briefly as follow: Let us suppose that a luminous point is placed at such a distance from the eye that, by proper accommodation of the latter, an exact image of the point is formed on the sensitive layer of the retina. As the retina, notwithstanding its complicated elementary structure, is so far transparent that nearly all rays pass through it, and only a few are reflected by its surface, the former portion will reach the choroid, and will in great measure be absorbed by its dense layer of dark pigment. The darker the pigment, the more complete will be the absorption; but, as an absolutely black surface, capable of retaining all the light it receives, does not exist in the eye, some portion of the incident rays must always be reflected, both by the choroid and by the sclerotic beneath it. The reflection, if we disregard what is effected by the polished boundary membranes within the eye (the membrana limitans, choroidal epithelium, &c., &c.), is wholly irregular, and is dispersed throughout the entire vitreous body. If the fundus of the eye reflected light regularly, "it would have precisely the action of a concave mirror, and the observer with the ophthalmoscope would see only luminous reflection, or floating images of his lamp and his instrument, but not the vessels of the retina, the surface of the nerve, the vascular network of the choroid, and so forth." The irregularity of the reflection is proved also by the fact that, in an eye in which two excentric artificial pupils had been made, or in which partial irideremia was present, when the fundus was illuminated through one opening only, the reflected light returned equally and in the same quantity through both; and through both the colours and objects of the interior were perceptible. (Businelli.)

There is, moreover, still further evidence afforded by pathological conditions known to the earliest oculists, such as separation of the retina from the choroid by serous effusion, or cat's-eye amaurosis, as well as by albinos, in whom the iris is translucent. The brightness of the interior of albinotic eyes depends entirely upon the light diffused over every portion of the retina from the illuminated



iris, and not at all upon a more abundant reflection, in consequence of the deficiency of pigment, of the rays entering through the pupil. It has been shown by Donders, that such eyes present the ordinary complete darkness of the interior, as soon as they are protected by a screen having a small circular opening, through which light is admitted to the pupil alone, the general surface of the iris being in shadow.

Lastly, Helmholtz has suggested the experimental proof furnished by taking "a small camera obscura (for example, an artificial eye) well blackened within, and having an opaque white surface, such as a piece of thick drawing paper, placed in the position to receive the image. The eyepiece of a microscope, with the drawing-paper substituted for the ocular glass, will usually answer the desired purpose, as its tube mostly corresponds exactly with the focal length of its objective. It follows that this objective will form upon the white paper clear images of surrounding objects; and yet, if we attempt to look through the objective, the interior of the tube will appear absolutely dark. We have in this an apparatus analogous to the eye, the objective representing the cornea and crystalline lens, and the white paper representing the retina; and we find in it the same complete interior darkness as in the eye itself, so long as the paper is accurately placed to receive clear images of external objects. But if the objective be removed from the tube, or if its distance from the paper be considerably varied, the bright whiteness of the latter becomes immediately visible to the spectator."

Of the light reflected from the ocular background, a portion returns through the dioptric media, and passes out of the eye. But, in consequence of the action of the refracting apparatus, and especially of the cornea and crystalline lens, the incident and emergent luminous cones coincide precisely; inasmuch that, if the eye be exactly accommodated for any luminous point, the rays leaving the organ will return to and be again united in that point itself. The object and its retinal image are in the position of conjugate foci, and the rays proceeding from either focus are remitted in the other; so that every ray in its exit from the eye follows precisely the same course as in its entrance, and the image of the retinal image is formed only at the luminous object point. In order to perceive the returning rays, it is evident that the eye of the spectator must be interposed between the source of light and the eye that is illuminated, which cannot be done without cutting off the illumination from the latter.

It is just as little possible to perceive light from the eye of another person when the latter is exactly accommodated for the pupil of the observer. For, under these circumstances, a perfectly dark image of the pupil of the observer will be formed on the retina of the eye that is observed. Conversely, the dioptric media of the latter will return an image of this dark portion of the retina to the former, and the observer will, therefore, see nothing but the reflection of his own dark pupil.

Under certain conditions, however, we may see the fundus of the human eye shine with a reddish lustre. This is the case, if light, say from a lamp, is reflected with a glass plate into the observed eye; part of the light returns to the glass plate and is reflected back to the lamp; part passes

through the glass plate and comes to a focus behind it. If we place our eye behind the glass plate into the course of the rays returning through it from the eye, we see the pupil of the observed eye shine.

After this principle was announced by Von Erlach, Professor H. Helmholtz, then of Königsberg, and since of Heidelberg, was the first to discover the reason why the retina was not distinctly seen, and to find the means of rendering it visible. The problem was threefold: the observed eye must be sufficiently illuminated, the eye of the observer must be placed in the direction of the emerging rays, and these must themselves be changed from their convergence, and rendered divergent or parallel. The solution of the main difficulty was obtained, when in a darkened chamber the light of a lamp was allowed to fall on a well polished plate of glass in such a manner, that the rays reflected therefrom entered the eye to be observed. The observer placed himself on the other side of the glass plate, and made the convergent rays divergent by a concave lens.

The combination of such an illuminating apparatus with suitable lenses forms an instrument by which it is possible clearly to see and examine the details of the background of the eye of another person. To this instrument Helmholtz gave the name of "Eye-mirror," or "Ophthalmoscope."

*Ophthalmoscopes, with reflectors formed by parallel surfaces of glass.* Helmholtz's *Ophthalmoscope*.—This instrument consists of reflecting glass plates, which form the hypotenuse of a prismatic box, the section of which is a right-angled triangle. The other surfaces of this hollow prism are composed of metal, and in order that they may absorb light as completely as possible they are lined with black velvet. The smaller of the two sides that contain the right angle is so connected with the basis of the instrument that it can turn freely on its optical axis; and it has an opening corresponding to this axis. The glass plates are held together by a rectangular frame, which is secured by screws to the prismatic box. In order, with the unsilvered mirror, to reflect half of the incident rays, we may employ either a single plate of glass, or a greater number, lying superimposed upon one another. The necessary angle of incidence of the rays to be reflected is, for one plate  $70^\circ$ , for three plates  $60^\circ$ , and for four plates  $56^\circ$ .

In the metallic framework of the instrument is an axis, on which two discs revolve, termed Reuss's discs, each of which has five openings, and in eight out of the ten are placed a series of concave lenses, of from 6" to 13" focal length, the other two openings being empty. By turning the discs these openings can be brought one after another into the optical axis of the instrument, so that the observer, applying his eye to a basin-shaped eyepiece, may look through any of them, and also through the glass plates. In order that the discs may not change their position, they have indentations on their margins to receive the ends of two springs.

In using this Ophthalmoscope the observer sits close in front of the patient, and places at his side a brightly burning lamp. An opaque screen is then so arranged that it shades the face of the patient. The observer first brings the mirror nearly into its right position before the patient's

face, and so manœuvres it that the plates of glass throw their bright reflection into the eye to be examined; upon which, looking through the instrument, he will see the retina shine with a red glow. If he be unable to accommodate his eye for the vision of fine details, he must turn one of the discs with the forefinger of the hand that holds the instrument, until he has found the necessary concave lens. If the illumination of the retina should disappear, the observer looks for the bright reflection from the glass plates upon the face of the patient, and guides this reflection back again into the eye.

The advantages of this Ophthalmoscope are, that it allows us to observe exactly the position of the retinal image of the flame, and the changes of this image in accommodation for nearer or farther distance; and also that a healthy eye can bear its illumination for hours without becoming inflamed or blinded. The disadvantages are, comparatively feeble illumination of the fundus oculi, and disturbing reflection from the cornea, which last objection is diminished as much as possible by polarization of the light by means of four plates of glass.

The instrument is chiefly useful, however, in physiological observations and experiments; in surgical examinations, where a larger field of vision and good definition with less magnifying power are mostly required, the perforated mirror with a convex lens is found to deserve the preference.

The *Ophthalmoscope of Follin* is essentially the instrument of Helmholtz, rendered stationary, and with the addition of a convex lens, which, placed near the lamp, throws divergent light upon the reflecting plates.

The instrument consists of the following parts: the apparatus of Helmholtz with its reflecting glass plates, is connected to a wooden pillar by means of a hinge, which permits of revolution about its vertical axis. The concave lenses necessary as ocular glasses are secured in a frame, movable on its horizontal axis. The stand bears also a slender arm, on the end of which the light together with its chimney glass are fastened. This arm carries also a bi-convex lens, placed between the light and the instrument, which slides backwards and forwards.

The addition of a convex lens as an illuminating glass is unquestionably an improvement on Helmholtz's instrument, but is not a contrivance of Follin's, Helmholtz having first suggested it himself. The setting up of the lens in the vicinity of the flame is of little advantage, since in practice, the mirror being made dependent upon the line of direction of the rays, its mobility is hindered, and moreover, the variations of the focus of the rays that are necessary for the determination of different depths in the eye are rendered impossible.

*Helmholtz's "Simplest Ophthalmoscope."*—The surgeon and the patient seat themselves in a darkened chamber, with a table so placed as to interpose a corner between them, and with their faces about a foot asunder. If the right eye is to be examined, the table must be to the left of the observer, who places upon it a lighted candle at the level of the eyes, near to himself, and interposes a screen between his eye and the flame. The patient is then directed to look through the clearest part of the flame at some imaginary point in the

distance of the room and behind the observer, who himself looks in a direction close to the edge of the screen, and sees the observed eye illuminated, and the more strongly, the nearer his line of sight approaches to the margin of the flame. In blue and myopic eyes the illumination is stronger than in brown and normal eyes, but in these it is recognisable. As soon as the surgeon has found the best position of his eye for the observation, he interposes a convex lens of 1" or 2" focal length and half an inch diameter, and holds it close before the patient's eye. He then sees the iris and pupil slightly magnified, and is guided by the outer parts of the eye to place the lens without difficulty before the pupil, so that the red field of the fundus oculi becomes larger and larger until it overspreads the whole surface of the lens. The observer will then usually obtain a clear image of the retinal vessels, as distinct strongly marked red lines; but, if he should not see them clearly, he must remember that this image is not formed on the surface of the lens, but nearer to himself, and that he must therefore accommodate his eye for vision at such a nearer distance as the position of the lens may indicate. When the two eyes are 12" apart, the observer will have the image about 8" or 9" in front of him, and therefore at a convenient distance for normal vision; but, if he be either near-sighted or presbyopic, he will require the further aid of the same glass that he is accustomed to use for reading.

The *experimental instrument employed by Mr. Laurence* consists of a horizontal stem about a foot long, supported by an upright stand. Two small uprights slide in a groove on the upper surface of the stem, and carry, one a convex lens of 2" focal distance, the other a small square of plate glass, both so arranged as to turn upon their vertical axes. The light is furnished by an Argand burner surrounded by an opaque chimney with a single small opening, and the place of examination is otherwise completely darkened. The patient is placed about three feet from the lamp, the convex lens about 2" from the cornea, and the glass plate about 4" from the lens. The eye, the lens, the plate glass, and the flame, must all of course be perfectly on the same level, and their centres must be in the same straight line. More recently, Mr. Laurence has modified his instrument in the following way. He illuminates the eye by a lantern having only one opening for the exit of light, and places in this opening a convex lens of such power that the flame is in its principal focus. By this arrangement the rays proceeding from the lantern are rendered parallel. They pass through the plate of glass to reach the eye, and under ordinary circumstances, will retain their parallelism on their backward course. The bi-convex lens is then placed, not between the plate and the eye observed, but between the plate and the spectator, so as to unite the rays into an actual image after they have undergone reflection, instead of before. The image thus formed may be magnified by a second lens, and Mr. Laurence unites the two in a tube, which thus resembles an astronomical telescope, and levelled at the reflecting plate. Mr. Laurence proposes to convert this tube into a terrestrial telescope by the addition of an erecting eye-piece.

*Homocentric Ophthalmoscopes.*—The *Ophthalmoscope of Ruete*.—A pillar rising from a round



wooden foot, has in its axis a cylindrical wooden rod, sliding up and down, and retained at any desired height by a spring on its lower end. To the top of this rod is secured a brass semicircle, which may thus be raised or depressed, turned right or left, at pleasure. A concave mirror, of about 3 Paris inches diameter, and 10" focal length, with a central perforation, is attached to the semicircle by screws, so that it may turn upon its own horizontal axis. Halfway up the pillar are two wooden rings, turning freely. Each ring carries an arm projecting horizontally. One arm supports a blackened screen, the other is graduated in 12 Paris inches, and supports two vertical pillars, made to slide backwards and forwards. These contain small rods, sliding up and down, furnished with springs, and carrying the necessary concave or convex lenses.

To use this instrument, it is placed upon a small table in front of the patient, whose pupil has first been dilated by atropia, and who sits upon a stool in a darkened chamber. Upon a table near him, but on the contrary side to the eye that is to be examined, stands a lamp that can be raised or lowered. The perforation of the mirror, the axis of the dioptric lens, and the flame of the lamp, must all be on the same level as the eye. While the patient looks at the lens nearest to him, placed at a suitable distance, the observer directs the light, reflected from the mirror, into the eye; and then, sitting behind the screen, looks through the perforation. If it be desired, by means of the formation of a dispersion circle on the retina, to include a larger portion within the field, the lamp must be moved forwards or backwards; and if it be desired to diminish the illumination, a third or a half of the mirror may be covered by the screen.

For examination of a vertical, erect image, it is necessary to place in the vertical pillar farthest from the concave mirror, a concave lens of from 8" to 9" focal length. This should be distant from 1" to 3" from a short-sighted and from 3" to 5" from a far-sighted eye, but by sliding it backwards and forwards the exact distance required by the accommodation of any particular eye may be found. A short-sighted observer must use his accustomed spectacle glass. The inspection of the erect image is more especially useful in order to examine in detail the objects of the fundus oculi, and to determine their peculiar colours, as well as the transparency of the whole refracting media.

For examination of an actual inverted image, it is necessary to substitute a convex for the concave lens. If the vertical pillar, instead of carrying a concave, carries a convex lens of about 1" focal length, the observer will obtain, when this lens is distant 9" or 10" from his own eye, and about 1" from the eye of the patient, an inverted picture of the retina, magnified from 2 to 3 diameters, and showing the finest branches of the central vessels, small aneurisms, extravasations, and so forth. If two convex lenses be used, the first of  $1\frac{1}{2}$ " about 1" from the eye of the patient, the second of  $4\frac{1}{2}$ " about  $5\frac{1}{2}$ " distant; this combination will afford an inverted image about three times magnified, but apparently filling a larger field than the former. The annoyance of reflected mirror images may be removed by turning the lenses on their vertical axes, so that they stand somewhat obliquely to the optical axis of the eye. An

image magnified nine or ten times, is afforded by two convex lenses, one of  $1\frac{1}{2}$ " focal length, the other of 3", the first about 2", the second about 6" from the eye of the patient; but the steadiness of the eye required by this combination can seldom be obtained.

*The smaller Ophthalmoscope of Ruete.*—To obviate the somewhat difficult management of this Ophthalmoscope, and to do away with the necessity of having the patient's head supported by an assistant, Ruete has constructed a smaller, portable instrument, of which the following is a description: A small, centrally-perforated, concave mirror (of  $1\frac{1}{2}$ " diameter, and 4" to 6" focal length), is attached by a hinge-joint to a brass staff, like, but larger than, that of Coccius' ophthalmoscope. Behind the mirror is a spring clip to contain ocular lenses. Immediately below the hinge the staff carries a longer rod, divided into six or eight joints, sliding backwards and forwards, one upon another. At the farther end of this is a spring ring to carry concave or convex lenses. Above the handle is a cross-bar which carries a pasteboard screen on a short stem. This instrument gives very good images, but, in consequence of the length of the handle and arms, its management and its application to the eye of the patient are sometimes difficult.

*The Ophthalmoscope of Anagnostakis.*—This instrument consists of a small, round, concave mirror, 5 centimetres in diameter, having a focal length of  $4\frac{1}{2}$ ". Its silvered surface is protected by a blackened plate of copper. The centre of the mirror is perforated, the opening having a diameter of 4 millimetres. For convenience in use, the mirror is attached to a short handle. The manner of using is the same as for other ophthalmoscopes.

*The Ophthalmoscope of Ulrich* consists of two tubes, blackened within, and united at an angle of about  $40^\circ$ ; one of them enclosing the mirror and lenses, the other admitting the light to the first. The length of the first tube, which Ulrich calls the "ocular, or observer's tube," is about 5", its diameter 1" 8". The second, or "light tube" has a smaller diameter, and on its hinder margin a length of about 2"; greater length being forbidden by the necessity of keeping the source of light away from the patient's head. One end of the tube is provided with an opening half-an-inch in width, adapted to the eye of the observer; the other end is open in its whole diameter, and incloses the eye of the patient. Both are finished by proper margins. The free end of the second tube has a screen that shuts off side light from the observer, and acts also as a cover for the tube itself. The source of light can either stand alone at a distance, or be attached to the instrument itself; the light being held in a ring turning on a horizontal axis. This ring is furnished with a screen to cut off rays from the head of the patient.

In the ocular tube, close to the opening for the observer, is a small concave mirror of 1" 8" diameter,  $1\frac{1}{2}$ " central perforation, and 3" focal length, and two convex lenses; one of them being close to the opening for the eye of the patient. The mirror is set obliquely across the tube, so that its incident and reflected rays correspond with the axes of the two tubes respectively. Its distance from the opening of the ocular tube is about 4" Behind the mirror, separated from it by a perforated diaphragm, is the  $4\frac{1}{2}$ " ocular lens, fixed in

a movable sliding tube or eye-piece. The 1" object glass is placed in front of the mirror, and has attached to its setting a rod fastened to a button and a screw, which passes through a slit in the side of the ocular tube, so that the object glass can be moved to and fro, and fixed at any point. The ocular tube is also furnished with a draw tube, which serves to steady the apparatus upon the eye of the patient, and also to retain the eye in any desired position.

To use this instrument it is held in the left hand for examination of the left eye, and vice versa; while the free hand regulates the positions of the object lens and of the draw tube. With clear vision at a distance of 9", no elongation by means of the draw tube is required, but only movement of the object lens to the extent of  $\frac{1}{4}$ " or  $\frac{3}{8}$ ". In presbyopia, the tube must be lengthened  $\frac{3}{8}$ " or  $\frac{3}{4}$ "; and in myopia it may be necessary to move the object lens as much as 1", and to substitute a weaker ocular (a bi-convex of 6") for the one ordinarily employed.

For examination of the cornea, iris, or lens the ocular is removed by withdrawing the tube in which it is set; thus reducing the instrument to a simple magnifying glass. This ophthalmoscope can also be employed in daylight.

Its advantages for examination of the inverted image only are these: That the whole of the necessary apparatus is united in a portable form; and that the tube, by totally excluding side light, facilitates the perception of aerial images.

They are much out-weighed by the disadvantages of having the source of light united to the instrument; of having the object lens with its axis straight, so as to transmit reflected mirror images; and of having the mirror stationary.

*The Ophthalmoscope of Stelhvag Von Carion.*—It consists of a concave mirror, having a focal distance of some inches, perforated through the middle, and attached by a joint at its edge to a handle. By this joint the mirror can be set in any required direction. Behind is a Rekoss's disc with its axis of rotation eccentric to the mirror, so that, by turning the disc, any one of its marginal holes containing lenses can be brought opposite to the mirror opening.

*The Ophthalmoscope of Hasner* consists of a brass tube, in which a second tube slides freely, and is capable of being fixed in any position by a screw, which projects through a slit in the outer tube. A perforated glass concave mirror of 7" focal length, set in a metal back, is suspended by screws at the free end of the tube, and can turn upon these screws as on its axis. It receives the light from a lamp through an opening in the side of the tube. At the free end of the second tube a two-inch convex lens, set in a metal ring, is suspended by the screws in the same manner as the mirror. Behind the mirror is a spring clip, united to the tube by a joint, and capable of being set at any desired obliquity. The distance of the lens from the opening in the mirror is shown in Paris inches by a graduated scale, and may be increased to 8".

In use the observer holds the screws by which the two-inch convex lens is suspended with the thumb and index finger of one hand, the remaining fingers of which rest upon the cheek or forehead of the patient, and maintain the end of the instrument at a distance of from  $\frac{1}{2}$ " to  $1\frac{1}{2}$ " from his eye.

By means of the screws the necessary obliquity is given to the lens, so as to displace laterally the reflected images of the mirror. The ocular tube is held by the screws with the thumb and forefinger of the other hand, the side opening is turned towards a lamp suitably placed, and, by means of the screws such a direction is given to the mirror that the rays falling upon it are reflected down the axis of the tube into the eye of the patient. When this is illuminated, the details of the fundus oculi may be brought into view by sliding the tubes. For ordinary cases a single convex lens will be sufficient, but in high degrees of presbyopia it may be necessary to place a second, of 15" or 20" focal length, into the spring clip. The same may also be done in order to obtain a more highly magnified image.

*Professor Ryba* makes the spring clip much smaller, and connects it by a twice-jointed stem to the edge of the metal plate behind the mirror. By this arrangement the ocular lens can be accurately applied to the central perforation of the mirror in any oblique direction of the latter, and in any direction of the axis of the tube.

The merits of this instrument are (1) Being composed of solid metal it occupies little room and is very portable. (2) The inverted image of the retina is easily found, because the tubes slide freely, and because their considerable diameter renders it unnecessary to look exactly in the line of their axis. (3) Its connection with the patient by the hands of the observer keeps it steady in its place. (4) The mobility of the mirror renders it easy to give any direction to the instrument without altering the position of the flame. (5) The reflected images of the object-lens are readily set aside by shifting it. (6) The retinal image contained within a blackened tube, from which all side light is excluded, appears much more clearly than when formed in the open air. (7) The clip behind the mirror facilitates the application and removal of ocular lenses. (8) By the graduation of the tube the distance of the observing eye from the convex lens can be read off, and in known vision of the observer, and with the lens at a constant distance from the patient, the refraction of the latter can be determined, approximatively at least, by a comparison of different observations.

*The Ophthalmoscope of Williams.*—This instrument consists of two small concave mirrors, having a focal length corresponding to the distance at which the observer sees small objects clearly. They are set in a spectacle frame in such a manner as to turn on vertical axes, and this frame being worn by the observer, the light from a side lamp is directed into the eye observed. The advantage of having both hands at liberty, claimed by Williams, is far overbalanced by the evils of difficult adjustment and uncertain fixation.

*The Ophthalmoscope of Desmarres* consists of a concave mirror 4 centimetres in diameter, and of 7" focal length, with two parallel holes for the observer, according as he may examine the right or the left eye. An ocular lens of  $1\frac{3}{4}$ " is fixed to an opening in the handle of the mirror, and can be applied to either of the perforations.

Another instrument likewise used by Desmarres, consists of two concave mirrors, united together back to back. The two mirrors have different foci, one at 12, the other at 9 centimetres. Instead of a central opening there is in each mirror a



small one near the margin. The whole instrument, together with a convex lens, is mounted in a tortoise-shell frame.

*The Ophthalmoscope of Heyfelder.*—This consists of a small concave mirror, the size of an English florin, having a movable handle of blackened wood. In the centre the metal covering of the mirror has a circular perforation two lines in diameter, the glass itself remaining entire. The concave and convex lenses may be inserted in a movable black ring, that may either be attached to a second wooden handle and used by the free hand, or, more conveniently, may be fixed to a small cross-piece of brass on the mirror, and thus placed at a distance of from  $\frac{1}{2}$ " to 2", either before or behind it. In this arrangement the whole apparatus is managed by one hand, and the other is left at liberty to steady the head of the patient.

*The Ophthalmoscope of Soleil*, according to the description furnished by Dr. Castorani, precisely resembles in appearance a botanical lens. It consists of a common centrally-perforated concave mirror, of 20 centimetres focal distance, and 32 millimetres diameter, of a bi-convex lens of 55 millimetres focal distance, and of a handle. When closed, it is 8 centimetres in length, 4 in breadth, and 18 millimetres in thickness.

*The Ophthalmoscope of Cosco* consists of a hollow upright stem of wood 10" in height, and furnished with a screw by which it can be fastened to the edge of a table. In this stem a wooden pillar slides up and down, and is retained in any desired position by a spring at its lower extremity. Its upper end is united by a simple joint to a brass ring, which is lined with cloth, and carries a movable wooden tube. This again contains a sliding stem, and carries a brass ring with a jointed brass rod terminated by a little knob. It carries also a concave mirror, supported by a brass semicircle, and turning in the tube on its vertical axis. The stem also supports in the same manner a lens. The focal length of the mirror is 8", and that of the lens is 2".

*The Ophthalmoscope of Jäger.*—In order to unite in one apparatus the advantages of Helmholtz's, Ruete's, and other ophthalmoscopes, Jäger has constructed an apparently complicated instrument, the description of which belongs to this place, since it is chiefly used with a concave mirror.

It consists (1) of a short tube which turns on its axis in a ring attached to a handle. The tube at its anterior extremity is sloped off at an angle of 60°, and has two opposite slits for the reception of the trunnions of a mirror. Outside the tube are two springs corresponding to these slits, and serving to secure the mirror in its position.

Within the tube is a diaphragm with a central perforation, one centimetre in diameter. At the hinder end of the tube is a sliding ring, also with a diaphragm and a corresponding perforation. This ring can be easily removed and replaced, and serves to hold a lens between the two diaphragms.

(2) Of a concave mirror of 7" or 4" focal length, fixed in a metal ring with two trunnions, and protected on its silvered side by a thin metal plate. The latter has a central opening, two decimal lines in diameter, and the mirror itself is drilled to correspond.

(3) Of a metal ring, also with two trunnions, and holding three or more plates of plane glass,

which are secured by a second ring screwed into the first.

(4) Of a metal tube, of which the broader part is made to slide over the front part of the tube, the slits in the sides of the tube corresponding to springs and receiving them. In the narrower part this tube will contain either a single bi-convex lens, or two plano-convex lenses, or the objective of a Brücke's magnifier.

(5) Of a black paper disc of from 6" to 12" in diameter, slit to the centre and fastened to a metal ring, by means of which it can be placed upon the ring within which the tube turns, the slit corresponding to the handle of the instrument. The lines are a Vienna inch apart, and as well as the numbers, are coloured white.

The instrument is commonly supplied with eight concaves, Nos. 2, 3, 4, 5, 6, 8, 10, and 12, and with four convex lenses, Nos. 2, 6, 8, and 12, which fit into the hinder end of the tube.

By placing the ring with the plane glasses into the front of the instrument, we obtain Helmholtz's Ophthalmoscope by substituting the concave mirror, and holding a strong convex lens No. 2 or 3, before the eye of the patient we obtain Ruete's, and by placing the objective tube in its position, with the necessary convex or concave glass between the diaphragms, the instrument can be used as a magnifier.

To use this ophthalmoscope, the observer places himself close to and opposite the patient in a darkened chamber, with their eyes at the same level, and with the patient's eye under the influence of atropia. A brightly burning lamp should be placed upon a table, from 4" to 6" from the side of the patient's head, and sufficiently far back to leave the eye in the shade. The mirror being fixed in its slits, and the tube rotated until the trunnions are directed upwards and downwards, parallel to the handle, the oblique section of the tube is turned towards the light, and the instrument is held upright, close to the eye of the observer, in such a direction that he, looking along the axis of the tube, through the perforation of the mirror, sees the eye of the patient. With the free hand, the trunnions are then so far turned that the patient's eye becomes thoroughly illuminated by the reflection, and that the pupil coincides with the centre of the illumination. The disturbing reflections from the cornea may be displaced by giving slight obliquity to the instrument.

By inserting No. 10 concave, we obtain an erect retinal image magnified about twenty-four times. By using the concave mirror of 4" focus, and holding a convex lens of 2", 3", or 4" immediately before the patient's eye, we obtain a clear inverted image, magnified from twice to four times. For examining the transparent media, it is best to use only the plane glasses, or a convex mirror of 7" focal distance, and by placing between the diaphragms a convex glass of 12", 8", or 6", we obtain any desired degree of enlargement.

To use this as Helmholtz's Ophthalmoscope the ring with plane glasses and the necessary concave lens must be inserted, the lamp brought forwards, and the patient shaded by the interposition of a screen, the shadow of which should just cover his eye. To shield the observer from the light, and to steady the eye observed, the disc

may be slipped over the ring, and the patient directed to look fixedly at some row, or some individual figure or line upon its surface.

*The Ophthalmoscope of Liebreich.*—It consist of two small tubes, moving one over the other by a rack and pinion. The tube nearest to the observer, has a piece cut out of its side at the free end, where hangs a small metallic concave mirror on trunnions and spring clips, in such a manner that it turns readily on its vertical axis, and can be removed with facility. The other tube turned towards the patient, carries at its free end a convex lens of  $1\frac{3}{4}$ " or 2" focal length, hung in the same way as the mirror. The tube containing the lens is securely united by a ring to a standard, which supports the whole instrument, and is provided with a clamp, by which it can be screwed to a table. Above the tube, a quadrilateral brass stem, 4" long, and 3" broad, is attached to the standard, and made to slide horizontally backwards and forwards, and is fixed, when desired, by a screw. At its farther extremity it carries a padded metallic arc, which receives the forehead of the patient, and holds the face at the same constant distance from the object-glass.

The fixation of the head is completed by a chin-holder independent of the tubes; but, like them, moving up and down upon the stem screwed to the table. The chin-holder terminates in a padded cup, connected with the upright by two sliding bars, so that the cup can be fixed in any required position. In order to give a determinate direction to the eye of the patient, a jointed stem is attached to the end of the tube, and carries at its extremity a knob. By moving this knob, and directing the patient to look at it, any necessary direction of the eye may be obtained.

A small semi-elliptical screen, fixed behind the mirror, shelters the observer, and another somewhat larger, the patient, from the light of the lamp. The larger screen is hinged to the ring which unites the tubes to the vertical stand, so as to move in accordance with different positions of the lamp.

For more exact measurements, determinations of enlargement, and so forth, a scale of millimetres is marked upon the brow-holder, and also upon the inner tube, by which can be shown the distance of the patient's eye from the convex lens, and the distance of the lens from the mirror. The distance of the little knob from the eye, and from the axis of the tube, can be measured easily.

By means of a camera lucida the image formed in the tube can be thrown upon the surface of the table.

In use the instrument should be screwed to the corner of a table, and the patient and observer seat themselves with this corner between them. The tube must be placed at the level of their eyes, and the lamp opposite to the gap in the tube. The patient is secured as steadily as possible by the brow and chin-holders, with his eye distant from the lens about as far as its principal focus, namely  $1\frac{3}{4}$ " to 2". This done and the lens so arranged as to displace reflected images, the patient is directed to follow with his eyes the movements of the little knob, which may be fixed wherever necessary. The observer then commences the examination; for the conduct of which no special rules are required.

For microscopic examination Liebreich fixes

the patient's head as for the ophthalmoscopic, withdraws the tubes from their containing ring, and replaces them by the body of a Schieck's microscope. The brow-holder (fixed to the ring) and the chin-holder determine the distance of the eye from the object-glass of the microscope, which can be moved forwards and backwards in a horizontal direction. For the purpose of lateral illumination by oblique rays, a convex glass of  $1\frac{1}{2}$ " focal length is fixed to the ring by a jointed arm, and can be placed in any required position.

This manner of examination is especially useful in determining the seat of exudation or vessels in the cornea, in difficult diagnoses of the deeper diseases of the iris, in turbidity of the lens, of the posterior capsule, and even of the vitreous humour.

*The best form of Ophthalmo-Microscope* with which I am acquainted, is one that has been described by Professor Wecker, of Paris. The body of a microscope slides in a ring attached to a tripod with adjusting feet. Two of these feet rest upon the forehead of the patient, and one upon his cheek, and they are padded to render their pressure painless. To one side of the ring is hinged a jointed rod bearing a collecting lens to illuminate the surface of the eye. By this arrangement the ring of the instrument being held by the surgeon, the whole moves with every movement of the patient, and the focal adjustment is not disturbed. In consequence, however, of slight movements of the globe removing the part under inspection from the field of view, Professor Wecker has found a power of 80 diameters to be the highest available. For inspection of the surface of the cornea, he finds a power of 40, and for the crystalline lens or its capsule, a power of 60 diameters to be the most generally useful. The instrument is figured in *Wecker's Études Ophthalmologiques*, vol. i. p. 272, and could be made from the drawing by any optician.

For the purpose of very fine measurements Dr. Liebreich has lately added to his instrument a micrometer, contrived in the following manner:

A circular plate of glass, fitted exactly to the inner tube, is graduated horizontally and vertically in millimetres; and, to facilitate reading, every fifth line is made somewhat broader and longer than the others. This plate is fixed to a short stem that passes through a slit in the tube, and can be moved backwards and forwards, or turned upon its vertical axis. This turning, which is necessary, in order to displace reflected images, is rendered possible, by means of a screw on the stem, by which the plate is fixed at the required distance from the object.

If measurements be required in some other direction than the vertical or horizontal, the whole tube of the instrument may be rotated on its horizontal axis in the ring that supports it.

To accomplish photography of the fundus oculi, Liebreich employs a metallic concave mirror of short focus (also a Coccius's or Zehender's mirror) with a central perforation of about  $5\frac{1}{2}$ " in diameter. The mirror is so fastened to the objective end of a camera obscura that it may be moved to and fro, and may turn on its vertical axis. The camera is then arranged as for photography, and the operator allows a side light, either direct or condensed by a lens, to fall upon the mirror in such a manner that it is reflected through the dilated pupil of the eye of the patient so as to illuminate the fundus,



The returning rays, rendered convergent by the refracting media, pass through the hole in the mirror to the object lens behind it, and form beyond this an inverted image of the fundus. This image is received upon a plate of ground glass at the back of the camera, and when, by movement of the objective, the best possible position is obtained, the ground glass is exchanged for a prepared plate in the ordinary way, and the image is fixed.

This apparatus is especially useful for demonstrations of the inverted image, for exact measurements, and for drawings.

*The Ophthalmoscope of Follin.*—A new instrument contrived by Follin, for praising which the French can hardly find words enough, is, in essentials, nothing more than Liebreich's ophthalmoscope, with some small modifications.

The body of the apparatus consists of two brass tubes sliding one over the other by a rack. The tubes are blackened within, and contain diaphragms with large central openings. At the extremity, there is placed a bi-convex lens fixed in a brass setting, and movable on its vertical axis by means of a milled head underneath. At the other end there is a glass concave mirror, covered everywhere but at the centre, and likewise movable on its vertical axis. The entire body is made to turn upon a stand, and can be raised and lowered by the rack movement. By a screw, the stand is secured to a table. From the lower part of the vertical stand there proceeds a horizontal arm supporting the second upright, which carries a small socket, covered with leather, as a chin-holder. By means of a screw on the horizontal bar, the patient can be drawn towards, or removed from the object lens, and a similar arrangement on an upright provides for raising and lowering the head.

Behind the mirror is attached a ring to carry any necessary convex or concave ocular lens; and on the side turned towards the flame there is a small semicircular plate of metal to screen the observer from the light. The body of the apparatus is provided with a slender jointed stem, surmounted by a knob, to serve as an object to steady the eye of the patient.

By means of a prism adapted to the back of the mirror, the image that is formed can be reflected upon the surface of the table. The most important difference between the ophthalmoscopes of Liebreich and Follin is not mentioned in the text. In the former instrument, the portion of tube that carries the object lens is fixed to the stand, and the portion that carries the mirror is movable.

In Follin's ophthalmoscope, this arrangement is reversed. In the one case, therefore, the adjustment moves the mirror nearer to, or further from the stationary lens; and, in the other, the adjustment moves the lens backwards and forwards between the mirror and the eye of the patient. Each construction has some advantages, and it would not be difficult to combine them in a single instrument.

*The Ophthalmoscope of Deval.*—It consists of a glass concave mirror 35 millimetres in diameter, with a focal length of 25 centimetres, and a central perforation of 3 millimetres. The mirror is attached to a handle, to the back of which is attached a clip, turning on a pivot, and serving to hold an ocular lens.

*Liebreich's small Ophthalmoscope* consists of a small concave metallic mirror, protected at the back by a bronze covering, and screwed to a simple handle 12 centimetres in length. The mirror has a central perforation  $2\frac{1}{2}$  millimetres in diameter, with a sharp edge; and the larger perforation of the bronze setting is sloped down to it. The reflecting surface is 3 centimetres in diameter, and has a focal length of 8". To the edge of the bronze setting is attached a jointed limb, carrying a small spring-clip for holding any ocular lens that it may be necessary to place behind the mirror. The whole is sold in a portable case, which contains also two object lenses,  $1\frac{1}{2}$ " and 2" bi-convex, and five ocular lenses, a 12" bi-convex, and 6", 8", 10", and 12" bi-concave.

*Galenzowski's Ophthalmoscope* which was only introduced in 1862, presents the tubular arrangement in its most compact and convenient form. It bears a general resemblance to Hasner's, but with the following differences:—the end of the tube that carries the object lens is prolonged beyond it and sloped to fit the orbital ridge of the patient, so as absolutely to exclude side light. The lens itself has a movement backwards and forwards, and can also be turned on its vertical axis. The tube that contains the mirror draws in and out by two or three slides like those of a telescope, so as to combine great range of movement with comparative lightness and portability.

*The Ophthalmoscope of Coccius.*—It consists of a small square plane mirror, 14 Paris lines in diameter, and perforated in the centre. The opening is two Paris lines in diameter, and its front margin is somewhat bevelled. The mirror is fixed in a thin plate of brass, having on its lower border a projection, which, by means of a screw, is fastened to a stem. This stem is  $1\frac{1}{2}$  Paris lines in thickness, and, including the portion that holds the mirror, 21" in length. At its lower end it carries a cross-piece, which can be secured by a screw to the upper extremity of a handle. The cross-piece is 18 Paris lines long, with a slit extending half its length, by which, after loosening the screw connecting it to the handle, the convex lens it carries can be moved nearer to, or farther from the mirror. This convex lens, of 5" focal length, rests in a spring-clip upon a stand, so that the centre of the lens is opposite the opening of the mirror. All the metallic parts of the instrument are coloured black by caustic potash, and when taken to pieces, the whole can be carried in a small box. Recently, Coccius's ophthalmoscope has been made after a different manner. A thin blackened plate of brass, pierced with an opening 4" in diameter, is, by means of its grooved margin, made to slide upon the edge of the mirror. The outer side is connected by a double hinge to a spring-clip, for the reception of a lens. By sliding this apparatus over the mirror, the illumination is diminished; while by placing a convex lens of 5" focal length in the clip, a collecting lens is placed in union with the mirror itself, and the cross-piece and the convex lens are rendered unnecessary. The spring-clip can also be turned behind the mirror, and employed to hold an ocular lens. Coccius has still more lately employed with great advantage a smaller plane mirror, to which the collecting lens is united by a ball-and-socket joint.

In use the collecting lens is turned towards the flame, which should be at least some inches farther

from it than twice its principal focal length, and on the same level as the eye to be examined. By loosening the screw the mirror is set obliquely to the lens and to the eye of the patient; and when it is rightly directed, we see, by casting the enlarged image of the flame upon the patient's cheek, a luminous circle with a dark central spot corresponding to the hole in the mirror. The patient must now look fixedly at an object behind the observer, and on the side opposite to that of the eye under examination, and the dark spot must then be thrown upon the centre of the pupil, while the observer, with his eye as close as possible behind the mirror, looks into the eye of the patient. Dilatation of the pupil by atropia is not necessary. For examination of the inverted image, a convex lens of  $2\frac{1}{2}$ ", or less, often of 2", is used, and is held, either between the thumb and forefinger of the free hand, in front of the eye examined, or upon a handle 6" long, with a spring-clip at the top; while, in examination of the short-sighted, concave glasses are used, such as Nos. 12, 8, 6, 4, 3, or 2.

*The Ophthalmoscope of Epkens and Donders.*—

A plane mirror perforated in the centre is placed in a cubical chamber, and turns by means of a milled head. One opening in the side of the chamber is turned towards the eye of the patient, and the observer looks through the opposite opening, which is furnished with the revolving disc of lenses contrived by Rekoss for the instrument of Helmholtz. Donders places in this disc three positive lenses, of the respective focal lengths of 20, 3, and 4 centimetres (about 8",  $1\frac{1}{5}$ ", and  $1\frac{3}{8}$ "), and three negative, of 16, 10, and 6 centimetres (about  $6\frac{2}{5}$ ", 4", and  $2\frac{2}{5}$ "). Epkens has united to the cubical chamber a cylindrical tube, at the farther end of which, where a micrometer is attached, the lamp is placed. At this end of the tube when necessary a positive lens can be inserted, the focus of which should be a short distance from the flame; so that a person looking into the mirror sees the whole lens illuminated, by which means a larger surface of the retina is lighted up. The whole apparatus is placed upon a stand, which is secured by a screw to the table, and on which the tube can be raised and lowered at will. At the micrometer end is a circular screen, covered with black stuff, and serving to exclude direct or superfluous light; and, on the under part of the tube, and from a bar, there is suspended a curtain of oiled silk, that separates the faces of the patient and the observer.

In order to give greater mobility to the instrument, Donders and Van Trigt made the tube to which the micrometer is attached turn in a ring, and the cubical chamber turn upon an axis. The lamp is separate from the instrument; and for the examination of eyes with widely dilated pupils, Donders has lately added to the tube which holds the micrometer a cup-shaped dilatation, with a collecting lens of larger aperture than the one placed before the micrometer, in order to illuminate a larger portion of the fundus oculi.

The disadvantages of this instrument are, that from the number and complexity of its parts, its consequent costliness, its somewhat alarming size and appearance, and its want of portability, it is little suited to the wants of the practical surgeon. It is eminently fit for physiological research, and, for this purpose, especially, as it admits of meas-

uring the parts it exhibits, it cannot be too highly extolled. For the purpose of taking measurements, the instrument is furnished with a micrometer attached to the outer end of the cylinder, and scarcely requiring explanation. The points of the micrometer, placed between the flame and the eye observed, are in proper accommodation clearly seen (in shadow) upon the retina. Their position may be changed by moving the tube which carries the micrometer, upon a tube within. Upon the latter is a graduated scale, showing the distance of the points from the crossing-point of the lines of direction of the observed eye. The points can be separated or approximated by a micrometer screw, which is furnished with a scale to show their distance apart. Further, the cylinder with the micrometer revolves on the cylinder within, on its own axis; so that the two points can be brought into any part of the field of vision. If  $n$  be the distance of the points asunder,  $x$  their distance from the anterior nodal-point of the observed eye, 15 millimetres the distance of its posterior nodal-point from its retina, and  $y$  the distance between the retinal images of the points of the micrometer, then  $y = \frac{x}{n} \times 15$  millimetres.

By placing at the opening through which the observer looks, a tracing apparatus such as is used for a microscope, and marking the distance of the points across the vessels of the retina, it is possible to determine the exact size of these vessels, and of other structures of the fundus oculi.

*The Ophthalmoscope of Sämman.*—A little cylinder, that, as in Helmholtz's instrument, carries a convex (collecting) lens, is joined to a hollow cube, that turns on its horizontal axis, and has round openings in two of its opposites. Within, this cube contains a mirror, placed on a vertical axis. This mirror consists of a plate of silvered glass, the foil being removed from a small elliptical portion in the centre. In front of one of the openings of the cube, is a little frame, open above, in which necessary lenses can be placed, and from which they may be readily removed.

Like Burow, Sämman has found the revolving Rekoss's discs, to carry lenses, very convenient to handle. But a combination of two concaves on account of the stratum of air between them, does not give a perfectly exact image; and if twelve concaves were inserted in a single disc, this would be too large, especially as it would be required to carry convex lenses also. Burow has, therefore, fixed his lenses in a straight slide, which, when their use is required, can be moved up and down in a frame.

*The Ophthalmoscope of Meyerstein.*—Not satisfied with the working of his first ophthalmoscope, which will be described hereafter, Meyerstein constructed a second instrument. It consists of a cup, which serves to screen the patient's eye from light, so that this ophthalmoscope can be used in any room in the day-time. Immediately in front of the cup is a perforated plane mirror, enclosed in a rectangular box, and fixed at an angle of  $45^\circ$  with the axis of the instrument. The side of the box opposite to the reflecting surface of the mirror contains a collecting lens. On the opposite side of the box to the cup, is a second cup, which receives the eye of the observer, and cuts off 'false light,' or the light of the lamp.

For more exact examination of the retina, the



cup for the eye of the observer may be unscrewed, and its place supplied by a small telescope. In a normal or emmetropic eye, parallel incident rays are brought to a focus upon the retina. If light be thrown into such an eye, the rays become parallel upon their exit from it; and the telescope must be adjusted as if for the inspection of an object in infinite distance, while for far or near sight, the ocular must be more or less pushed in or withdrawn. For examination of the cornea, iris, or lens, the ocular tube must be drawn further out, and the telescope used only as a magnifier.

In comparing the merits and disadvantages of this instrument, the same may be said as in the case of Ulrich's; only that Meyerstein's is more difficult to handle, that the great distance of the observer's eye from the mirror considerably diminishes the field of vision, and that its power of illumination is altogether insufficient.

(b) *Convex mirror in combination with a convex lens.*

*The Ophthalmoscope of Zehender.*—It is a small convex mirror, placed on a short handle, and furnished with two lateral moveable arms, one of which carries the collecting lens, and the other a spring-clip for any ocular lens that may be needed. The handle is moveable, and can be screwed into the margin of the mirror at two opposite points, so as to turn the collecting lens to the right or the left at pleasure. The handle, acting as a lever, is apt to increase the very slight movements of the collecting lens that are often needed; and hence Arlt has dispensed with the handle entirely, and perhaps with some advantage, holds the instrument by one point, on the arm that carries the collecting lens. By this the size of the case is conveniently diminished, and the instrument, with its six necessary lenses, is rendered extremely portable.

The mirror consists of a circular, highly polished plate of metal, having a curvature of 6" radius. It is pierced in the centre by an opening, funnel-shaped from behind forwards, with a sharp edge, and with a diameter on the reflecting surface of  $1\frac{1}{2}$ ". The focal length of the collecting lens may be from 1" or  $1\frac{1}{2}$ " to 2" or even 3". If a concave or convex ocular lens be required in the examination, it may be placed in the second arm, which is furnished with a spring-clip and two joints, so that it may be turned behind the opening of the mirror, and so close to it as to be almost in the same place.

The optical principles on which this ophthalmoscope depends are briefly as follows: convergent rays of light, falling upon a convex mirror, are reflected parallel to the axis of the mirror, provided their degree of convergence be such that they would unite, if prolonged, at the extremity of its radius of curvature, in the so-called imaginary focus of the mirror itself, but, if they would intersect, or unite in the axis of the mirror, between it and its imaginary focus, divergent, and consequently their convergence or divergence increases the farther their point of intersection of the axis of the mirror is distant from the fixed extremity of its radius of curvature.

It should be further remarked, that in Zehender's instrument there is no loss of light from the canal of the perforation; and also that reflection from the cornea is reduced to a minimum.

The advantages mentioned in the last paragraph are obtained equally from the ophthalmoscopes of

Coccia and Liebreich, which are now universally made with metallic mirrors, and with sharp margins to their central apertures. The instruments of Coccia and Zehender, moreover, are frequently seen in more convenient forms than those described in the text, and so much alike as to be only distinguishable by inspection of the mirror, which is fixed in a bronze setting with a small spring-clip for ocular lenses, as in Liebreich's small ophthalmoscope. The setting is attached to a short handle, and at the point of junction there is a double-jointed rod, about two inches in length, turning either to the right or left, and carrying the collecting lens in a clip at its extremity. Besides the mirror and collecting lens, the cases commonly sold contain an objective and five oculars; the former  $1\frac{1}{2}$ " bi-convex, the latter 12" bi-convex; and 6", 8", 10", and 12" bi-concave.

(c) *Silvered Glass Lenses as Ophthalmoscopes.*—The chief purpose of silvered lenses is to unite together the reflector and the collecting lens. In describing the conditions under which this modification is available I follow chiefly the statement of Hasner. Every ordinary lens transmits only a portion of the light that it receives. A second portion is absorbed, a third is reflected, partly from the anterior, and partly from the posterior surface. The reflection, however, under ordinary circumstances, is so small, that it is insufficient for the illumination of an eye. But if one surface of the lens be covered with silver, or with quicksilver amalgam, the reflection becomes, under certain conditions, so considerable, as to afford as much illumination as the ordinary plane, or even the concave mirror.

The direction of the rays reflected from silvered lenses is very variable, and is determined not only by the radii of curvature of the covered and of the uncovered surfaces, but also by the power of refraction of the glass of which the lens is formed.

*The Ophthalmoscope of Jäger.*—As a simple ophthalmoscope, Jäger recommends a lens, the silvered and the anterior surfaces of which possess different curvatures; so that according as the centres of curvature lie upon the same or on different sides of the lens, the reflected rays that pass through its unsilvered central portion are refracted at their exit by the necessary concave or convex surface. The mirror is either furnished with trunnions, to be placed in Jäger's instrument already described, or with a simple handle, so that it may be used as a lorgnette.

*The Ophthalmoscope of Klaunig.*—This consists of a double convex glass of 14" focal length, having a diameter of 35 millimetres, and a central blackened perforation with a diameter of  $4\frac{1}{2}$  millimetres. On one side this glass is silvered as a mirror, and it is set in a blackened brass capsule. A handle, which screws into one side of this capsule, may by practice be easily dispensed with. As, in perforating the lens, the canal is often made too large, and the examination, therefore, rendered difficult, Klaunig has, recently, only perforated the cover, and has replaced the opening by a concave lens of 12" focal length, placed behind the silvering and united with the convex lens in a horn mounting.

The same rules apply to the use of these mirrors as to the examination in general. To make the observation less fatiguing, and the images per-

ceptible by an inexperienced observer, Klaufig uses a second mirror in the manner following: The mirror for the reception of the image is placed as near as possible to the eye of the patient, or about  $1\frac{1}{2}$ " distant from it, and at the same height. The eye of the observer being now placed in the proper direction, about 9" or 10" from this first mirror, a second concave perforated mirror of about 6" focal length is held before the observer's eye. Upon this second mirror the light of a lamp is allowed to fall, from a distance of 8", and this light is reflected to the first mirror, and from that in a concentrated cone, into the eye of the patient. In this way, the eye is thoroughly illuminated, and the retinal image, reflected from the first mirror, is seen by looking through the perforation of the second.

*The Ophthalmoscope of Burow.*—This consists of a simple lens, silvered upon one side, with the silvering removed in a central circle of  $1\frac{1}{2}$ " in diameter, and fixed in a setting of blackened brass. It is so ground that its focal distance for transmitted light is 5"; but that its silvered surface acting as a concave mirror, will bring rays received from a flame 10" distant to a focus at 6".

To examine the fundus oculi, a convex lens of from 1" to  $1\frac{3}{4}$ " focus is held before the patient's eye, and the mirror moved farther or nearer, according to the state of refraction, until the inverted image is seen in the focus of the lens.

Burow claims as the advantage of his instrument, that it facilitates ophthalmoscopic study for beginners—that is, that unpractised persons, by its means, can learn to perceive the retinal image with great readiness.

*The Ophthalmoscope of Hasner.*—This form of instrument is extremely simple. It consists of a circular periscopic dispersing lens, an inch in diameter, the convex side of which is silvered. In the centre, a small portion of the silvering is removed for a sight-hole, and the whole is put into a simple metal casing. For ordinary examination of the erect image, the surgeon should have four glasses, Nos. 4, 6, 8, and 12; but, for more exact examination, it is wise to have in reserve the almost superfluous and seldom needed silvered concave glasses. Six or eight such glasses, fitted into a case, form the most complete and the most compendious apparatus for the examination of the direct image.

In use, these glasses are held by the margin between the thumb and the index finger, and so turned obliquely towards the light, that a luminous disc is thrown upon the patient's eye. The eye of the observer is placed close behind the glass. The simple application and easy change of glasses, the compact form of the whole, the correction of reflections, the approximation of the observer's eye to the mirror, and of the mirror to the eye of the patient, are all reasons why this form of ophthalmoscope merits high commendation.

(d) *Prismatic Ophthalmoscopes.*—*Ulrich's Prisms.*—Professor Ulrich, of Göttingen, has the merit of having been the first to apply the complete reflection effected by prisms, to the illumination of the background of the eye. He took two prisms of glass, presenting in section the forms of right-angled triangles with equal containing sides, and so united them, that one containing side of the upper prism corresponded with the lower, and that the hypotenuse of one intersected that of the other at right angles.

*The Ophthalmoscope of Fröbelius.*—This instrument is a modification of the original ophthalmoscope of Helmholtz, suggested by the need of a brighter illumination, and consists in this, that instead of four plates of glass, Fröbelius fastened in front of the instrument a rectangular glass prism with plane sides, and drilled through from the hypotenuse to one side, so that rays from the flame, falling upon the hypotenuse, may be reflected into the patient's eye; and returning rays may be transmitted, without reflection, through the perforation of the prism and a concave lens, to the observer. For easy application of the concave lens, Fröbelius employs a Rekoss's disc, with glasses of Nos. 6, 8, 10, and 12.

*The Ophthalmoscope of Meyerstein.*—This, the first instrument contrived by Meyerstein, is formed of a plane-sided right-angled glass prism, perforated from one side to the hypotenuse, and fixed in a setting. The rays of light falling upon the side of the prism, reach the hypotenuse, and are from thence reflected into the patient's eye. The rays returning from the eye pass in great part through a canal in the prism, and thence, through the tube of the setting, to the eye of the observer.

*The Ophthalmoscope of Coccinus.*—It consists of a small rectangular unequal-sided glass prism, of which the hypotenuse is turned towards the source of light. The rays are refracted from the side next the observer, through the other side, to the eye of the patient. The prism rests on a short handle, which is screwed into a brass basis of the prism, and supports also the setting with a concave lens. The setting is open on the side next the prism, so that different lenses may be inserted and placed close to the prism. At the lower angle of the setting is a simple hinge-joint, by which the concave lens can be placed obliquely to the observer's line of sight, so as to obviate refraction.

The flame is placed near the head of the patient, and at the same level. The eye of the observer must be held close to the reflecting surface of the prism, and must be directed close to its angle.

For the sake of stronger illumination, Zehender employed prisms, of which the sides containing the right angle were ground to be either concave or convex as required.

While, on account of their total reflection, the illumination by prisms is very good, yet still their application in practice has more disadvantages than benefits. They are high in price, their management is difficult, and in repeated or very careful examinations, they become fatiguing, because, in order to inspect the whole surface of the retina, the position of the flame requires frequent alteration. Moreover, the observer loses the focus that is afforded by a concave mirror, or by a plane mirror united with a convex lens.

(e) *Solar Ophthalmoscopes.*—Under the expressive heading "A Sun Ophthalmoscope," Mr. Streetfield has published a communication received by him from Dr. Macdonald, of New York, who states that he has been in the habit of using solar, in lieu of artificial light, for the purpose of ophthalmoscopic investigation. The reflection from plane or concave mirrors being too dazzling, convex mirrors only are employed. Of these Dr. Macdonald uses two—one with a curve of 4" radius, and the other of 3". They are about 1" in diameter, composed of glass, and their silvering is removed from a central circle 1" in diameter. The patient



is placed with his back to the sun, and the examination is conducted in the usual manner.

*Binocular Ophthalmoscopes.*—*The Binocular Ophthalmoscope of Giraud-Fenlon.*—At the time when all optical instruments: spectacles, telescopes, microscopes, stereoscopes, and so forth, had been successfully constructed in accordance with the physiological principle of binocular vision, the ophthalmoscope was still left to stand alone. The law of its action, that the rays of light emerging from the eye return in the track of their incidence, seemed to present an insurmountable obstacle to the attainment of the conditions of binocular vision. Dr. Giraud-Fenlon, however, in considering the position of the actual inverted aerial image formed between the ophthalmoscopic object-lens and the observer, was led to inquire why the rays diverging from this image should not be seen as readily with both eyes as with one. He found the difficulty to depend upon the distance to which it would be necessary for the observer to retire. If the centres of the observer's eyes were from 2" to 2½" apart, the focal length of the objective 2" and the diameter of the pupil of the observed eye 3/16", the observer's eye would require to be 20" from the image. If the pupillary diameter were only 1/16", the other elements of the calculation remaining the same, the distance would have to be increased to five feet. It is apparent that, even in the former case, from loss of light and diminution of the visual angle, no details of the fundus oculi would be discernible.

Dr. Giraud-Fenlon next provided himself with a concave mirror of about 30 centimetres focus, and as large as that of the ordinary laryngoscope. In its horizontal diameter he made an oblong slit, 7 centimetres in length, and 6 millimetres in breadth, through which both eyes could look at once. By placing a lamp above and behind the patient, in a vertical plane with the eye to be examined, the pupil of which must be fully dilated, an observer may see the optic disc, say with the right eye, in the ordinary way. After a while he will see it also with the left eye, the two images partly overlapping one another.

The two images thus obtained have a great tendency to separate and to vanish behind the pupillary margin. By great practice, and very extreme convergence of the ocular axes, it is sometimes possible to unite them, and to produce a stereoscopic effect.

Having thus theoretically solved the problem of binocular ophthalmoscopy, Dr. Giraud-Fenlon sought to render his discovery available in practice. M. Nachet, jun., had long before constructed a microscope in such a manner that the actual image formed by its objective was divided by a system of prisms, and presented at once to both eyes of a spectator. Acting upon this principle, Dr. Giraud-Fenlon placed behind the mirror two rhombs of glass with their edges meeting on the vertical diameter of the opening, and their surfaces ground, to afford a complete double refraction at angles of 45°. By this means the rays proceeding from the actual image of the fundus oculi were divided, and, like those of stereoscopic pictures, were easily so united by the aid of lenses or prisms, as to afford an appearance of relief.

If the mirror and the observer's eyes are now brought nearer to the patient, and the instrument fitted with prismatic decentred convex ocular

glasses, as in the common stereoscope, the image assumes great magnitude. The eye under inspection disappears from view, and there only remains an aerial picture, relatively of immense size, "any description of which would be inadequate, and would appear exaggerated." From the extent of the image, and according to the well-known property of the convex glass, required at an objective, the whole surface will present an appearance of anterior convexity.

As already mentioned, the lamp for this examination is placed above and behind the patient, so that the rays pass over his head. The mirror is attached to a horizontal bar turning on pivots upon the horizontal box that contains the rhombs, and no lateral movements are required for the necessary illumination. The rhombs must be kept perfectly horizontal, and the eyes of observer and patient must be on the same level.

In this ophthalmoscope the distance of the actual image from the observer is less, by half the distance between the eyes, than in a monocular instrument. The mirror may, therefore, have a shorter focal length than in the latter, and the examination may be made from a nearer point. Myopic observers require simple ocular prisms of 7° or 8°. Hypermetropic, or presbyopic, require convex lenses, decentred by about one centimetre, which exert, moreover, a considerable magnifying power.

For the examination of the erect image, the mirror must be brought close to the eye, and the convex oculars replaced by concaves of from 6" to 10" focal length. Both kinds are decentred, and are placed, the concaves with their thin edges inwards, the convexes with their thin edges outwards. In Dr. Giraud-Fenlon's instrument, as made originally, there was no provision for altering the distance between the ocular openings. The instrument was altogether useless unless its width accurately corresponded to the distance between the eyes of the observer. A slight deviation from the proper width produced double images, and a larger deviation altogether excluded one eye from the visual act, and reduced the instrument to a monocular ophthalmoscope of inferior illuminating power. The exact fit required was not easily obtained, and especially in this country, where there was little power of selecting from a stock, was sometimes altogether unattainable. It followed that many observers failed to realize any stereoscopic effects; and that many doubts were cast upon the value of Dr. Giraud-Fenlon's beautiful and ingenious invention.

These doubts were, however, in a great degree set at rest by an improvement, which consists in leaving one of the rhombs entire, and dividing the other into two portions, the outer of which is moveable, and is governed by a screw. The apparent positions of the two images formed by the rays which come from the aerial image, is thus placed perfectly under the command of the spectator, and any instrument may be adjusted to meet the wants of various observers.

*Murray and Heath's adjusting binocular Ophthalmoscope.*—At the same time that Dr. Giraud-Fenlon was employed in contriving the improved or adjusting form of his own instrument, it was most happily suggested by Mr. J. Zachariah Laurence, that the division of the rays might be effected by four small mirrors, the two central ones

arranged as in the original (Wheatstone's reflecting) stereoscope; and that the outside mirrors would admit of adjustment, not only of distance, but, also, of inclination. An instrument of this kind was manufactured under the superintendence of Mr. Heisch, of the firm of Murray & Heath, Piccadilly, and succeeded admirably in practice. It was found, however, that the mirrors, if made of metal, would be liable to tarnish, and difficult to clean; and if made of silvered glass, they produced confusion by reflecting from two surfaces. Eventually it was necessary to substitute prisms for the mirrors; and by the joint labours of Mr. Laurence and Mr. Heisch, the instrument has been brought to very great excellence.

The power to vary the inclination of the ocular prisms, makes this ophthalmoscope independent of the decentred lenses required for Dr. Giraud-Fenlon's. Their places may therefore be filled by any spherical oculars that special circumstances may require.

The instrument consists of a horizontal metallic plate 1 centimetre wide and 10 centimetres long, with a central perforation. Behind this plate the central prisms are fixed, and the lateral ones slide in moveable settings furnished with an index and graduated scale, by which their distance apart can be read off at a glance. Their inclination is regulated by a screw that acts upon both of them at once. The mirror turns upon a pin on the upper part of the plate, and the instrument is completed by a moveable wooden handle. The metallic portions are constructed of aluminium bronze, and the total weight is thus reduced to 2 ounces and 50 grains. The case, as fitted up by Messrs. Murray & Heath, contains also an object-lens and the pairs of oculars, and is made of a shape and size convenient for the pocket.

I have found by careful experiments, that the binocular ophthalmoscope may be constructed for lateral as well as for vertical illumination, and that it may be fitted with the mirror and collecting-lens of Coccia's or Zehender's instrument. In this way it becomes much more convenient for the direct image. It may also be fixed to a stand, and rendered available for clinical demonstration.

As regards the difference between Dr. Giraud-Fenlon's instrument and that of Messrs. Murray & Heath, any comparison is greatly in favour of the latter. The power to alter the inclination of the reflecting surfaces is most valuable. It gives perfect rest to the ocular muscles of the observer, which have no longer to adapt themselves to pencils of a given divergence, but receive exactly what they require. It allows of the ready displacement of reflected images of the mirror, and thus greatly clears the field of vision. It also allows, by the removal of the ocular prisms, amplifying lenses of higher power than these prisms to occupy their positions, and thus affords more enlargement of the image. The English instrument is, moreover, much less heavy than the French one, which weighs four ounces, and which is, therefore, less convenient both for the hand and the pocket.

*Auto-ophthalmoscopes.*—*The Auto-ophthalmoscope of Coccia.*—The first complete instructions for self-examination with the ophthalmoscope were given by Professor Coccia, whose statements are here followed.

In commencing the examination, a plane mirror is held perpendicularly before the eye, close to it,

and in such a position that the optic axis is directed to the inner edge of the central perforation. A waxlight should then be placed behind the mirror, in the continuation of the optic axis, so that the inner edge of the mirror, the plane, and the optic axis are all in one line; the mirror is then inclined at a small angle from the eye (from the temporal side), upon which an image of the flame becomes visible in the mirror, close to the actual flame itself, and deviates inwards from the latter (towards the nose) as the inclination of the mirror is increased. A slight movement, which allows the image of the flame to deviate somewhat upwards and inwards, will then bring the reflection of the optic disc and vessels into view. In order to follow the course of the central trunks, which mostly proceed upwards and downwards, it is necessary to guide the image of the flame upon them, after having first diminished the light by the interposition of a strong concave lens, or of a diaphragm with a small perforation.

For complete and thorough self-examination with the ophthalmoscope of the optic nerve, retina, and choroid, it is necessary to dilate the pupil, to use a lamp for illumination, and to place a convex collecting lens behind the mirror. Coccia employs a steel plane mirror with a sharpened central perforation, and recommends, according as the observer can bear more or less dazzling (which cannot be entirely obviated), a collecting lens of from 2" to 3" focal length. The dazzling will then not be greater than that which is experienced in being examined by another person with an object lens of 2" for the inverted image. The best view of one's own fundus is obtained by holding, with the free hand, a convex lens of 2" or 3" focal length, at from 1" to 2" behind the mirror; or a weaker lens, of from 4" to 6" focal length, close to the lamp. For self-examination of the refracting media, Coccia employs with greater success two mirrors, in the manner first proposed by Leydeler. After having dilated the pupil of the eye to be examined, a perforated plane mirror is placed before the other, and so inclined that its image of the flame is reflected by the second large plane mirror, upon the eye under examination, an illuminated image of which will then be seen in the second mirror. If it be desired to inspect the media of the left eye, the perforated mirror is therefore placed before the right eye, and so directed that its image of the flame falls upon the second mirror at a proper angle to be reflected into the left eye. As soon as this is the case, the right eye, through the opening in its mirror, will see the illuminated image of the left eye in the second mirror. In order to test accurately the transparency of one's own crystalline lens, Coccia employs as his second mirror a concave of 4" or 5" diameter, and 26" or 24" focal length. The lamp is best placed laterally, in front of the eye to be examined, which must be screened from its direct light.

As advantages of autoscopia, Coccia points out that the examination affords proof, by allowing the red vessels to be seen when either no part, or only a part of the flame itself is visible, that the fibrous layer (of the retina) is insensitive to light, and that the bacillary layer is not a simple catoptric apparatus; since, if it were so, the experiment would not succeed. It allows, moreover, of simultaneous subjective and objective examination, since the light from the optic nerve and its vessels



is partly distributed upon the contiguous portions of the retina, and being perceived by them, is by our imagination transferred to the blind spot. Further, it may be observed that near the borders of the optic disc, the light of the candle flame begins to be more white, in consequence of the deficient choroid no longer returning red rays. Lastly, it is of great interest to observe precisely the boundary between the bacillary bodies and the optic nerve. A small ring at the margin of the optic disc is well known to be sensitive, and it certainly is so, as far as the bacillary bodies extend. The autoscopic examination teaches the observer that the subjective image of the candle flame is abruptly cut off where the clear objective image ceases. The knowledge of these circumstances, and an exact acquaintance with the optic disc of one's own eye, the difference between veins and arteries, the form of the nerve and its physiological boundaries, are all of great assistance in the recognition of disease, and afford a standard of the natural appearance of the disc in respect of colour, condition of surface, and other particulars. The discovery of the nerve in the eye of another person is also facilitated by the practical knowledge gained upon oneself, that its position is not central, but somewhat below the horizontal meridian of the eye.

The auto-ophthalmoscope of Coccijus is now sold in a very simple form. It consists of a brass tube  $5\frac{1}{2}$  centimetres in length, and 3 centimetres in diameter, closed at one end by a plate perpendicular to the axis of the tube, in which is set a plane mirror of highly-polished steel, 2 centimetres in diameter, with its reflecting surface turned outwards, and with a central perforation 3 millimetres in diameter. The tube is blackened within and carries at its other extremity a  $3''$  bi-convex lens, covered by a metal plate having a circular eccentric perforation, with a diameter of 12 millimetres, that extends from the centre of the lens to its circumference. With a very little practice and knack, the optic disc can be readily brought into view, but an examination of the whole fundus oculi is difficult and tedious. The field of vision is very limited indeed, and the eye has to be turned in all directions, and examined bit by bit, in order to see as large a portion of the retinal surface as can be scanned at one glance in the eye of another person. Moreover, the principle of the apparatus renders it impossible to see the macula lutea. Many of these disadvantages have been obviated by the invention of the instrument next to be described.

The *Auto-ophthalmoscope of Heymann* affords to one eye a vertically inverted image of the fundus of the other; in order to examine the left eye with the right.

The various parts of Dr. Heymann's very ingenious apparatus are inclosed in a box, supported on a stand, and furnished with two ocular openings like those of a common stereoscope, and with the various screws and milled heads necessary for the purpose of adjusting the mirror, lenses, and prism. The side of the box that is undermost in examining the right eye must be turned uppermost in examining the left, by which means the necessary reversal of the whole instrument is effected. It would be useless to describe here in detail the several mechanical arrangements, the purposes of which will at once become apparent when the instrument is taken in the hand.

For use, it is necessary in the first place to adjust the distance between the ocular openings to suit the spectator, and then to place a brightly burning lamp behind the mirror. On looking into the apparatus, if the illuminated fundus be not in view, it must be sought by very gentle movements of the mirror and prism; and as soon as a trace of it is perceived, it will be easy to guide it into the centre of the field of vision. This done, the lenses should next be so moved as to bring out the details of the picture.

#### *The Auto-ophthalmoscope of Giraud-Fenlon.*—

In this instrument, by a contrivance equally simple and ingenious, the whole of the fundus of either eye can be rendered an object of vision to the other, either in the inverted image or the erect.

The apparatus consists of two plane mirrors, inclined to one another at a right angle and placed in front of the observer. An ordinary object-lens is placed between the left eye and the mirror opposite, and an ordinary ophthalmoscopic mirror is placed in front of the right eye in such a manner as to receive rays from a flame placed to the right side of the right eye, and to reflect them directly upon the plane mirror in front of the right eye. The practical effect is, that the rays leaving the left eye, instead of proceeding straight forwards to an observer in front, are twice bent at a right angle, and brought back to the right eye without any change in their relative positions.

The *Auto-ophthalmoscope of Zehender*, which was contrived in order to facilitate self inspection of the excentric portion of the retina, is essentially the same as that of Dr. Giraud-Fenlon.

It consists of two plane mirrors, so arranged that they can be inclined towards one another at any necessary angle. A lamp is placed at the side of the observer, facing one of the mirrors. The first, or illuminating mirror, reflects rays from the flame into the eye, and also reflects a portion of the returning rays towards the second mirror, by which they are again reflected in the visual axis of the observer. If the eye be emmetropic, and the emergent rays parallel they will be united into an erect virtual image of the parts from which they come. If the emergent rays be convergent, they may be rendered parallel, or divergent by substituting for the second plane mirror a convex one, of which the radius of curvature should be double the negative focal length of the concave lens that would produce the desired correction. If the illumination be otherwise insufficient, a concave mirror may be used instead of the first one, but if this be done, the second mirror must in any case be convex. For parallel rays, its radius must be equal to, or somewhat less than that of the first; and for convergent rays, its radius must be still farther diminished according to the degree of their convergence.

#### *The Examination with the Ophthalmoscope.*—

(1) If it be desired to inspect carefully some single point of the fundus oculi, a fixed instrument will be found the most desirable, but it will be far less adapted for a more extended survey. With the fixed instrument the observer sees only from a distance, that is to say, he has before him an image of the retina at his distance for clear vision. While by this he is spared all exertion of his eye, it must not be forgotten that he loses that sharpness of perception which we obtain, as if from a magnifier, by the close examination of objects.

With fixed instruments, moreover, a careful inspection of the periphery of the ocular fundus becomes very difficult, since for this purpose the patient must turn his eye in all directions, and will often be required to give it a degree of obliquity that he will be unable with any steadiness to maintain.

"The moveable mirrors are free from the above-named defects, and can be so managed as to display all parts behind the equator of the eye, without any considerable changes in the direction of the organ. They require, however, if used for the examination of the erect image, far more practice and dexterity than the fixed instruments, since it is necessary for the observer, in spite of his proximity to his object, to maintain accommodation of his eye for distant vision, and also to hold the mirror with great steadiness, partly in order to keep the image in his field of sight, and partly in order not to dazzle the patient by to-and-fro movements of the reflecting surface, such being among the greatest disadvantages of ophthalmoscope examination." (*Heymann*.)

For clinical demonstration, or for observation with little study or practice, or for purposes of exact drawing or measurement, the large instruments must be preferred, in which the different parts of the ophthalmoscope, and the eye examined, are all fixed as steadily as possible. Among these, the best are those of Liebreich, Follin, Epkens and Donders, and the larger one of Ruete; while, for hand use, the small, cheap and portable forms, and especially those of Coccius, Zehender, and Hasner, deserve the preference. In most cases, too, a simple concave mirror (the ophthalmoscope of Anagnostakis) will suffice, if the following proportions be observed: Its focal length should not be less than 5", nor more than 10", its diameter about 5 centimetres, and the diameter of its central perforation not more than 3 or 4 millimetres. Glass mirrors, from which only the metal is removed, are preferable to those with a central perforation. When ocular lenses are required, they must turn easily upon their axes, so as to be applied closely to the back of the mirror.

(2) *With regard to the illuminating powers of different ophthalmoscopes, the following observations are made by Zehender:* The faintest light is that which is reflected from a plate of unsilvered glass, when the angles of incidence and reflection are 70°. It is necessary, however, to take into account the distance of the reflecting surface from the eye under inspection; because there is, for everyone, one determinate distance at which it will receive more light than at any other, and within or beyond which the degree of its illumination diminishes. Simple concave mirrors direct upon the examined eye a cone of light, having the reflecting superficies for the base, and of greater intensity the shorter the focal distance of the mirror. Experience teaches, however, that only mirrors of considerable focal length are available for ophthalmoscopic examination, and that, if their focus be nearer than 6", they are wholly useless. If a cone of light be thrown upon the eye from a distance by a concave mirror of considerable surface, only those rays will penetrate the organ that strike the cornea within the limits of a circle the size of the pupil. If the mirror be brought nearer to the eye, there will be found a position at which all the rays reflected from it enter the pupil; but this will be at too great a distance to allow of ex-

amination of the erect image of the retina. If the observer bring the mirror near enough for this purpose, by far the greatest part of the light will fall upon the iris, and the pupil will receive only those rays that are reflected from the immediate border of the central perforation, and that does not afford an illumination stronger than that of a plane mirror. Simple concave reflectors, therefore, do not give sufficient light for close observation, although their action is extraordinarily good in the examination of the inverted image.

The light reflected from a plate of silvered glass is the incident light in undiminished quantity. Coccius first used such a mirror, and obtained with it about the same illumination as with Helmholtz's instrument. He, however, increased its action by employing a convex lens to cast an enlarged image of the flame upon the mirror. In respect of illumination, the improvement thus gained was as if the plane mirror were exchanged for a concave of a focal length equal to that of the lens, with the additional advantage that, by changing the lens, this focal length could be varied to meet the requirements of any particular case. For the purposes of examination, this arrangement possessed a still greater advantage over the concave mirror, since the eye of the observer is, with the former, brought actually within the cone of reflected light, instead of being placed behind its base, as with the latter. It is obvious that with the plane mirror and lens, the virtual base of the light cone will be as much behind the mirror as the actual source of light is in front of it, after allowing for the virtual approximation of the flame to the mirror that is affected by the lens. But, in such a combination, the focal length, and the size of the image of the flame, increase and diminish in the same ratio, and in such a degree that in concentrating the light upon a portion of the mirror not much larger than the pupillary diameter (in which case alone no light is wasted) the marginal rays undergo a considerable spherical aberration, which renders them useless for the purpose of illumination. In Zehender's convex mirror, however, this spherical aberration of the marginal rays is much diminished, and interferes much less with their illuminating power; since both axial and marginal rays, when reflected from a convex mirror, have a considerably greater focal distance than when reflected from one that is either plane or concave. It follows from these considerations that it is best to use a concave mirror for the inverted image, and, for the erect image, the mirror of Zehender or Coccius. The merits of Hasner's silvered lenses have been already pointed out and explained.

The observer who requires a fixed instrument must always be of the minority, and its use will be almost limited to surgeons in consulting ophthalmic practice, to those who have to instruct students, and to those who have opportunities and leisure to make careful drawings of the appearances they observe. For all these purposes, the large ophthalmoscope of Liebreich answers admirably; but I should think the modification of it contrived by Follin would be in many respects more convenient. The mobility of the object lens itself, as well as the power to draw the patient gently towards it, or to make him recede from it, without altering the field of vision, and without moving the eye of the observer, would often be highly valuable. Such instruments should be obtained only from English makers. The



foreign ones that I have seen have been at once dear and bad. The threads of their screws are always defective; the parts that should be steady quiver and shake, the parts that should glide easily stick fast, the parts that should be immovable slide downwards, in tardy and reluctant obedience to the law of gravitation. By the time that all the faulty portions have been replaced in this country, the instrument will be far more costly than one originally of English construction, made to work as smoothly and easily as a microscope from the first. I trust my readers will take warning from this experience.

I have found that the most convenient method of using a stationary ophthalmoscope is to attach it to a small table constructed for the purpose. My own has a surface of about a foot square, and is supported by a strong central column heavily weighted at the base. In practice, this arrangement possesses many advantages over the corner of a larger table.

The small foreign instruments are generally cheaper than the English, often much cheaper, and, if of simple construction, are fully equal to them. The hand-ophthalmoscopes of Liebreich, Coccius, and Zehender, are largely imported from Berlin; and may be obtained of excellent quality from any instrument-maker or optician. The binocular instrument of Dr. Giraud-Fenlon, is made chiefly by MM. Nacet et fils; and in consequence of the number they manufacture certainly cheaper than elsewhere. Messrs. Murray and Heath's instrument has been made only by themselves. The difference between the effects produced by binocular and monocular ophthalmoscopes is very considerable, and, for a beginner or an inexperienced observer, is very important. In order to estimate this difference correctly, it must be remembered that the difficulties of ophthalmoscopy are twofold. There is, first, the difficulty of seeing, and then there is the difficulty of interpreting what is seen. Of these, the first is much the same with all instruments; but the binoculars reduce the second to a minimum.

In using the monocular ophthalmoscope of Coccius or Liebreich for the inverted image, in spite of abundant light and perfect definition, the details of the picture appear to be all in the same plane. The vessels of the retina can be distinguished from those of the choroid by colour and direction, but not by any appreciable difference in their position. The depressions formed by choroidal atrophy or posterior staphyloma, and the elevations from sub-retinal hæmorrhage or effusion, present colours which contrast with those of the general field, but scarcely any appearances by which, prior to reflection, their sunken or raised position can be positively determined. Even the cupped disc, the most marked of the surface changes of the fundus oculi, betrays itself chiefly by the bending of the vessels at its margin, and, by inexperienced observers, is often mistaken for an elevation. It may fairly be said, I think, that the limited power of one eye to furnish data for correctly estimating relief, is the chief source of difficulty in the interpretation of ophthalmoscopic appearances.

With a good binocular ophthalmoscope this difficulty vanishes. The difference between the appearances presented by the two methods, is like the difference between the appearance of a tree growing in a field and a tree painted in a picture.

Not only is the depressed optic nerve immediately recognised as an unmistakable cup or cubity, but even small effusions of blood or lymph, or serum, on the one hand, or patches of atrophy on the other, present aspects that are conclusive with regard to their relations to the general level of the field. The vessels of the retina, too, are seen to stand out from, and to be distinctly on a plane anterior to, those of the choroid; which, again, in young light eyes, with good illumination, may be distinctly traced to different strata of the membrane.

For those surgeons who have obtained a thorough mastery of the older forms of the instrument, and with whom the process of eliminating optical illusions, or of using the data by which relative position can be determined, has become almost instinctive, the binocular ophthalmoscope is only so far advantageous as the picture it presents is more beautiful. But for less skilful observers it is of high practical value. There are few ophthalmoscopic questions more important or having a greater bearing upon diagnosis and prognosis, than to determine whether a given mass of pigment be infiltrated among the retinal tissues, or deposited beneath the retina, in the choroide. It is of equal importance to be able to recognise with certainty the commencement of serous sub-retinal effusion. By binocular vision, all these conditions can be determined at a glance; by monocular, if at all, only after protracted and possibly hurtful examination. It follows, I think, that, by observers who desire to learn the use of the ophthalmoscope quickly, and to avoid errors of interpretation, after having had but small experience, the binocular instrument should be unhesitatingly preferred.

For the erect image the binocular ophthalmoscope possesses little advantage over the older forms, and even when adapted for lateral illumination, it is not so easy of use. For this purpose, therefore, it is not calculated to supersede the ophthalmoscope of Zehender; but it is still quite available in the hands of an observer who will take the trouble to master the difficulties of manipulation. For the erect image, it will generally be needful slightly to approximate the prisms. The respective merits of the different binoculars have been sufficiently noticed in the former section.

Before purchasing a binocular ophthalmoscope, it is prudent to make certain of the possession of binocular vision. This is not universal, and those in whom it is wanting, are often unconscious of their deficiency. The test is very simple: the eyes should be directed towards a candle-flame, or other convenient small object, at a distance of eight or ten feet, and a prism of  $16^{\circ}$  or  $20^{\circ}$ , with its angle towards the nasal side, should be held before one eye. With binocular vision the result will be either two images of the object, or an internal strabismus very manifest to a bystander. If neither of these consequences follow, a binocular ophthalmoscope will be wholly useless.

With regard to the choice of a monocular instrument, I find myself compelled to differ from Dr. Zander in two particulars. First, with regard to the utility of the simple mirror; and, secondly, with regard to the superiority of a concave mirror for the inverted image. My own earliest attempts at ophthalmoscopic investigation were made with the simple mirror, the so-called instrument of Anagnostakis. I have long since wholly dis-

carded it, not because it will not suffice for many cases, but because it will not suffice for all. I am convinced that difficult investigations will be most successfully conducted with an instrument that is, from daily use, perfectly familiar to the observer; and for this reason I confine myself to a mirror that carries a magnifying lens behind it.

With regard to the concave mirror, I should, until very recently, have echoed Dr. Zander's statement, and should have agreed with the opinion of Mr. Hulke, that Liebreich's small ophthalmoscope is the best and most convenient for the inverted image. Lately, however, the contrary testimony of very skilled observers has induced me to investigate the question with some care, and to compare the performance of different ophthalmoscopes upon eyes well adapted for testing them. I have come to the conclusion that my former preference was the result of habit, and that the best ophthalmoscope for the inverted image is, beyond all question, that of Coccious. It illuminates the fundus somewhat less brilliantly than Liebreich's, but more uniformly; it is less interfered with by reflections of the mirror from the cornea, and by images of the flame upon the retina of the eye examined; it affords better definition, and permits the use of a higher magnifying power; lastly, though inferior to Zehender's for the erect image, it yet shows it very fairly, and in a manner far superior to Liebreich's.

*Preparations for the Examination.*—Among the various forms of ophthalmoscope already described, only those of Ulrich, Meyerstein, and Galenzowski, and the large instrument of Liebreich, are adapted for use in the daytime, without any disturbing influence of daylight. For all others, the first essential is a moderately darkened chamber. The second essential is a good light. It is possible to use the sun's rays, admitted through a small opening in a closed shutter; but, on account of the great uncertainty of this light, of the dazzling that it produces, and of its inequality from the passage of clouds, it is not to be recommended. Practically the best light is that of an oil-lamp, burning with a clear and steady flame, covered only by a chimney-glass, and so arranged as to be raised or lowered at pleasure. A naked candle-flame may be used for very susceptible patients, to reduce the dazzling to a minimum. With regard to the position of the light, it should be the rule of a beginner to place it near the head of the patient, on the same side as the eye to be examined, and so far back as to leave the cornea in shadow. It is also important that the flame, the eye of the patient, and the eye of the observer, should be all at the same level.

For binocular ophthalmoscopes, as already mentioned, it is necessary to have a vertical instead of a lateral illumination. Partly from the ready mobility of the burner, and partly because the intensity and size of the flame can be regulated at will, I am disposed to think that gas affords the best light for all ophthalmoscopic purposes. The most convenient bracket is one that may be seen at the Royal London Ophthalmic Hospital, Moorfields, and that possesses a universal movement, upwards, downwards, and to either side, while the chimney of its argand burner remains always perpendicular. The burner itself may be either of metal or porcelain, but should be closed underneath by fine wire gauze, to subdivide and regulate the

draught. There should be two taps, or, if only one, it should be remote from the flame, so as to check the pressure from the meter, and to prevent noise in combustion. These arrangements not only afford, above the blue part of the flame, a perfectly steady and motionless cylinder of white light, but they give the power of regulating the height of this cylinder at pleasure, and of placing it exactly in any desired position for any kind of examination. The next best arrangement is an upright moveable burner, made to stand upon a table, and connected with the gas-pipe by an elastic tube. The bracket with universal movement is, however, of such great general utility, that it cannot be too strongly recommended as an essential part of the fittings of the consulting room. It will be found invaluable for laryngoscopy, especially for the application of instruments to the larynx; and it will greatly facilitate many procedures about the mouth, nostrils, and ears. There are probably few practitioners who have not experienced the difficulty of getting any assistant to hold a light in the exact place where it is wanted.

"Since," as Hasner has very forcibly remarked, "it is perfectly intelligible that the laity should be alarmed by being brought into a darkened chamber, by the use of artificial light in the daytime, and by the application of mysterious lenses and reflectors, it is proper, even if fear be not expressed, in every case to avoid making a mystery of the ophthalmoscope. More especially to timid patients the nature and objects of the examination should be first carefully explained."

*The position of the lamp and of the patient being arranged,* the latter must next be shown a point in the distance, behind the observer, at which he must look fixedly. As the anterior pole of the axis of the optic nerve corresponds to the outer third of the cornea, the fixing point for vision must be to the left side of the head of the observer when the left eye is examined, and *vice versa*. If the patient, as for example in total blindness, be unable to direct his eye by the sense of vision, he may still often do so by muscular sense, if his own finger be placed in the position or direction towards which his eye should be turned.

It is desirable to keep the patient as still as possible, and at the same time distant from the lamp; and it is best when the eye can be opened wide without assistance. When it is necessary to hold the lids asunder the irritation often produces a considerable flow of tears, and makes the patient restless and unsteady.

Special attention must be paid to the condition of the pupil of the eye examined. If this be much contracted, which, from the sudden influx of light, would usually be the case at the beginning of the examination, only a small cone of rays will be admitted, and only a small portion of the retinal surface will be illuminated. In such cases the pupil must be dilated, either by covering the other eye, or by directing the patient to accommodate for his far point; or, lastly, by the use of a mydriatic.

Two grains of extract of belladonna, dissolved in a drachm of distilled water, will produce sufficient dilatation; but the best mydriatic agent is the sulphate of atropia, for applying which Professor Donders recommends the following solutions:

(1) Gr. iv. in ʒi. aq. destill. (gr. j.-3 ij.) as a preparation for operations; to avert threatened synechia, closed pupil, or prolapsus iridis; and to



restore vision in cases of central cataract, or central opacity of the cornea.

(2) The first solution diluted with 15 parts of water (gr. i.— $\frac{3}{4}$  iv.) to produce complete dilatation and immobility of the pupil, so as to allow of examination of the interior of the eye in all directions. The dilatation is produced in from 30 to 45 minutes, and the sight is commonly disturbed only for about 24 hours.

(3) The first solution diluted with 80 parts of water (gr. i.— $\frac{3}{4}$  xx.), 1 in 9, 600, for common use. One or two drops of this solution, retained for a few seconds between the lids, will give in from 30 to 60 minutes a sufficient dilatation to examine the eye in most cases. The dilatation will continue from 8 to 36 hours. By some practice it is possible, however, in the great majority of cases, to see the details of the fundus oculi, and to form a diagnosis, through a moderately narrow pupil, without artificial dilatation. The attempt should generally be made, since there will always be opportunity to dilate the pupil afterwards, if the general inspection should display occasion for a more special one. In many cases, however, as in diseases of the choroid, glaucoma, and so forth, this will not be necessary, and the pupil will be wide enough. In many other cases the morbid phenomena consequent upon mydriasis, the dazzling, obscured vision, and disturbance of the accommodation, will be very troublesome, or even hurtful.

The necessity for a mydriatic may frequently be obviated, and the contraction of the pupil diminished, by making the examination with blue light, which has the additional advantage of being more pleasant to the observer. The merit of this suggestion is due, I believe, to Dr. F. Argilagas, of Cuba, who employed a mirror of blue glass, silvered at the back, and with only the silvering removed from the sight-hole. After this, a blue chimney-glass came into very general use; and a screen has lately been recommended by Mr. Ernest Hart and others. This may be of cobalt blue glass; or if it were desired to transmit the rays only, it might be made of two plates of white glass, cemented together, and inclosing, as in Dr. Boehm's tinted lenses, a film of a solution of ammonio-sulphate of copper or of Prussian blue. My own practice formerly was to use the blue chimney-glass, but latterly I have preferred a blue object-lens, made by cementing a plane glass of the A tint between two plano-convex lenses of the required power. With such a lens it is necessary, of course, to place it in front of the eye, before the reflection from the mirror is allowed to fall upon the pupil. M.M. Janssen and Follin have lately contrived an apparatus that can be fitted to any lamp, and that carries a screen of any desired tint. It is well adapted for the consulting room, but the blue lens has the advantage of ready portability. The same advantage attaches to the atropinised gelatine, recently introduced as a substitute for mydriatic solutions.

*Conduct of the Examination.*—All preparations being made, the observer takes the concave mirror in the hand that is on the side towards the lamp, places its upper edge against the superior margin of his orbit, and looks through the perforation at the eye to be examined; he then causes the mirror to turn a little on its vertical axis, until the inverted image of the flame is cast upon the eye under

examination, the pupil of which will then return a more or less intense reddish or whitish glow. For a general inspection of the refracting media, it will be sufficient to look at the eye from different distances, and to cause it to make slight movements, upwards, downwards, and to either side. If no diseased conditions be apparent, the observer proceeds to examine the inverted image of the fundus. For this purpose he takes a bi-convex lens, of 2" or 3" focal length, in the thumb and index finger of his free hand, rests his little finger upon the forehead of the patient, and brings the lens in front of the examined eye, so that the light from the mirror, passing through this lens, will be concentrated upon the pupil. The actual inverted image of the fundus will now be found between the lens and the observer, in the focus of the former; and, to render it visible, the observer must usually move his head somewhat farther back. This movement requires considerable practice, since it is especially necessary, in executing it, to maintain the mirror in unchanged direction. Even for a sound eye, and far more for a diseased one, unexpected to-and-fro movements of the cone of light will soon become unbearable. The distance of the lens from the examined eye should be such as to make the focus exactly coincide with the pupil. For this purpose the pupil itself affords the best standard. When the pupillary margin limits the field of vision, the lens is too near the eye. As the distance between them is increased, the pupil enlarges, and finally, in the focus of the lens, its margin disappears. The distance of the mirror from the lens must be the focal length of the latter, added to the distance for clear vision of the observer. The first object to be sought within the eye is the entrance of the optic nerve. Sometimes, before its white surface becomes visible, darker streaks may be seen traversing a bright red ground. These will be the vessels that proceed from the entrance itself, and by following one of them, in the direction of its increasing thickness, towards the inner and inferior part of the eye, by movements of the observer and mirror in the opposite direction, the white surface of the optic disc will presently be perceived.

At the beginning of the examination, as soon as the nerve surface is found, it is desirable—since the eye of the observer has then a distinct object of sight, and the eye of the patient is accommodated for its far point—to form, by the clearness of the central vessels, a judgment of the state of refraction of the eye, by which the selection of a concave lens for the erect image may be assisted. The fine arterial twigs, passing over the nerve surface, serve as test-objects for more accurate determination.

After inspection of the nerve surface, attention should next be directed to the vessels, to observe whether they present a normal condition at their place of entrance, to note their course over the white disc, and their conduct at and after passing to the red background. After the vessels should be observed the transparency of the retina, its relations to the choroid and to the nerve entrance, next the pigment-layer of the choroid, and then the observer should return to a more careful and accurate study of the entrance to the nerve; lastly follows the inspection of the refracting media, the vitreous body, the crystalline lens, the cornea, and then that of the iris.

When the habit is once acquired of commencing at the nerve entrance, and studying the topography of the inner eye from behind forwards, so to speak, it will be easy to examine cases in which the crystalline is impaired or the retina detached, or in which one side of the globe is obscured.

*Difficulties of the Examination.*—Every honest observer will have to acknowledge, at the commencement of his investigations, that he has only succeeded in seeing a luminous reddish disc, and will find that he requires continued practice in order to learn the use of the ophthalmoscope; and what is even more important, to understand the appearances it reveals—precisely as practice is needed in order to obtain skill in auscultation, or in tactile examination. Difficulties arising from this cause cannot, of course, be entirely obviated; but still there are certain sources of trouble to the learner about which information may be given, and which are briefly referred to in the following paragraphs.

The first of these difficulties depends upon the presence of the object-lens, and upon the reflection of its image in the mirror by the cornea of the examined eye, a reflection that may prevent the possibility of accurate examination. In order to displace it, the eye under examination should be slightly moved, and the object-lens somewhat rotated upon either its vertical or its horizontal axis; it may also be necessary to alter the position of the flame. The small, bright, round image of the mirror may, by an inexperienced observer, be mistaken for the optic disc itself. The presence of a dark spot in the image, corresponding to the central perforation, and the absence of vessels, are the indications by which this error may be avoided.

It is not at first easy to obtain the proper relative distances between the eyes of patient and surgeon, and between the mirror and the lens, that are necessary for clear images. On this subject, however, directions have been already given.

Another difficulty may be that the examiner, in spite of brilliant illumination, obtains no clear definition; and this may arise from a mistaken endeavour to use the greatest possible amount of light. Many objects are best shown by moderate illumination, and a very brilliant light, may itself be a source of erroneous diagnosis. Experience shows this to be the case in opacities of the media, which are more clearly seen in front of a dimly lighted fundus than against strong illumination; it is, therefore, prudent to use a moderate degree of light for studying the topography of the eye, and especially for determination of the relative depths of objects; and to advance to further illumination only when the localities are known, and for any object that may specially require it.

A final difficulty, especially in the erect image, is the proper accommodation of the eyes of the observer. The short-sighted, and persons generally who are unaccustomed to the use of optical instruments, experience this difficulty, that they involuntarily accommodate the eye for its near point, when the object of vision is close to them; on account of this their eyes are readily fatigued, and soon suffer from congestion and lachrymation. With the ophthalmoscope, as with all optical instruments admitting of adjustment, it is necessary to accommodate the eye for its far point, and to arrange the apparatus accordingly. Heymann advises the use of concave glasses in ophthalmo-

scopic examination, as an exercise of accommodation; since in using a stronger concave than is necessary for correction, although the image will appear smaller, the greater the difference between the refraction of the media and the compensation of the lens, yet this small image is exceedingly clear and sharp. Then by degrees using weaker glasses with continually nearer approach to the eye examined, and at the same time with continual endeavours to accommodate for greater distance, the image of the retina may be seen at last without optical assistance.

I proceed now to the consideration of certain physical conditions, in order to explain the means by which a clear image of the fundus oculi can be obtained.

The human eye, in respect of its refraction, resembles a strong combination of positive lenses. If such a combination be placed between our own eye and any object, the object is rendered visible under certain definite circumstances, as an erect, or as an inverted image, and under other circumstances it becomes invisible. The visibility of the object is chiefly determined by its relation to the focal point of the combination of lenses, partly by the distance between the lens and the eye, and also by the greater or smaller range of accommodation of the observer. If the object be either at the focus of the lens, or a little within it, the observer receives either parallel or slightly divergent rays, and unites them into an image upon his retina; but at the same time, as the object is seen under an increased visual angle, it appears erect and magnified. This statement, moreover, of the visibility of an object situated in the focus of the lens, only applies to observers who possess normal power of accommodation; for if the observer's eye be so constituted that it can only accommodate for near objects, the object in the focus will not be visible, and the object and the lens must be brought nearer together in order to obtain an erect image. The object continues visible, however, whether the eye of the observer be close to the lens or distant from it; only the greater the distance, the smaller will be the field of vision, from the loss of the marginal rays of light.

If an object be placed beyond the focal point of the lenses, then the divergent rays proceeding from the object are so refracted in their passage that they become convergent, and unite to form an inverted image on the other side. This image is larger the farther it is from the lenses, and the nearer the object is to the focus. It is only clearly visible when intercepted at the common focus of all the pencils of light entering into its formation; but, if this common focus be very far distant, the image, on account of imperfect definition and illumination, again becomes imperceptible, and cannot be seen either upright or inverted.

When we come to apply these laws to the system of refraction of the eye and to the retina as an object of vision, the next question is, where is the retina? Does it lie within, in, or beyond the focal point of its own refracting media. The reply is, that it may be found to occupy any of these positions; but we can seldom ascertain which prior to examination, particularly in cases of blindness. If vision remain the point can be certainly determined by the distance, farther or nearer, at which objects can be clearly seen. If



without the help of a lens the patient cannot clearly see either near or distant objects, the retina lies within the focus, since no rays are united into clear images (hypermetropia). If there be good vision at long distance, then the retina is in the focus, since parallel rays are united upon it (emmetropia). And if it be necessary to bring objects very near the eye, then the retina lies beyond the focus, and receives images only from divergent rays (myopia).

When we know the relation of the retina to the focal point of the eye, and see it with good illumination, it is easy to deduce whether in any particular case it will be visible in erect or inverted image or not, and it can be deduced farther, as we shall proceed to show, in what manner a clear image can be obtained.

(1) *The Examination of the Virtual Erect Image.*—If we assume that an eye to be examined is thoroughly illuminated, its pupil widely dilated, and that its fundus is observed by a person of normal or far-sighted vision, the retina may be clearly seen in the absence of a lens, without accommodation for the far point, but if the eye to be examined is accommodated for its near point, or if it be unable, as in myopia, to accommodate for a distance, its retina will be invisible in the erect image, because situate behind the focus of its refracting apparatus. In such a case, the patient, if normal sighted, (emmetropic) must accommodate for distance, but if short-sighted, and unable so to accommodate, the focal length of his refracting media must be increased artificially, so that the retina may come to lie in, or in front of the focus. This object is attained by the interposition of a negative lens. In general, the glass selected must be one or more degrees stronger than that habitually used by the myope, so as to place his eye in a state equivalent to one accommodated for infinite distance, and for this purpose the dispersing lenses of 2", 4", 6" and 8" negative focal length are chiefly used.

If the eye examined be blind, there is no means of ascertaining beforehand which place the retina occupies in relation to the focal point, and, therefore, what glass will be required to render it visible. The question can only be determined by experiment.

If the observer be himself short-sighted, he must make his eye equivalent to one that is emmetropic, by the use of a negative lens of shorter focal length than that which he uses habitually. In examination of an emmetropic eye, he will therefore require a weak negative lens, and in examination of a myopic eye, a stronger one than would be required by an emmetropic observer.

The field of vision, obtained in the direct method, is not limited by the dimly seen pupillary margin. In order to determine its proper boundary we may imagine lines drawn from the pupillary margins of the eye observed to the observer, and having their crossing-point in the centre of the observer's pupil. If these lines be considered as rays of light, emanating from this centre, we find that the observer's field of vision upon the retina of the observed eye corresponds to a dispersion circle, in which the central point of the pupil of the observer presents itself. If this central point, or rather its image seen through a concave lens be situated in the first focal point of the eye, the dispersion circle will then be equal in size to the pupil of the eye observed. Usually, however, the

eyes of the observer and observed are not near enough to each other for this, and then the dispersion circle corresponding to the field of vision will be smaller than the pupil of the eye observed, and smaller still, the farther the observer is remote. (Helmholtz.)

(2) *The Examination of the Actual Inverted Image.*—It has been already stated that a simple or compound lens possesses the property of exhibiting an object that lies somewhat beyond its focal point, in a magnified and inverted image, and that this image is visible when intercepted at the point of union of all the pencils entering into its formation. This property of lenses may be brought into application in examining the retina through its own refracting system, for, if the retina be at a sufficient distance behind the focus, or if we diminish the focal length by optical means, we obtain an inverted image of the retina at a short distance in front of the eye, and we may see this image clearly by withdrawing from it so far as our own visual power may require. Luminous objects are visible to our eyes from different distances, accordingly as we may be able to accommodate. If proper accommodation be made, there will be formed by focal union of the rays of light upon the retina a clear, inverted image. When, therefore, we perceive the inverted retina of the examined eye as an illuminated membrane, we know that the rays of light proceeding from it are united to form an image, for which our own eye is accommodated.

If we inquire into the utility of such an actual image for the examination of the fundus oculi, the answer will depend upon its size and brightness (both of which are determined by its distance from the eye represented), and also, more especially, upon its being visible to an observer. To the unaided eye, however, the image is generally invisible, on account of its smallness and dimness. It is, therefore, necessary to use optical means in order to bring it into view. If we consider the retina to be illuminated by a flame or mirror, situated in the far point for which the eye is accommodated, so that an inverted image of the flame is formed exactly upon the retina, then the rays leaving the eye will return by the same course that they pursued in entering, and coming under slight divergence, they, therefore, return convergent. If now a convex lens of short focal length be placed a few inches in front of the observed eye, the rays passing through the lens to enter the eye will be strongly refracted, and will be united in front of the retina in the vitreous body, so that they will proceed overcrossed to form a dispersion circle on the retina. The rays reflected from the fundus of the eye will also be united, after they have again passed through the lens in its focus, where they will form an inverted image of the circular illuminated portion of the retina; and this image, if regarded from a proper visual distance, will be clearly visible to the observer. It is necessary that the observer should look at the focal point of the convex lens, in which point the aerial inverted image will be seen. Since the obscurity of the image increases with its size, and with its distance from the eye, it is generally advantageous to be content with moderate enlargement, and to use glasses of 2", 2", 3", 3", or 4" focal length; although lenses of such strong refraction have the

disadvantage that their foci are very small and narrow, and, therefore, are lost by the least movement of the eye, and that with increasing strength of the lens, the intensity of the light for the observed eye is increased. In the description of the several ophthalmoscopes, it has been already stated that numbers of convex glasses should be used with each.

In this method of examination the short-sighted observer can approach nearer than the far-sighted, and it will be advantageous for the latter to approximate his eye to the image by the use of a weak convex ocular glass. If the eye examined be blind, it can only be determined experimentally whether any or what lenses will be required. The inverted image may be magnified by a second convex lens. The rays from the inverted image reach the observer slightly divergent, but by a second lens they may be rendered less divergent, and will appear as if they came from the direction of a continuation of this less divergent course, and from a point nearer to the eye of the patient, determined by the intersection of the peripheral rays.

The arrangement of the combination of two lenses necessary to obtain a highly-magnified image, may be, according to Stellwag, by a combination of two convex lenses behind the opening of the mirror, so that the anterior will bring the inverted diminished image within the focal distance of the second. The enlargement will be very considerable, and the object will be seen inverted, as its inversion by the first lens will be left unaltered by the second.

Or, by placing before the observed eye a convex lens of shorter focal length than its focal distance from the hinder surface of the mirror, and looking at the inverted image thus produced through another convex lens placed behind the mirror, and of a focal length greater than its distance from the image formed by the first lens, the enlargement will be more considerable, the greater is the focal length of the first lens (so long as this is less than the distance between the two), and the greater the magnifying power of the second.

Or, by placing before the observed eye a convex lens, and intercepting the convergent rays returning from it by a concave lens behind the mirror. In this case the convex lens must have a focal distance greater than the sum of the distance between the lenses added to the focal distance of the concave.

In order to obtain considerable enlargement of the inverted image of a myopic eye, Liebreich proceeds as follows: He holds a convex lens of greater focal length than the distance for which the examined eye is adjusted, at a somewhat greater distance in front of it than the focal length of the lens. The refracting media of the eye then form an image in the plane of the distance for which the eye is accommodated; and this already strongly magnified image is seen through a glass, the power of which is, indeed, very limited, since the object is too far within its focus, but which can at once remove the image of the iris, and enlarge the field of vision.

Let it be supposed that the examined eye has a myopia =  $\frac{1}{3}$ , so that its far point is at a distance of only 3"; and that a lens of about 4" focus is held about 4" or 5" in front of it. There will then be a highly magnified inverted image of the

fundus, distant 3" from the eye itself, and  $1\frac{1}{2}$ " or 2" from the lens. By the latter, on the one hand, the image is enlarged, and, on the other, the inverted image of the iris is projected in a larger size and at a greater distance, so that it does not confine the field of ophthalmoscopic vision. The distance at which the observer must place himself will depend partly upon his own accommodation, and partly upon the strength and position of the lens and the position of the image—matters that can be easily determined by trial. It will be found, without reference to exact accommodation for the image, that the observer cannot depart much from a certain definite distance without diminution of the field of vision.

Everything situate at, or within the principal focus of the eye examined, may be seen erect with the mirror alone. Thus the retina of an emmetropic or hypermetropic eye, a detached retina, and an intraocular morbid growth or foreign substance, may be seen in their natural positions without an object-lens.

Everything situated beyond the principal focus of the eye, such as the retina of a myopic eye, or the bottom of a deeply excavated nerve disc, may be seen inverted with the mirror alone. Everything situated at, or not much within the focus, may be seen inverted by the interposition of a convex lens. The inverted image appears to move in a direction contrary to that of the movement of the head of the patient or of the observer, and in the same direction as the movement of the convex lens. The erect image appears to move with the head of the patient or the observer. By this difference the two can be distinguished apart at a glance. In order to understand clearly the effect of the inversion, it is well to take a piece of thin writing-paper, and to draw upon it a circle to represent the fundus of the left eye of a person placed opposite to the spectator. The circle may

Su.

be surrounded by the letters Na. Te. so arranged as to indicate the superior, inferior, tempo-

In.

ral, and nasal boundaries of the figure. To the nasal side of the centre a small circle may be drawn for the optic disc, with lines radiating chiefly towards the temporal side, to represent the blood-vessels. The sketch, as it stands, will give an idea of the erect image, with its temporal side to the right of the spectator, and the vessels passing to the right. If the piece of paper be turned bottom upwards with the written side still towards the spectator, the ordinary conditions of the inverted image will be fulfilled, and the inversion of all parts will be complete.

If the paper, still upside down, be now turned with the written side away from the spectator, and held towards the light, the effect will be like the inversion produced by the first form of Laurence's reflecting ophthalmoscope or by the auto-ophthalmoscopes of Heymann and Giraud-Fenlon. The figure is still inverted, but the spectator is placed behind it, and the position of his right hand is changed with regard to it; hence the vessels pass from his left to his right, as in the erect image, while the upper parts are seen below and *vice versa*. The simple experiment described will make this clear in a moment. The comparative uses of the two methods of examination may be stated in the following manner:



So long as the observer is occupied with the relative positions of the larger parts of the fundus oculi, rather than with a close scrutiny of fine objects, the inverted image should be preferred, and especially, when it is desirable to diminish illumination on account of disease. Notwithstanding the absence of high magnifying power the examination of the inverted image, on account of the larger visual field and more comprehensive view that it affords, is sufficient to guard against any grave errors in practice. The examination of the erect image, indispensable for many purposes, such as the observation of changes in the optic nerve, pulsation of its vessels, and so forth, is chiefly needed for the investigation of the fine details of changes, the seat of which has already been made known by the indirect method. The same rules apply to these as to all diagnostic means; and for the right estimation of morbid changes, it is before all things essential to compare the diseased parts with the healthy tissues around them, as well as to compare different portions of diseased structure with one another. The relations between the two methods are for the fundus of the eye much like the relations between unaided examination and examination through a lens, of the more external parts of the organ. For the inspection of a small corneal opacity, or of a pigment-spot on the anterior capsule, the magnifying glass renders us important service; but still we should diagnose the affections of the cornea and of the pupil badly, if we regarded the magnifier in any other light than as an occasional auxiliary. (v. Graefe.)

Since in examination of the inverted image we obtain a general view of the retina, while the examination of the erect image gives the clearest and most magnified view of details, it follows that in exact inquiries the two methods should be combined. Neither the one nor the other, however, should be continued too long, or repeated too frequently, as a diseased eye may be seriously injured by prolonged or unduly repeated examination.

The foregoing section still leaves room for a few observations that may be useful to beginners, with regard to the best method of conducting an ophthalmoscopic examination.

It is an important element of success, that the patient should be comfortably and easily seated: well back in the chair, and with the head erect. Mr. Streatfield has invented a special chair for the purpose, with a high straight back, that may be occasionally useful. It is described and figured in the third volume of the '*Ophthalmic Hospital Reports*.'

The observer should be seated with his eyes not perfectly on a level with, but a very little higher than, those of the patient. The two faces should be precisely opposite to one another, feature for feature, and the surgeon should use his right eye for the inspection of the left, and *vice versa*. The patient should be cautioned not to turn his head, when told to alter the direction of his gaze. Before commencing it is well to observe what amount of control he possesses over the movements of his eyes, and how far he is able to look upwards and downwards, to the right hand or the left.

It is well known that ocular movements are best guided by reference to some object of vision. Mr. Hulke has made the useful and practical suggestion to place a large screen, divided into numbered compartments, at some distance behind

the surgeon, who, knowing the position of the figures, would tell the patient to look at 7 or at 9. This is an excellent contrivance, but still it may sometimes be replaced by objects that are always in readiness, namely, the fingers of the hand that holds the mirror. For this purpose I depart from the common practice, and, for the inverted image, place the handle of the mirror horizontally across my face, applying it to the right eye with the left hand, for examination of the left eye, and to the left eye with the right hand, for examination of the right. I take the handle between my forefinger and thumb only, turn the palm towards the patient, elevate the remaining fingers, and tell the patient to look at them steadily and to follow their movements. If the sight be tolerably good, the observer will thus obtain complete command of the position of the globe, and may guide it in any direction. If the optic disc be nearly out of sight, a slight change in the place of the fingers will bring it into, and keep it in the centre of the field. If the sight be defective, it is easy to keep the fingers in to-and-fro movement, by which means they are seen more readily than any stationary object. If the sight be good, and the pupil not under the influence of atrophía, the fingers will be too near the patient to serve as suitable objects of vision. In accommodating the eye for them, the contraction of the pupil that is usually associated with the action of the ciliary muscle, would interfere with the admission of light. This difficulty is easily obviated by directing the patient to look past the fingers at an object on the other side of the room.

The horizontal position of the mirror-handle has the additional advantage of placing the object-lens in the hand that corresponds to the temporal side of the eye examined. If it be held in the other hand, the nose of the patient is in the way, and he breathes over the hand and up the sleeve of the surgeon. I am accustomed to take the object-lens between the thumb and index finger, and to rest the ulnar side of the tip of the third finger against the upper margin of the orbit, a little external to the vertical meridian of the eye. If there be any tendency to closure of the lids, it is easy in this position to take up a fold of skin with the finger, and to control the upper lid, without in the least alarming or hurting the patient, and it is also easy to exert any degree of pressure upon the globe.

To use the ophthalmoscope of Coccíus in the manner described, it is necessary to remove the handle from its usual position, and to fix it opposite to the horizontal axis of the collecting lens.

The ophthalmoscopes of Coccíus and Zehender, on account of their collecting lenses, require slightly different management from the simple concave mirror. The beginner will find it best to place either of them nearly in the position it will require to occupy, and to arrange the position of the collecting lens, so as to throw a brilliant inverted image of the flame upon the cheek of the patient, as a preliminary to looking through the perforation, and guiding the light into the aperture of the pupil. In the examination of the erect image, the eye of the observer is brought close to that of the patient, so much so, as to interfere with any object of vision. The movements of the globe can therefore only be guided by verbal directions, or by slightly moving the head of the patient with the hand; and the observer will find it useful to vary

his own point of sight, and to look into the eye from every possible direction.

The binocular ophthalmoscopes require the same general management as the monocular, and may be fitted with mirrors of any surface, and with or without a collecting lens. As usually made, they are only adapted for vertical illumination; but I find that they will work equally well with lateral. It is evident, however, that binocular vision is of less importance for the direct image; and I hardly think that Zehender's instrument is likely to be superseded.

The lenses commonly sold with ophthalmoscopes are altogether insufficient for the demands of practice. I have had the small clips removed from my instruments, and replaced by others large enough to carry lenses of the spectacle-box. By this plan a great variety is at command, and will be found highly useful. For the erect image the weaker concaves are often advantageous, and for the inverted the common 12" ocular may be replaced by much higher powers. I frequently use a 5" ocular, in combination with a 4" object-lens. It must be remembered that the distance between the lenses must be equal to the sum of their focal lengths, and that hence every increase in the power of the ocular must bring the mirror nearer to the patient.]

C. Bader.

[OPIUM. The concrete juice obtained from the unripe capsules of the *Papaver somniferum*. Opium is not only one of the oldest known medicines, but it is perhaps without exception the most valuable drug in existence for therapeutical purposes. Its virtues were known alike to the Greeks and Romans. Homer alludes to the *μήκων*, or poppy growing in the gardens; Hippocrates distinguished the therapeutical action of the red from the white poppy; Dioscorides and Pliny alike discussed meconium, as they called the juice we know as opium.

The word opium is derived from the Greek *ὀπρος*, "which signifies the juice by way of eminence, as we call the Jesuits' bark 'the bark,' by way of eminence, because most useful and excellent." (*Jones' Mysteries of Opium Revealed*, 1700.)

It is the juice derived from the unripe capsules or rind pods of the poppy head by incisions which are made horizontally and obliquely through the epicarp and sarcocarp of the capsules, care being taken not to penetrate the cavity lest any of the juice should run therein among the seeds, and so be lost. A white milky fluid exudes from the incisions in drops which, having thickened, is, at the end of twenty-four hours, removed into wooden or earthen vessels, in which the juice is diligently stirred until the different collections made are thoroughly inspissated, water or saliva being sometimes added to keep up the moisture. The opium is finally dried without heat, usually by exposure to the sun, first in small cakes, then in masses which are enveloped in the poppy leaves. The chief of the order *Papaveraceæ* is the *Papaver somniferum*, from which the opium is obtained as above described. There is, however, the red poppy or *papaver rhæas*, which flowers in June or July, and abounds in our corn-fields. It has but slight narcotic property, and requires no further description here. The *Papaver somniferum* or white poppy grows wild in Asia and Egypt, but is much cultivated in Hindostan, Persia, Asia Minor, Egypt, Europe, and also in England. Great quantities

are grown near Mitcham in Surrey for the sake of the *poppy-heads* for the English markets.

The opium from abroad obtained as above described is a dark rich brown solid, the tint of which varies according to the locality it comes from and the mode of drying it.

For the purity of solid opium there is no one single test. The amount of morphia in it would be the best, but the process to ascertain it would be far too expensive to be practical. Usually the colour, texture, and aroma are, to judges in the matter, criterions of the excellence or otherwise of the article.

The varieties of opium are: I. *Smyrna* opium. This is the Turkey or Levant opium of commerce, and usually considered the best commercial form. It yields more morphia and meconic acid than either Constantinople or Egyptian opium. From a pound of this opium eight or nine per cent. of morphia can be obtained. (*Pelletier's account in Journ. de Pharm.* xxi. 572.)

II. *Constantinople* opium varies more than the *Smyrna* in the amount of morphia it contains. Thus Guibourt says it contains only half as much as the *Smyrna* variety, whilst Christison has obtained fourteen per cent. (*Journ. de Pharm.* xxi. 547.)

III. *Egyptian* opium has a redder tinge than either of the preceding, nor does it blacken by keeping like either of the others. It varies much as to its strength, but usually contains less morphia than either of the preceding kinds.

IV. *Trebizond* or *Persian* opium occurs in the form of cylindrical sticks, which by pressure the one against the other are usually somewhat angular. There is very little morphine in this form of opium, which has a strong opiate odour, and is intensely bitter to the taste.

V. Of Indian opium there are three varieties known in commerce, viz. the Malava, Benares, and Patna; the two latter being so similar are considered as one by Pereira under the head Bengal opium. 1. *Bengal* opium is imported in balls about three pounds weight. This variety very soon gets covered with mouldiness from exposure to the air, and it contains much less morphia than does good Turkey opium. *Garden Patna* comes to this country in small thin square cakes. *Malava* opium is improving in quality, it comes over either in rounded cakes or balls enveloped in poppy heads or in flattened cakes without any exterior covering; the morphia it yields is about one-third that furnished by *Smyrna* opium.

VI. *English* opium, which occurs in flat cakes or balls enveloped with leaves, most resembles fine Egyptian opium. According to Hennell it contains seven and a-half per cent. and to Morson four per cent of morphia. (*Pereira*, vol. ii. p. 2094.)

The constituents of opium are numerous, and may be considered as follows: Morphia, narcotina, codeia, narceine, meconine, thebaine, pseudomorphia? meconic acid, brown acid, extractine, sulphuric acid, resin, fat, oil, gummy matter, caoutchouc, albumen, odorous principle (volatile oil?) and lignin. (*Pereira*.)

The chief constituents and those only which it is deemed necessary here to give an account of are—morphia, narceine, codeine, narcotine, and thebaine. These all have properties essentially different in their action upon the animal economy



from each other and from opium itself, into the composition of which they enter; and it is the object of the writer as far as possible to give the latest results of physiological investigators into their effects. Before, however, so doing it would be best to describe the effects of opium itself upon the human system.

Opium may be considered as a *therapeutical agent* in small doses, and as a *poison* in large doses, —or more physiologically its action may be said to consist of three stages. 1st, that of excitement; 2nd, that of depression or of full medicinal effect; and 3rd, of excessive medicinal effect, in which case symptoms of poisoning are manifested, and death occurs or is imminent.

In the first stage, that is when a small dose, say from  $\frac{1}{6}$  to  $\frac{1}{2}$  grain of opium is administered, the symptoms are those of gentle excitement of the system, there is a general rise of the circulation, a sensation of fullness in the head which may be pleasurable or amount to giddiness, the ideas become exalted, the person talks more brightly, a general sense of comfort is experienced, and the skin feels warm. The mouth and throat get dry, hunger is lessened, thirst occasioned; the bowels are usually slightly confined; sleep may occur, but is usually the effect of a larger dose. The pupils of the eyes are contracted in proportion to the amount given.

In the second stage, when a full medicinal dose has been given, the symptoms are those of depression of the system and narcotism of the brain. The excitement rapidly disappears, the thirst is increased, appetite diminished, nausea, and sickness often follow; the pulse goes down even below the natural, sleep more or less profound is induced, previous to which a great sense of muscular languor or prostration may be complained of. The sleep may be accompanied by dreams, pleasant or the reverse according to circumstances. On waking, the patient is often "heavy" in the head for some time, or giddy, and often sick or too nauseated to take food for some hours.

In the third stage there are symptoms of poisoning, and death occurs, unless averted by treatment. The symptoms of poisoning with opium, says Christison, "when it is administered at once in a dangerous dose, begins with giddiness and stupor generally without any previous stimulation. The stupor rapidly increasing, the person becomes motionless and insensible to external impressions, he breathes very slowly generally, lies quite still with his eyes shut and pupils contracted; and the whole expression of the countenance is that of deep and perfect repose. As the poisoning advances, the features become ghastly, the pulse feeble and imperceptible, the muscles exceedingly relaxed, and unless assistance is speedily procured, death ensues." (*Christison on Poisons*.) Death occurs by apnoea or cessation of respiratory action chiefly through paralysis of the muscles.

Such may be considered the physiological effects upon people in health; we must now pass rapidly on to the *therapeutical effects of opium*.

These are many indeed, and require some kind of arrangement in order to show upon what class of affections the influence of opium is most serviceable; as a general rule it might be said that it will be found most valuable in affections peculiar to those parts of the system upon which its physiological phenomena are most marked, when a small

dose is administered to a healthy individual. Thus the diseases and derangements of the cerebro-spinal nervous system deserves the first place.

It is by virtue of its soporific powers that it is so valuable in *cerebral affections*, giving artificial sleep to the restless, and to such, "the sleep of an opiate is better than no sleep" (*Albutt.*), giving ease and comfort to the troubled mind, giving rest to the delirious and the raving, giving power to the exhausted brain, and life and enjoyment to the melancholic. In delirium tremens there is no medicine better than opium when given with care, for in this complaint the patient dies unless he sleeps, and rapidly recovers after the brain has fairly slept.

*Pain* is the next great evil which opium combats, and for which it is an invaluable remedy. Pain which unrelieved harasses and exhausts the patient, and which may shorten life, can be completely kept in abeyance and cured by this drug. Of the forms of pain and the best mode of applying the opium, some notice will be found in *Articles Neuralgia, Sciatica, Subcutaneous Injection, &c.*

The other chief nervous affections, for the most part of a reflex spinal nature, are excessive sensibility of the nerves or hyperæsthesia, which may be worse to bear than pain itself, and *muscular spasm* or cramp in its various varieties of lock-jaw, tonic spasm, epilepsy, chorea, cramps, vomiting, retention of urine, &c. These are all affections of the nerves which opium will oftentimes allay and sometimes cure.

Upon the *cutaneous system* opium has great power: its action is two-fold; for whilst it will diminish pain and hyperæsthesia, it will increase the excretory function of the skin, copious perspiration being often the result of a fair dose of opium, which is therefore valuable as a *sudorific upon the vascular system*. The great importance of opium as an antiphlogistic must not be overlooked. It is constantly prescribed with calomel in febrile and inflammatory constitutions; say, for instance, in scleritis and orchitis, and the object with which it is given is partly to prevent the calomel acting too much on the bowels and other secretions, and partly to ease the pain of the inflammation. Now, I believe opium deserves far more credit in these diseases than it usually obtains. I have seen severe inflammations rapidly abate directly after a full dose of opium; and it is well known that sometimes a fever may be cut short, and rapid convalescence follow the timely administration of an opiate. Opium acts upon the pulse, it reduces its frequency, as it does also of respiratory action; it acts on the skin, causing diaphoresis; it arrests pain, and the exhaustion consequent upon it; it gives sleep, and so prevents anxiety; it possesses moreover a power of arresting some secretions, all of which favour the idea of opium being antiphlogistic. In peritonitis therefore, and every other *itis*, as well as fevers, opium is of great value, except in those cases in which there is a tendency to coma or sopor.

*On the Respiratory System*, the effect of opium is more depressive than upon the circulatory and the nervous. Great care is required if opium is administered in a case in which the lungs are much interfered with in their action, or likely to be more than usually loaded with secretion, as in bronchitis. The tendency of a large dose of opium is to dimi-

nish respiratory action, to benumb the cutaneous respiratory (reflex) nerves, to cause a collection of secretion in the lungs, and diminish the power of its expulsion. Still it is very valuable in spasm of the bronchial tubes, in pleurisy with care, and in phthisis more particularly. No remedy will in some cases give greater comfort, and apparently sustain lung-power so much as opium.

The Digestive System is usually affected somewhat disagreeably by opium given by the mouth for an affection of any part of the body. The mouth and throat are rendered dry, though less so than by atropine; there is thirst, the bowels are confined, their evacuation is rendered of a lighter colour from deficiency of bile, and nausea, sickness, and loss of appetite may result for a time.

As a rule, all or nearly all these ill effects upon the digestive system are obviated by giving the opium by the hypodermic plan (*see Subcutaneous Injection*); still, whether administered by mouth, by rectum, or by the cellular tissue, opium acts most beneficially in cases of spasm of the bowels (colic), of the stomach (vomiting), intus-susception, &c.; it allays the pain of many intestinal inflammations and affections; and is at times the only medicine which will check diarrhoea.

*Upon the Urinary Organs* opium has not always the same effect; it usually diminishes the amount of the secretion of the kidneys, and causes it to be turbid and high coloured. It diminishes the sensibility and contractility of the ureters and bladder; consequently it is of great use in spasm of these parts, and also in allaying any irritability about the urino-genital organs.

There are many other objects besides those above enumerated in which opium, though not the sheet-anchor, as in delirium tremens, in mania, and some other diseases, yet is invaluable as a remedy. In phagedæna for instance, the "ulceration" is often amenable to opium alone, and a large amount can be given in this disease without producing any apparent systemic effect until the phagedæna is checked. It is of great use in some venereal affections.

*Its administration.*—Opium may be administered in many ways; thus, it may be given by the mouth, by the rectum, by the skin, by the cellular tissue, and by local application to various parts, as the eye, the ear, the os uteri, &c., by the skin, as by lotion enepidermically, or embrocation iatraleptically, or to a blistered surface endermically, or by injection beneath the skin hypodermically. This last is the best plan for all cases of urgency, such as of insomnia, of mania, delirium tremens, tetanus, severe pain and spasms, as of retention; also in those cases in which the stomach is upset by the use of opium by the mouth. For indeed all cases in which rapidity and certainty of action are especially indicated. For local pains, if superficial, the endermic method may be used, or lotion or liniment, rather than derange the stomach; when, however, that organ is not very susceptible the preparations of opium may be given by the mouth. Opium may be given in the solid form in doses of from one-quarter of a grain to one, two, or three grains. (The medium dose is  $\frac{1}{2}$  to 2 grains, the full or large dose two to five grains. *Pereira*.) So given, it is often very useful in urgent vomiting, and in other cases in which the tincture and other forms are instantly rejected. For enemata with opium, care is required, and the dose should

the first time be smaller than by the mouth, as absorption from the rectum is very rapid.

*On Opium-eating.*—This practice is carried on to a greater extent in Turkey and Persia than in any other part of the world. The following extract is from one of the best accounts given of this habit:—

"The causes leading to the use of opium are many, and among them may be reckoned the following: long-continued diarrhoea, as a remedy for which opium is used in the first instance, and its use afterwards continued as a habit; chronic coughs, in which opium is also used as a popular remedy; habitual drunkards also frequently have recourse to opium as a new stimulus after they have abjured wine. Persons holding high offices or dignities in the state, have also recourse to opium, when the preservation of their character forbids them the use of wine; some very strict believers also take opium as a restorative in cases of great exertion, as the Tartars (couriers), who travel with astonishing celerity. Opium-eaters generally begin with doses of from half a grain to two grains, and gradually increase the quantity till it amounts to two drachms or more a day; they usually take the opium in pills, but avoid drinking any water after having swallowed them, as this is said to produce violent colic: to make it more palatable, it is sometimes mixed with syrups or thickened juices, but in this form is less intoxicating, and resembles mead. . . . The effect of the opium manifests itself one or two hours after it has been taken, and lasts for five or six hours, according to the dose taken, and the idiosyncrasy of the subject. In persons accustomed to take it, it produces a higher degree of animation, which the *Theriaci* (opium-eaters) represent as the acmé of happiness.

"The habitual opium-eater is instantly recognised by his appearance. A total attenuation of body, a withered yellow countenance, a lame gait, a bending of the spine, frequently to such a degree as to assume a circular form, and glossy, deep-sunken eyes, betray him at the first glance. The digestive organs are in the highest degree disturbed, the sufferer eats scarcely anything, and has hardly one evacuation in a week; his mental and bodily powers are destroyed—he is impotent. By degrees, as the habit becomes more confirmed, his strength continues decreasing, the craving for the stimulus becomes even greater, and to produce the desired effect the doses must constantly be augmented." (*Oppenheim, Brit. and For. Med. Rev.* vol. iv. p. 394.)

*On the Tolerance of Opium by the System.*—But although such are the symptoms produced by opium upon people who habitually take it without any necessity for it in such large quantities as two or three drachms a day, still opium may be taken under certain circumstances for many years in daily doses far exceeding the ordinary average—in doses, in fact, varying from two or three grains to ninety or one hundred. One patient had for fifteen years previous to his coming under my care taken as his average dose *thirty* grains of morphine daily, equivalent to about ninety of solid opium. Notwithstanding that he suffered almost incessantly from neuralgia, he had the aspect of a man in fair or good health. He had a good colour, and manifested none of those dire effects or symptoms described above as following the habitual use of



opium, taken without any necessity for it; and I cannot but think that the existence of the disease produced the tolerance of the drug, and I cannot imagine, judging from the very large doses other people have taken to my certain knowledge for many years, but that these *super-effects*, so to call them, of morphine or of opium, are greatly modified by the existence of certain states of the constitution, and by certain actual diseases. See, for instance, how great an amount of opium can be given without any apparent effect as long as phagedæna is going on—a tolerance of the drug is produced, which has no apparent effect on the system generally until the phagedæna has stopped. I have seen sixty drachms of laudanum thus given in three days to an hospital patient without causing sleep until the progress of the disease was checked. In neuralgia, then, in phagedæna, in cancer, in certain conditions of the brain, as for example mania, opium may be tolerated in enormous doses for days, months, or even years. “But what is still more extraordinary,” says Chapman, “in a case of cancer of the uterus, which was under the care of two highly respectable physicians (Drs. Monges and La Roche) at Philadelphia, the quantity of laudanum was gradually increased to *three pints* besides a considerable quantity of solid opium.” (*Chapman, Elem. of Therap.* ii. 199.) Opium-eaters, it is said, seldom attain to the age of forty years if they have begun to use opium at an early age. I agree with Christison and others in doubting this assertion; and fully believe that where certain states of the system exist, such as those above mentioned, not only is a tolerance of the drug produced, but in such cases, cancer for instance, or other severe painful diseases, life is lengthened under its use, death is as it were staved off by the opium, which acts by reducing the phenomena, conducting to death, to their lowest point; opium does this by relieving the pain, the anxiety, the mental wear and tear—the exhaustion—by keeping down the quick pulse (as in phthisis), and by giving directly and indirectly that potent restorer—sleep.

*Opium-smoking* is largely had recourse to in China and the Indian Archipelago. The first effect of it is to render the Chinese smoker loquacious and animated; gradually the conversation drops, laughter is occasionally produced by the most trifling causes, and to these effects succeed vacancy of countenance, pallor, shrinking of the features, so that the smokers resemble people convalescent from fever, followed by deep sleep for half an hour to three or four hours. The Malays are rendered outrageous and quarrelsome by the opium-pipe. (*Pereira.*)

The Preparations of Opium are very numerous, and it must here suffice to give but a brief mention of those chiefly employed.

A. Those from the poppy itself are—1. Decoctum Papaveris, a very useful anodyne fomentation. 2. The Syrupus Papaveris, at most an uncertain preparation, although much given to children. 3. Extractum P., a milder preparation than the Ext. opii.

B. Of opium itself there are—1. Pilulæ Opii vel Thebaicæ, five grains of which contains one grain of opium. 2. Pilulæ Saponis Compositæ, of the same strength. 3. Pulvis Cretæ Compositus cum Opi, forty grains of which contain one grain

of opium. 4. Confectio Opii has 1 grain in 36 (L. Ph.) 5. Emplast. Opii, a cutaneous tonic anodyne for lumbago, &c., of mild power. 6. Extractum Opii, more powerful properly than solid opium, the inert principles being mostly removed by digestion and evaporation. Dose  $\frac{1}{2}$  gr. to ii. or iii. 7. Tinctura Opii. Laudanum. The most common preparation of opium. Its strength varies in the three Pharmacopœias, but Squire (*Trans. of the Pharm.*) says they are all of the same strength, and that one grain of powdered opium is employed to produce thirteen minims of the tincture. Dose for adult, m x. to 3i. The tincture is a powerful anodyne and soporific; very minute doses must be used on children. 8. Enema Opii. Very much used for painful affections of the lower abdominal viscera. 9. Linimentum Opii. 10. Vinum Opii, the laudanum of Sydenham; very serviceable as an application for the eye. 11. Acetum Opii, 20 drops of which are said to be equal to 30 of laudanum. Dose vi. to xxx. minims. Then there are various preparations into the composition of which opium enters; but the effect is not in them that of pure opium. The chief of these are 12. Tinct. Camphoræ Comp.—One grain of opium exists in about 3 ss. (267 minims L. P. 240, E.); it is a very useful anodyne in chest affections, usually called Paregoric Elixir. 13. Pulvis Ipecac. Comp., or Dover's powder, contains one grain in x.; a very useful form, the action of the opium being modified by the ipecacuanha. 14. Pulvis Kino Comp. &c. &c.

We pass now to the action of the alkaloids derived from opium, the only one of which in common use is morphine; of late years, however, some of the others have been a good deal employed. Claude Bernard, who has especially studied the action of the alkaloids of opium on animals, divides them into two classes:—

1. The soporific alkaloids, morphine, narceine, and codeine.

2. The toxique (poisonous), and non-soporific narcotine, thebaine and papaverine.

Let us adopt this arrangement, and consider first the soporific alkaloids.

1. Morphia, morphine, from Morpheus, the god of sleep. This important alkaloid has for its symbol M., its formula is  $C^{35}H^{20}NO^6$ . Its salts have a bitter taste, and like morphia itself are reddened by nitric acid, turned blue by the neutral sesquichloride of iron, and reddish brown by iodic acid, iodine being set free. The salts of morphia in most common use are the acetate, the hydrochlorate, the sulphate, and bimeconate.

The effects of morphine upon the human system are really much the same as those of opium; but there are certain differences and certain constitutions in which morphine acts and suits better than opium. Of the two, opium is more exhilarating and exciting; morphine more sedative, anodyne, tonic, and at times, more depressing than opium. It may be for these reasons that opium seems to be more in vogue in surgical cases, and morphine in medical. The sleep of both opium and morphine is not infrequently accompanied by giddiness, a fullness and lightness in the head, by loss of appetite in the morning, nausea and perhaps sickness. Opium seems to cause more dreaming than morphine, and perhaps more sickness, when both drugs are given by the mouth. Upon pain—equivalent doses being used—morphia has de-

cidedly a more anodyne and lasting effect than opium.

In cases of cerebral irritation, and also of certain pulmonary affections, opium has a less sedative effect than morphine. In chronic bronchitis it will often happen that the former will irritate the stomach and bring on cough; the latter will not, but materially relieve the disease. Except when taken hypodermically, the sensations produced by morphia are not so agreeable or luxurious as by opium.

In comparing the effects of morphia with those of opium, when the former is used the bowels are supposed to be less confined, the tongue is made less dry, and the head less prone to suffer. Morphia acts less also as a diaphoretic.

Since it was pointed out and proved by the writer's experiments in 1858, that hypodermic injections acted generally and upon the whole system, both opium and morphine have been largely used by subcutaneous injection for general as well as local affections. Morphine is the most frequently employed. It may be asked has morphine, thus used, any different action from or advantage over opium. My own experience leads me to believe that morphine is infinitely preferable in the majority of cases, in which subcutaneous injection is deemed advisable. For this method is not required in trivial maladies, for such are very amenable to stomachic medication; but in a case of urgency, such as of violent pain, of wild delirium, of severe spasm, morphia is more effectual and more permanent in the good it effects than opium, though likewise subcutaneously injected. If temporary ease, comfort, or gentle excitement are wished for, opium will produce those effects better than morphine. But on the other hand, the effects of opium—more exhilarating for the time—sooner pass off. I speak from observation of the effects of both, when injected into the cellular tissue, upon the same patients, one of whom, an intelligent lady, said she found the influence of  $\frac{3}{4}$  of a grain of morphine usually lasts twice as long as those from thirty minims of tincture of opium (evaporated to a less bulk). The throat is less dry from morphine, the bowels less, if at all, confined from it, and this is a great advantage, as morphine may be daily injected into patients necessarily recumbent, without inducing constipation.

And here I may mention, that morphine has frequently, for the time its effects last, destroyed the appetite, when taken by the mouth; but in the same patients it often acts as an incentive to eat, given hypodermically. The disadvantages of the subcutaneous injection of morphia are chiefly the sickness, which is to be avoided by not injecting (as so many do) too large a dose; and local irritations, which are to be avoided by using solutions of the alkaloids instead of tinctures, &c. (See *Subcutaneous Injection*.)

Codeia, or Codeine, Symbol Cd., consists, according to Pereira, of  $C^{35}H^{20}NO^6$ . It occurs as a hard white crystalline substance, very difficult to dissolve at ordinary temperatures; soluble in alcohol and ether. It has scarcely been used in medicine, except during the last few years. Those who first investigated it differed greatly as to its action. Kurkel said it caused convulsions; Gregory, great excitement of the circulation, vomiting, and depression; Barbier and Majendie, sleep in small doses, stupor in large. I believe

it is now more purely obtained, the effects being, according to my observations, pretty uniform.

Codeia is a less powerful, although a purer cerebral narcotic than morphine, and for stomachic administration Majendie was, I think, correct in stating one grain of codeia to be equal to half a grain of morphia. The dose would therefore be from 1 to 3 grains. Codeia has been for some years used for spasmodic cough and other chest affections, in the form chiefly of syrup of codeia, by Drs. Walsh, Williams, Cotton, and others; and in cases of insanity and insomnia, by Dr. Tuke and others, in doses of from  $\frac{1}{2}$  of a grain to 1 or 2 grs.

The sleep produced by it is lighter and more refreshing, and unaccompanied by the heaviness produced by morphia. We learn from the experiments of Claude Bernard upon animals, that codeia benumbs the nerves of sensibility to a much less extent than morphine does; that they wake almost instantly to their natural state without effort; and that its effects, slighter in degree, are mainly apparent upon the cerebral functions. Given by the mouth to the human being, the sleep produced by it is lighter and more refreshing than that from morphia; and although sufficiently profound, the waking from it to the thoroughly normal state is far more rapid than from morphia; neither is it accompanied by the stupor, the giddiness, the sickness, and the headache, which often attend the use of the latter drug. The experiments of Claude Bernard upon animals show that codeia, hypodermically injected, benumbs the nerves of sensibility much less than morphia does. Dogs wake up instantly without any *effarement*; whilst from morphine they awake dull and heavy, with a wild eye, senses confused, tail down, &c.

The most recent French writers upon the hypodermic method, Jousset, Bouchardat, &c., say codeine has not been employed subcutaneously on the human subject. The following are my results of its use on six or seven patients:—

That a full codeine injection acts somewhat like a mild morphine injection. Its first effects are upon the circulation, which it gently excites, but the effect is more transient than that of morphine. The brain is then tranquillised, and sleep may follow, but not always. Pain is less influenced than is cerebral irritation. Sickness I have not yet seen from the codeine injection, nor is the dull heavy sense of constriction of the head a sequence as it may be of morphine. I have known it cause headache in one case, to be quite inert in two or three cases, and in one patient it simply increased the circulation, but had no effect on the brain.

In doses such as I have used for injection, viz. from one-fourth to three-fourths of a grain, I consider codeine a less reliable anodyne and a less powerful narcotic than morphine, and altogether a milder preparation. Still cases may occur in which it would be very useful, whilst opium or morphine are inadmissible. Codeine, on account of its difficult solubility, has to be injected slightly warm.

*Narceine.* Narceine, from *νάρκη*, stupor, was first obtained by Pelletier in 1832. It has a formula of  $C^{28}H^{20}NO^{12}$ , and occurs in fine white silky needles, radiating in tufts from a centre. It dissolves in 230 parts of boiling water or 375 parts of water at 60°. In the latest edition of Pereira, narceine is presumed to be inert, as two grains thrown into the jugular vein of a dog produced no



symptoms. This alkaloid has, however, been more carefully examined of late by Claude Bernard, Charles Liné, Lecomte, Behier, myself, and others, as well as by Dr. Debout, who experimented upon himself. So that the effects both of stomacheic and hypodermic doses are pretty well established.

According to Claude Bernard, the sleep produced by narceine has its own peculiar characters. It is a more profound sleep than that of codeine, but on the other hand it is not the heavy sleep of lead (*sommeil de plomb*) which morphine produces in so high a degree, but there is in the narceine sleep a slight dulling of the nerves of sensibility. There is a perfect calm without the least agitation. On waking the animals, they return very rapidly to their natural state, and very slight excitation is necessary to arouse them. M. Le Dr. Laborde investigated the action of this alkaloid upon children in the Hospital des Enfants (Paris), and believes that the narceine sleep has this merit, that upon children the waking from sleep is not accompanied by any of the distressing phenomena—the heaviness of the head, the painful sensations of the digestive canal, &c., which follow the use of the other alkaloids of opium. Dr. Debout's results upon adults are much the same. He also thinks the sleep is lighter, the brain is not congested, nor do painful dreams occur from its use.

Behier, in his conclusions, considers "that it calms the cough and diminishes the expectoration of phthical patients. 2. When subcutaneously injected it calms pain like other narcotics, and in the same doses" (which is somewhat vague, so much do doses differ). 3. That it notably suspends the excretion of urine without destroying or modifying the sensation of the *besoin d'uriner*. Chas. Liné believes "narceine is incontestibly of all the alkaloids of opium the one which possesses the dormitive power pushed to the highest degree. With equal doses, in the majority of cases neither morphine nor codeine produce so prolonged or complete a sleep." 2. The unpleasant symptoms, vomiting, &c., are less intense than from morphine. 3. It will often remove pain which morphine fails to influence, and so will morphine, vice versâ.

My own opinion of its hypodermic action is in favour of the above-quoted statements, *with modification*. It certainly has more power than codeine as an anodyne, and much the same power as a narcotic. I consider it less curative in its action on pain than morphine is, but I cannot find equal doses of those two alkaloids to have equal effect. I think the truth is more nearly expressed when I say one grain of narceine is the equivalent of half a grain of morphine. Certainly less cerebral disturbance follows the injection of narceine, but I have also several times found it inert.

Narceine may be administered in solution in doses of from quarter of a grain to one or two grains. As a syrup (Guillemette), citric acid is used to dissolve it.

For hypodermic injection I employ this strength: narceine gr. v.; ac. hydrochloric m. ii.; aquæ calidæ m. xl. To be used warm.

We come now to the non-soporific alkaloids: narcotine, thebaine, and papaverine. Of these little is at present known. Narcotine and thebaine are considered by Claude Bernard as the exciting substances of opium. Thebaine he thinks acts upon the upper or cervico-dorsal portion of the spinal marrow; narcotine upon the cerebral hemispheres.

These alkaloids are called toxic in contradistinction to those which before death produce sleep. Thebaine he considers the most poisonous, and curiously enough morphine the least so; thus you can kill a dog by injecting one deci-gramme of thebaine into the veins, but you may inject two grammes of the hydrochlorate of morphine without causing death. Codeine he considers next to thebaine as a poison. Thebaine causes death by convulsions and arrest of the heart's action. So may the others, but narceine is the exception; it is neither excitant nor convulsive. Given in a poisonous dose, the animals die "*dans le relâchement*." (*Arch. Générales*, 1864, p. 461.)

"Of the exciting agents," says Dr. Brown-Sequard, "there is one which will probably be soon employed in medicine; it is thebaine. This alkaloid, according to Bernard, causes violent convulsions; but it will be found a precious remedy, if, as stated by Orfila Majendie, and quite recently by Ozanam, it produces tetanic convulsions, chiefly in the arms."

Narcotine has no narcotic action, neither has it yet been used in medicine.

*Antidotes to Opium Poisoning.*—The first indication is to remove the poison from the stomach; the second, to neutralize any that may remain; the third, to counteract the effects of that already absorbed.

If the poison can be evacuated *at once*, no dangerous symptoms need follow. To make the person vomit, mustard or salt emetics may be used, or the back of the throat tickled with a feather or the finger. If the stomach-pump is at hand it is the most effectual. Antimony might be subcutaneously injected, if other emetics failed.

There is no known chemical antidote (unless it is atropine) to opium, although infusion of galls, magnesia, iodine, and chlorine have been recommended. Atropine and belladonna have frequently and rapidly aroused animals which I had previously narcotised with morphine, but they are remedies which if administered in doses at all large may only deepen the narcotic sleep. They are, therefore, best administered by the hypodermic injection, as their action can by that means be exactly regulated and excess avoided. If narcotism has gone to any extent the breathing will be stertorous and very slow, the pulse slower than usual, the pupils closely contracted, the brain too insensible to be easily or at all aroused. The chief treatment must then, in addition to that above mentioned, be directed to avoiding death by apnoea (the cessation of respiratory action) and to restoring the sensibility of the nervous system. For these purposes the best are *cold affusions* frequently and suddenly applied; walking the patient about, if it is possible to wake him; *ammonia* to be frequently breathed; sinapisms to the legs, arms, and chest; and above all things, and the sooner the better, *artificial respiration* where danger seems great. Life may often be saved by keeping up artificial respiration until the poison is so far eliminated from the circulation that the patient can be trusted to carry on his own breathing. Several cases are on record in which life has been restored after three, four, and more hours, by diligent perseverance with artificial respiration. (See Mr. Smith's case, *Med. Chir. Trans.* xx. 86; and *Marshall Hall on Drowning*, Lond.) The Marshall Hall method is for many reasons

the best, one of the chief being that the semi-paralysed tongue is very likely to act as an effectual plug to the windpipe, if artificial respiration is carried on, whilst the patient remains supine. (*Marshall Hall on Drowning*. Churchill.) Electricity may be used to arouse the circulation, and then by degrees small cups of strong coffee, with or without a little brandy occasionally, tea, &c. Ammonia and caffeine may be given in small and repeated doses, or injected subcutaneously. The frequent application of cold water to the hands, face and head, and chest, to be continued as long as the respiration shows a tendency to stagnation.]

(*Charles Hunter*.)

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[ORTHOPÆDIC SURGERY. Orthopædy, a term which appears to have been first used by M. Andry, Dean of the Medical Faculty of Paris, who in the year 1741 published at Paris a work in two volumes on "Orthopædy; or, the Art of Preventing and Correcting the Deformities of the Body." He derives the term from *ὀρθός*, straight, and *παῖς*, genitive of *παῖς*, a child; others, however, derive it from *ὀρθός* and *πούς*, or foot, but as the practice which it represents is by no means limited to the cure of deformities of the feet, there appears to be sufficient reason for retaining the former definition.

Orthopædic Surgery has for its objects the scientific treatment of deformities, congenital and non-congenital, whether affecting the feet, hands, spine, neck, eyes (as in squinting), knees, hips, or other portions of the body. Many of the affections which the term is thus made to include are more intimately allied than at first sight might appear, and not unfrequently their mutual dependence upon each other may be traced. Having frequently the same origin, depending upon the same laws, and affecting structures physiologically similar, they will be found to be amenable to the same principles of treatment.

For a detailed description of some of the more important subjects included in Orthopædic Surgery, see articles TALIPES;—SPINE, CURVATURE OF;—SPINE, DISEASE OF.

The origin and development of Orthopædic

Surgery is but a portion of the general history of the progress of pathology and scientific surgery, in which it forms an important part.

The treatment of deformities was limited to mechanical means, and was essentially conducted by the instrument-makers, and a class of practising empirics previous to the introduction into this country of subcutaneous tenotomy, in the year 1836, by Mr. Whipple, of Plymouth. In the following year, 1837, Dr. Little first divided the tendo-Achillis in London, and introduced the principles recommended by Stromeyer in the treatment of clubfoot. This led, in the year 1838, to the establishment in London of the Royal Orthopædic Hospital, and subsequently several other similar institutions.

There can be no doubt that Orthopædic Surgery is mainly indebted for its existence, as a branch or department of practice, to the discovery of subcutaneous tenotomy, an operation which was perfected by Stromeyer, and performed by him in the year 1831; although he freely admits that, in the performance of this operation, he was guided by the principles laid down by Delpech in his work *L'Orthomorphie* (1829).

Delpech first divided the tendo-Achillis in the year 1816. The operation, however, was not subcutaneous, the limb being transfixed with a common scalpel, and the wound on either side of the tendon an inch in length. Serious inflammation followed, and Delpech had not repeated the operation when he published his work in 1829.

By the employment of subcutaneous tenotomy, as now perfected, and rendered free from all risk of local inflammation, and from any danger to the patient, the surgeon is enabled to treat successfully the more severe cases of deformity which were previously incurable—not only the severe cases of clubfoot and wryneck, but especially contractions of the knee-joint, elbow, fingers, and toes; and in the latter class of deformities, many fingers and toes, which formerly would have been amputated, are not only restored in form, but also in usefulness, free motion existing when contraction has been removed. In severe cases of contraction of the knee-joint, also, useful motion is frequently restored.

Orthopædy, therefore, embraces a large field of practice:—the removal of congenital deformities, as well as those acquired from disease or injury—the latter, whether resulting merely from weakness of bones, ligaments, or muscles; or from spasmodic and paralytic affections, which frequently give rise to severe contractions and deformities.

As a general rule in the treatment of deformities, it is necessary to combine with tenotomy the employment of instruments and mechanical supports; and therefore the scientific construction and adaptation of instruments is an important department of study, in which great advance has been made of late years, more especially in the construction of light and at the same time powerful instruments used in the treatment of lateral curvature of the spine; and also the instruments at present in use for the treatment of wryneck, contracted hip, and contracted fingers, are especially worthy of mention.

By the use of these improved instruments, the necessity for operating in many cases of severe deformity has been done away with, especially in contractions of the knee-joint when occurring in young people; and in these cases it has been found the contraction may generally be cured by



mechanical means alone, acting on the principle of gradual mechanical extension, even when the leg is flexed upon the thigh at a right-angle. Tenotomy may also be dispensed with, as a general rule, in cases of Talipes valgus, or flat-foot, even when severe, if occurring in young people. In these cases the contraction of the Achilles and peronei tendons, or, more properly speaking, of the muscles with which they are connected, may be overcome, and the arch of the foot completely restored, by mechanical means alone.

With the operative and mechanical, it is generally necessary also to combine what may be termed the physiological means, consisting of a well-regulated system of gymnastic exercises and passive motions, for the purpose of increasing muscular strength, and of obtaining an increased range of motion in the joints implicated in the deformity. In many cases the mechanical and physiological treatment may be conducted simultaneously, when the more severe part of the contraction has been overcome; and with the restoration of form we may also obtain restoration of motion. This may frequently be accomplished in contractions of the knee-joint, also in the elbow-joint, and at the articulations of the fingers.

The combination of mechanical support with gymnastics will also be found extremely useful in cases of incipient lateral curvature of the spine, and cases may thus be cured when gymnastics alone, or in combination with lying down, would certainly fail. These principles of treatment, which theoretically have generally been thought to be antagonistic to each other, have been found practically to be of the utmost service when judiciously combined; and there can be no doubt the gymnastic treatment of deformities has of late years been too much neglected in English Orthopædy, which has relied almost exclusively upon mechanism and tenotomy. The further cultivation of gymnastics, and an investigation into the practical advantages to be derived from the so-called special systems of gymnastics or movements which have been advocated by various authorities on this subject, will no doubt be accomplished by those engaged in orthopædic practice, and by so doing one of the present strongholds of quackery will be destroyed.

Galvanism is another therapeutic agent, which ought to be employed to a greater extent than it has hitherto been, in the treatment of that large class of contractions and deformities depending upon infantile paralysis, and met with in the later stages of that affection. In these cases the natural tendency is towards recovery, which is sometimes complete; but partial restoration of power always occurs, and this may be either promoted or retarded by the treatment adopted. There can be no doubt of the advantages of galvanism when commenced early enough, and properly applied in these cases; it should be applied three times a day, for a quarter of an hour each time, when the limb is immersed in hot water; or, when both legs are affected, two cans of hot water should be used, and one of the galvanic wires dropped into the water in each can.

With galvanism, in the treatment of these cases, should also be associated the daily employment of shampooing, passive exercises, systematically conducted, warm clothing, and in some cases the use of mechanical supports, to aid in the attempts to walk.

Where the loss of temperature is very marked, as in the more severe cases of infantile paralysis, great advantage is to be derived from the use of Dr. Junod's hæmospatic or exhausting apparatus; by the employment of which, for a quarter of an hour every morning, the blood can be drawn into a paralytic leg in sufficient quantity to raise its temperature to the natural degree, and this it will afterwards maintain with little diminution for twenty-four hours. The apparatus is but little used at the present time, its advantages not having been sufficiently brought under the notice of the profession.

By a judicious employment of the various means which modern science has placed at the disposal of the surgeon, he is now enabled to cope successfully with the large class of congenital and non-congenital deformities, which within our own recollection were always regarded as hopeless and incurable; and the special study of this department of practice falls within the range of Orthopædic Surgery.] (William Adams.)

**OSCHEOCELE.** (From *ὄσχεον*, the scrotum, and *κῆλη*, a tumour.) A hernia which has descended into the scrotum.

**OSTEOSARCOMA or OSTEOSARCOSIS.** (From *ὀστέον*, a bone, and *σὰρξ*, flesh.) [A term originally intended to express the conversion of the osseous tissue into a mass of less solid consistence than its original structure, whereby a soft or fleshy tumour is formed along the course of the affected bone. This very indefinite term was at first employed chiefly to designate the tumors produced by the cancerous affections of bone, in which the osseous texture becomes expanded, absorbed, and replaced by a soft material, in all respects similar to carcinoma of the other tissues, but in course of time it was applied to any growth, regardless of its nature, which caused enlargement of the bone, and swelling of the soft parts covering it.]

Much confusion has arisen from this indiscriminate use of the word, as cartilaginous, osseous, cancerous, cystic, and other growths in bone have been comprised under this common title without regard to their pathological distinctions.

Although still occasionally employed in a wider sense, the term is now generally restricted to the cancerous tumours of bone; and to these affections the present article alone has reference.

Amongst the writers of the last century, Heister, J. L. Petit, and Duverney have particularly described this disease under the name of *carnification of the bones*, but they did not altogether distinguish it from certain cases of caries and exostosis; nor did they recognise its malignant character.]

Callisen regards osteosarcosis as a disorder by which the texture of the bones is converted into a fleshy or lardaceous substance, accompanied with a tendency to carcinoma. (*System. Chirurgiæ Hodiernæ*, p. 204, vol. ii. edit. 1800.) We are to understand by osteosarcoma, says Boyer, an alteration of the osseous structure, in which, after more or less distension from separation of its layers, the substance of the bone degenerates, and is transformed into a mass, the texture of which is very diversified, but more or less analogous to that of cancer of the soft parts; while the local and general symptoms still more strikingly resemble those of the latter disease. (See *Traité des Mal. Chir.* t. iii. p. 587.)

[The same author states that all the bones are

liable to be attacked by this disease, but those of the face, and especially the ossa innominata, are more subject to it than the bones of the extremities.]

Those cases of fungous disease in the antrum which expand the bones of the face, make their way to the surface, and, destroying the skin, present such frightful specimens of disease (See ANTRUM), are regarded by the same author as a kind of osteosarcoma, proceeding from carcinoma in the neighbouring soft parts; and this he adduces as an example of his first species of osteosarcoma, or that arising in consequence of previous disease in other parts. In the second species, the disorder commences in the bones, and the soft parts are secondarily affected.

Boyer states that, when the disease has made considerable progress, and, the tumour having existed for a long time, the bony texture has disappeared more or less completely; in lieu of it, an homogeneous, greyish, yellowish, hard-like substance is found, the surface of a slice of which is smooth, much like that of a very hard white of egg, or old cheese, the consistence varying from that of cartilage to that of very thick bouillie. The surrounding soft parts, which have participated in the disease of the bones, are converted into a similar material; muscles, tendons, periosteum, ligaments, vessels, cellular substance, all are confounded in the same homogeneous mass, and have undergone the same degeneration.

In some examples the disease is less advanced; portions of the bone are then met with whose texture and consistence are nearly natural, and which are merely somewhat enlarged. But, in proceeding towards the centre of the disease, the substance of the bone is found softened, and less dense than cartilage, still manifestly retaining, however, a fibrous texture; while, more deeply, it is converted into a material which resembles the soft parts when affected with carcinoma.

In these tumors cysts are often found; sometimes containing a fetid ichor—sometimes a fluid like clear bouillie; and, in certain cases, a quantity of semi-transparent, tremulous, gelatinous matter is noticed in the middle of the lardaceous, medullary, or brain-like substance. He records an instance in which nearly the whole humerus was changed into a gelatinous mass. (See *Mal. des Os*, t. i. chap. 22.)

Dupuytren considers osteosarcoma to be “a true cancerous degeneration of bone,” which attacks more particularly the jaws, the extremities of the long bones, and the iliac bones in the neighbourhood of the acetabulum. (*On Diseases and Injuries of Bones*, Syd. Soc. 1846–7.)

With the view of removing some of the obscurity of the present subject, Dr. Cumin, of Glasgow, proposes that the term, osteosarcoma, should be limited to a degeneration and morbid growth of the lining membrane of the longitudinal canals, and cancelli of bones, accompanied in all cases by absorption of the solid osseous substance. “The disease (he says) is essentially one of destruction of the affected bone, which is produced partly by the pressure of the enlarging tumor, and partly by the diversion of the fluid circulating within the bone to the support of this morbid growth. It always originates within the periosteum, and retains that as its investing membrane.” It is generally slow in its progress; and, in its com-

mencement, the symptoms cannot be readily distinguished from those of chronic rheumatism, or syphilitic pains. After some time, a tumor is perceived, at first firm, but afterwards becoming softer, and, in certain cases, communicating to the surgeon's hand the feel of a distinct pulsation, synchronous with that of the artery of the limb, and capable of being interrupted by compressing the trunk of the vessel. In time, hectic fever, colliquative perspirations, and diarrhoea come on and the patient sinks. Towards the close of the illness, fracture of the bone at the affected part very commonly takes place on some slight exertion, aggravating in a remarkable manner the patient's general distress, but rather lessening than increasing the pain in the bone, connected with distention of its texture. (*Cumin*, in *Edinb. Med. Journ.* No. lxxxii. p. 13.)

This gentleman, in considering the question whether osteosarcoma is of a cancerous nature, expresses his belief that, although all the varieties of the disease are highly formidable, they are not all truly cancerous. One case, which he has himself related, he sets down as cancerous from a view of the whole of the symptoms, and “more especially from the disease having shown itself in two different places at the same time.” Another case, described by him, he does not regard as having exhibited any features of the latter disease. The malignant osteosarcoma of Dr. Cumin, Mr. Crampton, and others (*Dublin Hospital Reports*, vol. iv. p. 558), is, in fact, as they have explained, the *fungous exostosis of the medullary membrane of Sir Astley Cooper*, which is now generally admitted to be medullary cancer of the bones. (See *Edinb. Med. Journ.* No. lxxxii. p. 17.)

Mr. Mayo does not restrict his view of osteosarcoma to the limits adopted by Dr. Cumin, and evidently includes the enchondromatous tumors under this term. “It consists (says he) in a growth of substance, nearly resembling epiphytic cartilage in texture, originating either upon the surface, or in the cancelli of bone. The form of the tumor is commonly more or less spherical: it may attain so great a volume as to be nearly a foot in diameter. When an osteosarcoma is small, the surface, displayed by a section, is tolerably uniform, or differs from the most transparent cartilage only in exhibiting minute oblong or irregular cavities. When an osteosarcoma is larger, cavities of considerable size are found in it, which contain a reddish fluid. In parts, the texture grates when cut, and contains phosphate of lime. This is distributed so as to form a kind of skeleton of light bony plates, disposed in a manner that looks like a crystallisation. The growth of such a tumor is commonly rapid. When it begins in the interior of bone the disease is attended with pain; when it forms on the outer surface, there is commonly no pain at all. An osteosarcoma has to the touch the firmness and elasticity of cartilage. This disease is ordinarily met with in the bones of the extremities, and in the lower and upper jaw. The cranial bones and vertebrae are less frequently if ever attacked by it. The disease does not, that I know of, pervade any other texture than bone. It bears, however, some external resemblance to gelatiniform cancer of other parts. It has not much malignity; so that when all the bones involved in it, with part of the adjacent sound bone, are removed by amputation, the complaint



seldom *reappears* either in the part or in another bone. If the part is not amputated, the skin over the tumor sloughs, or ulcerates, the tumor is exposed, and a discharge, sanious, or ichorous, takes place from it, under which the patient gradually sinks." (See *Outlines of Human Pathology*, p. 50.)

[Bell held the opinion that the bones are very rarely the seat of primary cancer, but that they become involved through extension of the disease from the soft parts surrounding them; the papers by Mr. Sibley and Mr. Baker on the statistics of cancer (*Med. Chir. Trans.* vols. xlii. and xlv.) give, however, an average of nearly four cases, originating in bone, out of every hundred of this disease. The Transactions of the Pathological Society, and the Medical Journals also, record numerous examples where bone was primarily attacked. Every variety of cancer has been met with in bone, but by far the most frequent is the encephaloid. Melanosis and colloid disease are rare; the latter has been mostly found in the articular ends of bones, expanding them and forming large tumors; the former generally infiltrates the osseous tissue, but without causing much enlargement.

Scirrhus in bone is not common. Nélaton (*Éléments de Path. Chir.* vol. ii. p. 28) and others even deny its existence. When met with it is generally in small scattered masses, which are deposited secondarily to the same disease in other organs, but a case is related where it occurred primarily in the lower jaw, and formed a large tumor without any similar deposit in the other parts.

Epithelial disease has, in a very few instances, been met with as a primary affection in bone, but it is usually the result of an extension of the ulceration from the neighbouring parts.

Osteoid cancer, or, as Mr. Stanley terms it, the "malignant osseous tumor," is of rare occurrence. Müller first directed attention to this disease under the name of the "Osseoid tumor," and it has since been ably described by Mr. Paget (*Surg. Path.* vol. ii.). Its malignant character is now generally recognised, although Lébert does not class it amongst the cancerous growths. (For a description of these several varieties of the disease, see article CANCER.)

Encephaloid disease is, in the great majority of cases, the cause of cancerous tumors of bone, and may be developed in its interior, or upon its surface beneath the periosteum. Occasionally the malignant deposit will assume the form of small nodules studding the osseous tissue; these increase in size at the expense of the bone, which, on maceration, shows excavations and holes from loss of substance: this variety is most frequently met with in the flat bones, but may also occur in the others. In some few cases the cancerous matter has been found to infiltrate the whole bone, causing absorption of its cancellated texture and replacing it, so that the bone becomes softened, and in this condition the disease has considerable resemblance to, and has been described as, Mollities Ossium. (See MOLLITIES OSSIIUM.)

When cancer is deposited in the substance of bone it may produce great enlargement by separation of its layers, and distension of the cancelli; the tumor is then divided into a number of irregular cavities which vary much in size and shape, and are filled by the morbid material. This form of the disease is often seen in the articular extremities

of bone, and has been called a *malignant exostosis*. Sometimes the outer layers are expanded by the cancerous growth, whilst the internal structure is destroyed: the investing shell becomes gradually thinned and friable, so that when pressed upon by the finger it yields with a crackling sensation, and has on this account received the name of a *Spina Ventosa*. (See SPINA VENTOSA.)

When the disease commences upon the surface of a bone, the tumor often increases rapidly in size, stretching the periosteum over it; the bone is gradually absorbed, leaving long sharp processes or needles projecting into the malignant mass; after maceration, this acicular arrangement is very striking, nearly all the osseous texture having disappeared, except these thin elongated bony spines, which, standing out beyond the level of the original bone, radiate in all directions from it, and form a bony framework for the tumor, whilst the cancerous matter composing it is deposited in the intervals between them and over their points; this variety of the disease has been described as a *fungous tumor of the periosteum*. Occasionally a section of one of these various masses will present a white or yellowish coloured lardaceous substance, which is greasy to the feel, and evidently contains much fatty matter; this difference in its consistence has obtained for it the name of an *Osteosteoloma* (*ὀστέον*, and *στέον*, fat.) In general, both to the eye and under the microscope, one of these malignant tumors of bone is precisely similar to soft cancer in the other parts, except that when primarily developed in osseous tissue the morbid formation may perhaps, in its early stages, be of a somewhat firmer consistence.

A favourite site for these cancerous growths is in the articular ends of bones, yet the cartilage covering them is very rarely, if ever, attacked; even when the cancellous tissue is completely destroyed, the articular cartilage, although perhaps slightly thinner than usual, is in other respects normal. Nélaton observes, that when these tumors do invade a joint, they creep round that part of the bone which is uncovered by cartilage, and find their way through the fibrous and synovial tissues; he mentions a case where the end of the femur was affected by cancer, which opened into the knee-joint through the intercondyloid notch, the cartilages everywhere remaining perfect. (*Op. Cit.* vol. ii. p. 28.)

Mr. Cæsar Hawkins has recorded an example of the disease protruding from the lower and posterior part of the patella, and thus gaining access into the joint.

When the osseous tissue has been largely destroyed, fracture may occur from very slight causes; it may happen that the interior of a bone has become completely disintegrated, whilst the cortex only remains, with little or no enlargement of the shaft, and in consequence of this thinning of its walls, the bone will readily break; this is one of the causes of FRAGILITAS OSSIIUM. (See this word; also Gerdy, *Maladies des Organes du Mouvement*, p. 306.)

The cancerous deposit may be very limited in extent, but yet has produced absorption of the bone sufficiently to permit of fracture from muscular or other efforts; under these circumstances, in some few instances, union has been found to have taken place. Occasionally the bone has become thickened and indurated in the neighbourhood of the disease,

as if to compensate for the loss of strength at the affected spot (*Path. Soc. Trans.* vol. x.); and some specimens show that, whilst the pressure of the morbid growth has been causing absorption of the osseous texture, formation of new bone has, at the same time, been taking place on and about the tumor.

This very fatal disease is met with mostly in persons who have not attained to middle age; it often commences with a dull aching, or a feeling of fatigue, in the affected limb, and pains of a rheumatismal character along the course of the bone, which are increased by exercise, and are generally worse at night—in this resembling syphilis—with an occasional darting, shooting sensation. As time wears on, difficulty is experienced in performing the various movements of the limb, and a firm hard swelling can be felt over the bone; the tissues covering it are at first free and movable, but, as the tumor increases in size, they are incorporated with it. The skin, however, retains its mobility for a long time, gradually becoming thin and tense, but is not changed in colour until disorganization threatens from pressure; the superficial veins are enlarged, tortuous, and congested; œdema of the limb below the affected part comes on, and often effusion into the joint. The pain in the tumor is now constant, of a stabbing, throbbing character, and is more severe at night; pressure, unless deep seated, does not much increase it, although the skin covering the tumor may be extremely sensitive, and neuralgic pains of parts farther removed are sometimes caused by implication of the nerves. When first felt, the growth is hard and often irregular on the surface, but as it enlarges the swelling becomes more uniform and softer, yielding to the touch, whilst a sense of fluctuation, more or less distinct, may not unfrequently be detected; if punctured with a grooved needle or a fine trocar, a bloody fluid is withdrawn, in which may be seen, under the microscope, the nucleated cells characteristic of cancer; occasionally the tumor will contain cysts filled with a serous or gelatinous fluid, more or less stained by blood extravasated into it. As the disease advances, the health of the patient gradually fails, and hectic sets in, from which he speedily succumbs; or, more rarely, the skin over the tumor may give way, leaving a large fungoid mass exposed, from which fatal hæmorrhage takes place.

The several preparations of opium, or morphia, must be freely administered to relieve the pain in these most distressing cases, together with stimulants and a nutritious dietary, but no treatment is of the slightest use except amputation. The whole of the affected bone should, if possible, be removed, and, if it be one of the extremities which is involved, amputation at the joint immediately above the seat of the disease should be performed. When cancer commences in the interior of a bone, it usually extends along the medullary canal for a considerable distance above and below the tumor, thus forming a plug of malignant deposit, which can only be got rid of, with certainty, by ablation of the whole bone.

In the large majority of cases, however, the disease recurs in some internal organ, and proves fatal, even after recovery from the operation; in St. Mary's Hospital, within the last three years, two cases of soft cancer of the femur have been submitted to amputation at the hip joint, and although the operation was in both

instances successful, the patients died within a few months from the same disease in other parts.]

Mr. Stanley states that medullary cancer is less likely to return when situated in the bones, and amputated, than when placed in any other texture, or organ. Yet few experienced surgeons will now venture to excise the upper or lower jaw bone for medullary tumors, known beforehand to be of this nature, when the disease is far advanced.

Boyer records two cases of osteosarcoma: one of the thigh; the other, of the os innominatum. The first patient was saved by amputation. And Dr. McClellan, of Philadelphia, a few years ago favoured me with the particulars of another case of osteosarcoma of the lower jaw, where the same operation was very skilfully executed. Dr. David L. Rogers, of New York, was among the first in the United States who removed the upper jaw-bone, which he did in a case of osteosarcoma in 1824. This is recorded in the *New York Med. and Phys. Journ.* vol. iii. p. 301. The operation has since been frequently performed in America and Europe. Dr. Mott has performed it thirteen times. (See *Bones and Jaw.*) The same distinguished operator has removed portions of the lower jaw six times, and twice taken out the bone at the articulation.

These operations have since been so frequently performed, that it would be superfluous to name every one of the operators. (*G. G. Gascogen.*)

See *Boyer, Traité des Maladies Chir.* t. iii. *Haller's Element. Physiol.* t. viii. p. 2. 5. *S. A. Kulmus, Diss. de Exostosi Steatomatode Claviculæ; Gedan.* 1732. *S. F. Hundertmark, Diss. sistens Osteosteatomatis Casum rariorem; Lips.* 1752. *S. G. Hermann, Diss. de Osteosteatomate, Lips.* 1767. *S. C. Plenck, de Osteosarcosi; Tub.* 1781, &c. *Sir B. Brodie, in Pathol. and Surg. Obs. on the Joints.* p. 301. *Dr. Cumin, in Edinb. Med. Journ.* Jan. 1825. *Ph. Crampton, in Dublin Hospital Reports, vol. iv. Svo.* 1827. *B. Bell on Dis. of the Bones,* 12mo. Edinb. 1828. *Herbert Mayo, Outlines of Human Pathology.* p. 56, Svo. Lond. 1835. [*L. Heister, Institutiones Chirurgicæ,* 1739. *J. L. Petit, Traité des Maladies des Os,* 1741. *Duverney, Traité des Mal. des Os,* 1751. *Pech, Osteosarcoma, ejusque speciei insignis descriptio; Würzburg,* 1819. *J. Cloquet, Dict. de Méd.* 1826. *L. J. Bégin, Dict. de Méd. et de Chir. pratiques,* 1834. *Nélaton, Elémens de Pathologie Chirurgicale,* vol. ii. 1847. *Stanley, Treatise on Dis. of the Bones,* 1849. *Rokitansky, Manual of Path. Anat.* vol. iii. Syd. Soc. 1850. *Lébert, Traité pratique des Maladies Cancéreuses,* 1851. *Paget, Lect. on Surg. Path.* vol. ii. 1853. *Gerdy, Mal. des Organes du Mouvement,* 1855; *Path Soc. Trans.*]

[OVARIOTOMY. (From ὠάριον, ovary; and τομή, incision). [Syn. *Ovariôtomie*, Fr. and Ger.—*Ovariôtomia*, Ital. and Sp.] Definition.—The operation for the removal of one or both ovaries. As it is only performed by surgeons when one or both ovaries are diseased it is a very different proceeding from the extirpation of healthy ovaries, which has been practised from remote antiquity to the present time on domestic animals for economical purposes, and both in ancient periods and in the middle ages on women, almost exclusively for immoral purposes. Galen, in his work *De Semine*, records that in Eastern Asia and in Cappadocia sows were spayed in order to fatten them, and to improve the flavour of their meat. He also points out the greater difficulty and danger of this operation than the castration of male animals: “Non tum ita tutum in feminis testium extractio administrari potest, ob sedem in quâ collocati sunt; . . . majusque in hoc quam in maribus periculum est.”



We find a passage in Pliny's "Historia Animalium" (lib. viii. c. 77): "Castrantur suis foeminae quoque, sicuti cameli, post bidui inedia suspensae pernis prioribus, vulva recisa; celerius ita pinguescunt," which appears dubious, whether castration or infibulation is alluded to.

In the IXth Book of *Περὶ Ζῴων Ἱστορίας* of Aristotle, the castration of cows and camels is mentioned.

Athenæus, in *Δειπνοσοφιστῶν* (lib. xii. c. 9), relates a story of Andramystes, a Lydian king, who kept castrated females instead of eunuchs in the service of his harem; and Gyges, another Lydian king, is reported to have had several of his concubines castrated, in order to prolong the charms of their youth.

Omitting some apocryphal records of later periods, we pass on to several writers of the seventeenth and eighteenth centuries, as Vierus, Riolan (*Opera prima*, Paris, 1610; *Anatome*, p. 142), Diemerbroeck (*Anatomia corporis humani*, Lyon, 1679; I. I. c. xxiii.), Boerhave (*Prælect. Academ. in prop. inst. f. 5 pars 2 and 669*), Graaf (*de mulierum Organ. Generat. inserv. Tract. nov. cap. 13*), Plater (*Observ. libri tres*, Basle, 1680, p. 248), &c., who either mention the extirpation of the ovaries as having been performed, or propose this operation in the treatment of nymphomania.

So far, by all these writers, the removal of sound ovaries from strong and healthy individuals, placed under the most favourable circumstances, was proposed or commented on. In the present day a diseased organ is extirpated from a person more or less weakened and distressed by long suffering. The ancient operation was the pander to luxurious vice and immorality. Modern ovariectomy, when successful, rescues the victim from otherwise hopeless suffering and certain death, and, even when unsuccessful, mercifully shortens her martyrdom.

It was not earlier than in the seventeenth and eighteenth centuries that ovariectomy was proposed and suggested as a radical cure for diseased ovaries, and as late as in the beginning of the eighteenth century, that this operation was first performed, although it remained long in discredit; and it is only within the last ten years that it has been at all frequently or generally practised.

Theodor Schorkoff, in his *Dissertatio medica inauguralis de Hydrope Ovarii* (Sept. 7, 1685), expresses the belief that the extirpation of dropsical ovaries would lead to a permanent cure, if the operation itself were less cruel and hazardous.

Schlenker, in the 21st thesis of his dissertation *De singulari ovarii sinistri morbo* (1722), proposes the question whether a radical cure of diseased ovaries might not be effected by the removal of the organ through an incision in the abdomen; but he leaves the answer to his more experienced colleagues.

Soon after him, Willius of Basle published (in 1731) a pamphlet, *Specimen medicum sistens stupendum abdominis tumorem*, which contains the following passage: "When, however, the dropsy fills all the chambers of the ovary, when the fluid is thick and viscid, and no hope of recovery is entertained, we question whether such an ovary ought not to be extirpated, and so the root and cause of the disease be removed. We know from experience that severe and large abdominal wounds have

healed; they are not likely to prove more dangerous in the case of attempting a cure by excision of the ovaries." Notwithstanding this advanced view, he still shrank from the execution of the operation, afraid of the extent of the incision required to remove large tumors; of the adhesions likely to be met with; the pain inflicted; the hæmorrhage, the exposure of the abdominal viscera, and its fatal consequences. Giovanni Targioni Tozzetti recommends the extirpation of the ovaries as a last resource, when all other curative means have failed. (*Prima raccolta di osservazioni mediche*, Firenze, 1752, p. 78.)

Ulric Peyer (*Acta Helvetica*, t. 1. Basil, 1751, app. 1), Theden (*Nova acta, nat. curios.*, tom. v. p. 289), and Delaporte (*Mémoires de l'Académie Royale de Chirurgie*, 1833, p. 757) recommend the extirpation of ovarian tumors; and Morand, the Secretary to the Academy, prophesies the ultimate triumph of this operation with the words: "Modern surgery is capable of great achievements; unlimited roads ought to be opened to her goal—to cure."

Antony de Haen (*Ration. Medend.*, part iv. cap. 5 § 2) and Morgagni were opposed to the operation, which W. Hunter and Van Swieten (*Commentaries in H. Boerhave's Aphor.*: 1770, tom. iv. § 1223) justify in extreme cases.

Dr. William Hunter, in a paper "On Cellular Tissue," published in 1762, in the second volume of the *Medical Observations and Inquiries*, after stating that the trocar is almost the only palliation in the treatment of ovarian dropsy, says: "It has been proposed by modern surgeons, deservedly of the first reputation, to attempt a radical cure by incision and suppuration, or by excision of the cyst." In support of his opinion, "that excision can hardly be attempted," having pointed out difficulties during the operation, and dangers following it, which modern practice has overcome, he concludes with the following words, which foreshadow some of the modifications in the operation, by which ovariectomy, once stigmatised as cruel, barbarous, scarcely less than murder, has become one of the most brilliant triumphs of modern surgery. Hunter says: "If it be proposed, indeed, to make such a wound in the belly, as will admit two fingers or so, and then tap the bag and draw it out, so as to bring its root or peduncle close to the wound of the belly, that the surgeon may cut it without introducing his hand, surely in a case otherwise so desperate it might be advisable to do it, could we beforehand know that the circumstances would admit such treatment." (*Op. cit.* p. 45).

Not many years later, ovariectomy found an enthusiastic advocate in Chambon (*Maladies des femmes. Maladies chroniques à la cessation des règles*, chap. xxxix. *De l'extirpation des ovaires*, Paris, 1798). Adhesions, he says, do not generally render ovariectomy impossible. They are mostly found between the tumor and the peritoneum, the broad ligament, the fallopian tubes and their fringes, and sometimes the omentum and the intestines. It is not always possible to determine the extent and the nature of the existing adhesions beforehand, when the tumor is movable. When the tumor is free, difficulties in the operation and serious accidents will seldom be met with, provided the patient is not suffering from any dyscrasia or is much exhausted, in which case the operation ought not to be performed. Adhesions with the omentum seldom interfere with the mo-

bility of the tumor, in which case their diagnosis is difficult. The adherent border of the omentum may be removed without danger. Abnormal connections between the tumor and intestines will not contraindicate the operation, unless there is a high degree of inflammation, by which the adhesion has been contracted. In such a case, the tumor will be found firmly connected with the intestines, and it will be better to abstain from the operation. Such adhesions are not only very extensive, but also very intricate, the tumor and the neighbouring intestine forming almost one mass. If it be impossible to remove the diseased parts: either a portion of the tumor must be left behind, and a protracted and dangerous suppuration would be the consequence; or a portion of the adherent viscus must be removed, which would place the life of the patient in jeopardy. He thought that all the different varieties of ovarian degeneration may be extirpated, provided none of the above contraindications were present. The same rules apply also to the dropsy of the tubes. There are ovarian tumors which, after having attained a certain size, will remain stationary. This will be observed sometimes in scirrhus. Such cases should not be interfered with. He concludes with the words: "I am convinced that a time will come when this operation will be considered practicable in more cases than I have enumerated, and that the objections against its performance will cease."

John Bell never performed ovariectomy, but Dr. Ephraim McDowell, a Virginian practising in Kentucky, who attended Bell's course of lectures in Edinburgh in 1794, is said by his biographer, Dr. Gross, to have been "enraptured by the eloquence of his teacher, and the lessons which he imbibed were not lost upon him after his return to his native country. Bell is said to have dwelt with peculiar force and pathos upon the hopeless character of ovarian tumors when left alone, and of the practicability of removing them by operation. It is not improbable that the young Kentuckian, while listening to the teaching of the ardent and enthusiastic Scotchman, determined in his own mind to extirpate the ovaries of the first case that should present itself to him after his return to his native country. The subject had evidently made a strong impression upon him, and had frequently engaged his attention and reflection. He had thoroughly studied the relations of the pelvic viscera in their healthy and diseased conditions, and felt fully persuaded of the practicability of removing enlarged ovaries by a large incision through the walls of the abdomen." (Gross's *Lives of eminent American Physicians and Surgeons*, pp. 209, 212.)

Dr. McDowell returned to Kentucky in 1795, and commenced practice at once; but it was not until fourteen years afterwards that he was consulted, in 1809, by a patient upon whom he first performed ovariectomy, and who survived in good health until 1841, and died after the completion of her seventy-eighth year.

In 1808, one year before Dr. McDowell's first operation, D'Escher (*Considérations médico-chirurgicales sur l'hydropisie encystée des ovaires. Thèse: Montpellier, 1808*), suggested the removal of diseased ovaries through an incision along the external border of the rectus muscle. Existing adhesions should be detached with the fingers or, if necessary, with a bistoury; the tumor ex-

tracted and excised after the application of a ligature around the pedicle. The ends of the ligature were to be brought out by the wound, the edges of which were kept in close apposition by lateral pads and a bandage around the body.

McDowell's case has long been considered the first case of ovariectomy on record; for the operation of L'Aumonier of Rouen, in 1776—which had been referred to as one of ovariectomy, and which even Dr. Little, in his table (published in 1843), enumerates as the first operation of ovariectomy—was a case of pelvic abscess, which he opened by an incision through the wall of the abdomen above Poupart's ligament, six or seven weeks after parturition. He seems also to have separated the fimbriæ of the fallopian tube from the sac of the abscess, and to have removed the ovary without any necessity, and without any idea of ovariectomy. His case may be found recorded in the *Histoire de la Société Royale de la Médecine*, 1782, tom. v. p. 298.

Another case, included in some of the tables of ovariectomy by Professor Dzondi, is one in which a pelvic tumor was cured by drawing out a cyst through an incision in the abdominal wall of a boy twelve years old.

Atlee, however, communicates (in the *American Journal of Medical Sciences*, vol. xvii. 1849, p. 534) a case which claims the priority to that of McDowell by more than a century. It is the case of Dr. Robert Houstoun, which may be found under the head, "A dropsy of the left ovary of a woman aged fifty-three years, cured by a large incision made in the side of the abdomen," in the *Philosophical Transactions* (from the year 1719 to 1733), abridged and disposed under general heads, vol. vii. p. 541 (London, 1734). From this case it will appear that ovariectomy originated with British surgery on British ground. Dr. Robert Houstoun operated, in August 1701, on a Mrs. Margaret Miller, near Glasgow, who since her last confinement, thirteen years before, when twenty-three years of age, suffered from ovarian dropsy. The tumor had grown to a monstrous bulk; she was much wasted, had great difficulty in breathing, want of appetite and sleep, and bed-sores from long confinement. This case is in many respects a very curious one, and the operator's own words are worthy of record. He says: "After having obtained the patient's consent that, in order effectually to relieve her, I must lay open a great part of her belly, and remove the cause of all that swelling . . . I prepared without loss of time what the place would allow, and with an imposthume lancet laid open about an inch; but finding nothing issue, I enlarged it two inches; but even then nothing came forward but a little thin yellowish serum, so I ventured to lay open two inches more. I was not a little startled, after so large an aperture, to find it stopped only by a glutinous substance. All my difficulty was to remove it. I tried my probe—I endeavoured with my fingers, but all was in vain; it was so slippery that it eluded every touch and the strongest hold that I could take. I wanted in this place almost every thing necessary, but bethought myself of a very odd instrument, but as good as the best, because it answered the end proposed. I took a strong fir-splinter, wrapped some loose lint about the end of it, and thrust it into the wound; and by turning and winding it, I drew out about two yards in



length of a substance thicker than any jelly, or rather like glue that is fresh-made and hung out to dry; the breadth of it was above ten inches. This was followed by nine full quarts of such matter as I have met with in steatomatous and atheromatous tumors, with several hydatids of various sizes, containing a yellow serum, the least of them bigger than an orange, with several large pieces of membranes, which seemed to be parts of the distended ovary. Then I squeezed out all I could, and stitched up the wound in three places, almost equidistant. The lower part of the wound was kept open by a small tent. Some serosity discharged from it for four or five days. The wound was covered in its whole length with a pledget spread with some home-made balsam, over that several compresses dipped in warm brandy, then several towels; all these dressings were fastened by swathing her round the body. An anodyne was given several times a day. The next morning the patient was found much refreshed by a good night's rest, the first she enjoyed for the three months past. After three weeks she was able to sit outdoors, wrapped up in blankets, superintending her farm-labourers. She recovered, and lived in perfect health from that time till October 1717, when she died after ten days' illness."

Although this isolated case of Dr. Houstoun undoubtedly strengthens the claim of British surgery to the honour of originally practising ovariectomy, it will hardly deprive Dr. McDowell of his undeniable merit of having been the first who, guided by scientific principles, enriched modern surgery with the operation. He followed up his first case by others. He performed the operation thirteen times altogether between 1809 and his death in 1830. The precise number of deaths cannot be ascertained, but of eight cures there can be no doubt. McDowell's successes were followed up by other American surgeons. In 1822 Mr. Smith, of Connecticut, performed a successful operation. He removed a cyst containing six pints of fluid, through an incision five inches long. He broke down extensive adhesions between the tumor and the abdominal wall and the omentum. The wound was united by means of adhesive plaster and roller. No unfavourable symptom occurred until the separation of the ligature, when an abscess formed, which had to be opened. The patient, twenty-three years of age, was able to walk after three weeks, and speedily recovered. (Case of ovarian dropsy successfully removed by a surgical operation. *Edinburgh Medical and Surgical Journal*, 1822; and *American Medical Recorder*, Philadelphia, vol. v. 1822, No. 7.)

In another case Smith was unable to complete the operation on account of extensive adhesions. He emptied the cyst, and the patient recovered. But the cyst filled again. (*Med. and Surg. Memoirs*, p. 231.)

In 1823 G. Smith removed an ovarian tumor from a negro woman, through an incision extending from the umbilicus to the os pubis, after previously having emptied the contents of the cyst. The peduncle was secured by a ligature. The patient recovered within twenty-five days. (*North American Medical and Surgical Journal*, January, 1826.)

Lizars of Edinburgh was the first to attempt ovariectomy in this country. He performed two

operations in 1825, of which the first was successful, the second fatal in fifty-six hours. He opened the abdomen on two other occasions, but only to prove errors of diagnosis. Both patients recovered.

The first attempt to perform ovariectomy in London was made by Dr. Granville in 1827, who operated in two cases. In one the operation was abandoned on account of the extent of the adhesions; the woman recovered. In the other case a fibrous tumor of the uterus, weighing eight pounds, was removed; but the patient died on the third day.

The ill-success of Mr. Lizars and Dr. Granville, who both operated by the long incision, brought discredit upon the operation; and it was not until 1836, nine years after Dr. Granville's failures, that a provincial surgeon, Mr. Jeaffreson of Framlingham, acted upon the suggestion of William Hunter, and performed ovariectomy by the small incision for the first time in Great Britain. A bilocular cyst was removed through an opening only an inch and a half long. The patient was alive in 1859, was fifty-six years of age, and had given birth to one boy and three girls after the operation.

In the same year (1836) another provincial surgeon, Mr. King of Saxmundham, successfully removed an ovarian cyst through an incision only three inches long; and Mr. West, of Tonbridge, also had a successful case, the incision being only two inches long. In 1838 Mr. Crisp, of Harleston, in Suffolk, removed a multilocular cyst through an incision only one inch long. The patient lived fifteen years after the operation, and enjoyed good health.

In 1839 Mr. West, of Tonbridge, had a second successful case; a single cyst, which contained twenty-two pints of fluid, having been removed by the short incision. Mr. West also had an unsuccessful case of completed ovariectomy, and one in which the adhesions prevented the completion of the operation. In the same year the first attempt to perform ovariectomy in a London Hospital, of which the writer has been able to find any record, was made at Guy's, by Mr. Morgan; a small incision was made, adhesions were found, the tumor was not removed, and the patient died in twenty-four hours.

In 1840 Mr. Benjamin Phillips operated at the Marylebone Infirmary, and completed the operation for the first time in London; but the result was unsuccessful.

In 1842 Dr. Clay, of Manchester, commenced his series of operations, performing ovariectomy four times, and in three out of the four with success. In 1843 he also operated four times, twice successfully. In 1843 Mr. Aston Key removed both ovaries from a patient in Guy's Hospital. His incision extended from the ensiform cartilage to the pubes, and death followed on the fourth day. Later in the same year, Mr. Bransby Cooper operated in the same hospital by the long incision, and removed a large multilocular cyst, but the patient died on the seventh day.

So that twenty-five years ago, although ovariectomy had been performed with very qualified success in one case in Scotland, and in at least ten cases with complete success by surgeons in our own provinces, it had never been performed successfully in London. It was the good fortune of Mr. Walne to

perform the first successful operation in London in November 1842; and he had two other successful cases in May and September 1843. In that year and in 1844, Dr. Frederic Bird had three and Mr. Lane two successful cases. Mr. Lane's first patient is now (1867) still alive and has had seven children. In 1843 and 1845, Mr. Southam, of Salford, and in 1845 Mr. Dickson, of Shrewsbury, published successful cases. In 1846 Mr. H. E. Burd had a case which is published in the thirtieth and thirty-second volumes of the *Medico-Chirurgical Transactions*, the patient having recovered and had a child two years after the operation.

In the same year Mr. Solly assisted materially in the progress of ovariectomy, by pointing out one of the causes of danger and the means of avoiding it; taking advantage of an unsuccessful case which occurred in his practice in St. Thomas's Hospital, to teach his pupils and professional brethren, that retraction of the pedicle behind the ligature is very likely to occur, and to lead to fatal hæmorrhage, unless prevented by great care. His clinical lecture, published in the *Medical Gazette* in 1846, contains a masterly review of the arguments for and against the operation, which must have had considerable effect upon the mind of the profession at the time.

The year 1846 is also noteworthy in the history of ovariectomy, as in that year Mr. Caesar Hawkins performed the operation successfully in St. George's Hospital, this being the first successful operation in any of our metropolitan hospitals. But Mr. Hawkins did not repeat the operation, and his example was not followed by others for several years; Dr. F. Bird and Mr. Lane being the only operators in London, except Dr. Protheroe Smith, who had a successful case, although Dr. Clay continued his operations at Manchester, and successful cases were recorded by Dr. Elkington of Birmingham, and by Mr. Crouch in 1849, and by Mr. Cornish of Taunton, and Mr. Day of Walsall, in 1850.

In 1850 Mr. Duffin inaugurated a new era in ovariectomy, by pointing out the danger of leaving the tied end of the pedicle to decompose within the peritoneal cavity, and by insisting upon the importance of keeping the strangulated stump outside. He acted up to this principle in a case which was published in the thirty-fourth volume of the *Medico-Chirurgical Transactions*. On the 12th of November of the same year, a memorable discussion took place in the Medico-Chirurgical Society after Mr. Duffin's case and Dr. Robert Lee's table of cases of ovariectomy had been read; which led to the common belief, not yet overcome, that we have no means of determining whether an ovarian tumor can or cannot be removed without the prelude of an exploratory incision. The debate was closed by Mr. Lawrence, one of the oldest, ablest, and most experienced Fellows of the Society, proposing the question: "Whether the attempts at treating diseased ovaries by surgical operation can be encouraged and continued without danger to the character of the profession?" No wonder that this discussion acted most unfavourably on the progress of ovariectomy.

Meanwhile Dr. Clay continued to operate at Manchester, but as his cases were not brought before any influential society, and only about twenty were published in detail, and as his operations were not performed in an hospital, his example led only very few surgeons to follow him; while his

adherence to the long incision maintained the dread with which the operation was regarded both by the profession and the public, long after chloroform had done so much to lighten apprehension, to abolish pain, and to lessen shock. Here and there an occasional case was recorded. Mr. Beale, of Halesworth, had a successful case by the small incision a fortnight after the above-mentioned memorable debate; but Dr. F. Bird himself either ceased to operate or to report his cases. In 1852 Dr. Tanner had a successful case, and a second in 1853. In the same year (1853), Mr. Borlase Childs and Mr. Erichsen had each one successful case. In 1855 Mr. Garrard of Halesworth had another, and in 1857, Mr. Humphrey of Cambridge and Mr. Hunt of Ashton-under-Lyne had each a successful case. Between his first case in 1852 and 1856, Mr. Baker Brown operated on nine cases; but his results were so disastrous, seven of nine patients having died, that the operation fell into still greater discredit, and an influential reviewer wrote, that "though it may excite the astonishment of the vulgar, it calls neither for the knowledge of the anatomist nor the skill of the surgeon," and that whenever an operation was performed "so fearful in its nature, often so immediately fatal in its results, a fundamental principle of medical morality is outraged." In some of the most recent surgical works the operation was not even alluded to; in the best works on diseases of women it was condemned. No successful case had occurred in Scotland since Mr. Lizars's partial success in 1825. Ovariectomy had only once been performed in Ireland. In London, Mr. Walne, Mr. Lane, and Dr. F. Bird had either ceased to operate or to publish their cases, Mr. Baker Brown had not operated for more than two years, and Mr. Caesar Hawkins's was still, after twelve years, the only successful operation which had been performed in any of our large metropolitan hospitals.

But with the year 1858 a new era began for this operation. The writer, on his return from the East after the Crimean war, resuming his duties as surgeon to the Samaritan Hospital, became strongly impressed by the miserable end of some patients who died worn out by the ordinary progress of the disease, by the inutility of palliative treatment, and by the danger of iodine injections. This led him, in December 1857, after carefully considering the evidence adduced for and against ovariectomy, to put the operation to the test of personal experience, pledging himself to make the results fully known to the profession. His first attempt was not encouraging. Finding the intestines in front of the tumor, he was induced to close the wound without proceeding further, on the representation that the tumor could not be ovarian. The patient recovered well, but died four months afterwards, from spontaneous rupture of a cyst into the peritoneal cavity, and he had the mortification to find that the tumor might have been easily removed.

The three following cases were successful; the first was in February 1858. The tumor was exhibited at the Pathological Society; the case was fully reported in the *Medical Times*, and more than one writer has traced to that case the commencement of what has been termed on the continent "the revival of ovariectomy in England." The fifth case, or fourth case of completed ovariectomy, was fatal. These five cases were brought



before the Royal Medical and Chirurgical Society in February 1859.

Mr. Hutchinson was the first to follow up ovariectomy in 1858. He had two successful cases in that year, and he assisted very materially in the progress of the operation by making his cases well known, and by the introduction of the clamp as a ready means of securing the pedicle, and of fixing it on the abdominal wall. Mr. Baker Brown, after an interval of more than four years since his second and last successful case, recommenced operating, and had two successful cases in 1858, and two in 1859; but six fatal cases in the practice of the same operator, in 1859, somewhat retarded the progress of ovariectomy in the favourable opinion of the profession.

Between his first case in February 1858, and March 1867, the writer has completed the operation of ovariectomy in 200 cases. He has also commenced the operation but has not completed it, or has made simple exploratory incisions in cases of doubtful diagnosis, in eighteen other cases. In seven cases he has removed both ovaries; four of the patients recovered. In two cases he has extirpated the second ovary of a patient. One had ovariectomy performed eight months previously by another surgeon. Death followed on the seventh day. In the other case he successfully removed the right ovary, eighteen months after having removed the left. In one case the patient was pregnant, and the child was delivered by cæsarian section after removing the ovarian tumor. The mother is still alive and in excellent health.

In the following table the number of these cases with the results are given in each year:—

Year	Completed ovariectomies		Incomplete operations		Exploratory incisions	
	Recoveries	Fatal	Recoveries	Fatal	Recoveries	Fatal
1857	—	—	1	—	—	—
1858	3	—	—	—	—	—
1859	6	5	—	—	—	—
1860	4	2	1	—	1	—
1861	6	5	—	—	1	—
1862	16	5	1	—	—	1
1863	18	13	—	—	—	—
1864	25	9	—	1	1	—
1865	26	8	2	1	1	—
1866	31	14	1	2	2	1
1867 up to March	3	1	—	—	—	—
	138	62	6	4	6	2
Total Number }	200		10		8	
218						

The per-centage of mortality may be seen in the annexed table:—

		Mortality		
		Reco.	Died.	pr.cent.
Completed ovariectomies	200	138	62	31
Incomplete operations	10	6	4	40
Exploratory incisions	8	6	2	25

Total number of operations 218 150 68 31.19

The two cases alluded to above where ovariectomy

was performed twice on the same patient, are not included in this table.

It is worthy of notice that increasing experience has been accompanied by diminishing mortality. Of the first 100 patients, 66 recovered and 34 died. Of the second 100, 72 recovered and 28 died.

Since 1858 many other surgeons have operated with more or less success in London and the provinces, as well as in Scotland and Ireland. Lately Dr. Mackinnon in New Zealand, and Dr. Tracy, of Melbourne, have become the pioneers of ovariectomy at the antipodes. In America, Atlee, Peaslee, and others have performed a number of successful operations.

In France this operation has made but tardy progress, notwithstanding Cazeaux's spirited and energetic advocacy at a meeting of the Académie de Médecine in 1856, and the writings of Charles Bernard (*Archives Générales de Médecine*, 1856) and Jules Worms (*Gazette Hebdom.* 1860).

In 1862 M. Nélaton came to England, and witnessed several operations. On his return to Paris he operated himself and published a classical lecture, and from this time we may date the progress of ovariectomy in France; although the operation had been performed before Nélaton's visit in England, by Woyerkosky in 1844, Vaulleuard in 1847, Maisonneuve in 1829, Hugott, 1838, Boinet, Richard, Jobert de Lamballe, and Demarquay. Nélaton performed his first operation in June 1862. Koeberle, of Strasbourg, has been his most successful compatriot but the operation has been performed by many French surgeons in Paris and the provinces. In Germany ovariectomy has been almost as unpopular as in France. Dieffenbach expressed himself disparagingly, and his contemporaries accepted the verdict. Crysman's and Dzondi's unfavourable results in 1819–21, brought the operation in still greater discredit. Dieffenbach, however, notwithstanding his former condemnation, operated in 1826 on a woman forty-four years of age. He made the incision in the linea alba, and extirpated a large ovarian tumor. He met with great difficulty in arresting the hæmorrhage, but his operation was crowned with success. Martini, Ritter, and others followed Dieffenbach's example, but with so little success that, during the period from 1826 to 1850, only three recoveries were achieved in twenty operations, and of eight incomplete operations five proved fatal. The most accomplished surgeons tried to redeem the reputation of ovariectomy, but when men like Langenbeck, Kiwisch, Heyfelder, Schuh, Siebold, and Scanzoni failed, it is not surprising that for several years the operation ceased to be practised. It is principally since 1862, after German surgeons had witnessed and studied the modifications and improvements in ovariectomy of their English brethren, and on their return operated with better success, that ovariectomy is finding its place among legitimate operations.

The number of cases and monographs on this subject published in different European languages spread the knowledge of the success of ovariectomy, and in rapid succession we hear of cases operated upon with varying success in all parts of Europe. The first ovariectomy in Portugal was performed on February 7, 1866, at Lisbon, by Dr. Antonio Barbosa. The patient died on the seventh day.

Although in the present article we are restricted

to a consideration of the operation for the removal of one or both ovaries, it appears desirable (in order that we may properly determine in what cases of diseased ovaries their removal can be justifiable or necessary) to briefly consider other methods of treatment which may be resorted to when ovarian cysts or tumours have attained so large a size that the comfort and general health of the patient is seriously interfered with, and where ordinary medical or palliative treatment has proved of little avail. In such cases the average duration of life certainly does not exceed two years, and these years are generally a period of great discomfort, possibly of extreme and hopeless suffering. Those cases in which, under expectant treatment or after repeated tapplings, life has been prolonged for many years, are rare exceptions to the above rule. Given their due weight they lead to some important practical conclusions, which may be summed up as follows:—

I. So long as an ovarian tumor does not materially interfere with the appearance, prospects, or comfort of the patient; so long as no injurious pressure is exercised by it on the organs of the pelvis, abdomen, and chest; so long as heart and lungs, digestive organs, kidneys, bladder, and rectum perform their functions without much disturbance; so long as there is no great emaciation, no very wearying pain, no distressing difficulty in locomotion; or so long as any such injurious influence can be counteracted by ordinary medical care, the patient *should be left to that care, undisturbed by any surgical treatment.*

II. All specific medical treatment, by iodine or bromine, or mercury, or lime, or potass, or by diuretics or other medicines used with a hope of checking the growth of ovarian cysts and tumors, or of leading to absorption of the fluid they contain, having been proved by ample experience to be absolutely worthless, no medical treatment should be adopted which can possibly injure the general health of a patient, or place her in a less favourable position than she otherwise would be for such surgical treatment as may ultimately be called for.

III. When, however, an ovarian tumor deforms a patient, or materially impedes locomotion, or interferes with the free action of heart or lungs, or obstructs the circulation through the large veins in the abdomen, or causes more or less constant and distressing pain, loss of rest, or emaciation, or leads to derangements of the digestive organs, or makes injurious pressure on the contents of the pelvis, surgical aid is required.

IV. The nature and connections of the tumor must guide us in our selection of one or the other of the following methods:—

1. Simple tapping through the abdominal walls.
2. Simple tapping through the vagina.
3. Simple tapping through the rectum.
4. Tapping followed by pressure.
5. Tapping and the formation of a permanent subcutaneous opening in the cyst-wall.
6. Tapping and the formation of a permanent opening through the skin, vagina, or rectum.
7. Incision.
8. Tapping followed by injection of iodine.
9. Ovariectomy.

1. *Tapping through the abdominal wall* is indicated when a cyst situated in the abdomen is large and single, or when there is more than

one large cyst. It is useless when the tumor is composed of a number of small cysts, or of semi-solid structure. In single thin-walled cysts, which contain a clear, limpid fluid of low specific gravity, simple tapping may effect a radical cure. In cases where the cyst-wall is thick, and the contents viscid or gelatinous, growth of the cyst and reproduction of fluid is the rule.

Tapping is by no means free from danger. Fatal hæmorrhage has followed it, either from puncture of some vessel in the abdominal wall or in the cyst; and a low form of suppurative inflammation of the lining membrane of the cyst is far from uncommon, when precautions are not taken to prevent the entrance of air into the cyst. Wounding of a vessel in the abdominal wall is most likely to be avoided by making the puncture in the linea alba, but even in this situation death has followed puncture of a dilated vein. Should a flow of blood follow the withdrawal of the canula, the safest plan is to make an incision through the puncture, and for an inch above and below it, so that the bleeding vessel may be seen and tied, or compressed by a needle. If the vessel be on the wall of an adhering cyst, it may be tied; but if the cyst have collapsed and bleeding should continue into the abdominal cavity, *immediate ovariectomy* would probably be the best treatment.

Entrance of air into the cavity of a cyst, and consequent inflammation of its lining membrane, may be obviated by the use of the syphon-trocar introduced by Mr. Thompson, of Westerham, and modified by the writer. It is introduced like an ordinary trocar, after a lancet-puncture through the skin. The piston or hollow tube is then withdrawn, and the fluid passes through the canula and tube without noise or exposure of the patient, who lies upon her side in bed. In this position no bandaging or pressure is necessary, as when the patient is seated in a chair. The tubend of the canula should always be held at a higher level than the end within the cyst, as air, though readily passing upwards along a tube into a cavity from which fluid is escaping, will not pass downwards except under the influence of suction. As the contracting cyst may be very easily detached from the canula, and ovarian fluid might then pass into the peritoneal cavity, the cyst should always be allowed to empty itself without any disturbance of the abdominal parietes by kneading or pressure. When the cyst appears to be empty, the patient should turn on her back, so that any fluid may gravitate away from the opening in the cyst-wall. The canula may then be withdrawn with one hand, while the abdominal wall is so grasped with the other, that no air can enter as the canula escapes. The puncture is then to be carefully closed by means of a hare-lip or "safety-pin," and twisted suture. This effectually prevents both oozing of fluid and entrance of air.

2. *Tapping through the vagina* is much more liable to be followed by cyst inflammation than is tapping through the abdominal wall, because it is not easy to prevent entrance of air. It should always be attempted by attention to the level of the canula; but it seldom succeeds. Indeed the object of selecting the vagina as the site of tapping has generally been to do more than simply empty a cyst, and with the hope that the fluid may escape by the depending opening as fast as it is



secreted, and the cyst gradually collapse and close. This hope is seldom realised. As a rule, air enters the cyst, the opening closes, the fluid remaining in the cyst, or that re-secreted, putrifies; suppurative inflammation of the lining membrane comes on, and all this is accompanied by a low form of exhaustive fever or pyæmia, which is only relieved by making and maintaining a free opening. The frequency of these consequences should make tapping through the vagina an exceptional practice; but it is to be recommended in cases where an ovarian cyst is bound down in the pelvis by adhesions, and its pressure on the bladder or rectum must be relieved. In such cases the puncture should be made where the fluctuation is most evident, and as near the median line as possible. The canula or an elastic catheter may be left in the cyst, and the safest plan is either to introduce a wire-seton or a drainage-tube through part of the cyst and fasten it in the vagina, or to make an incision as the canula is withdrawn and keep the opening patent by a pledget of iodised lint, in order to permit free escape of any fluid as fast as it is secreted.

3. *Tapping through the rectum* has some advantages over tapping through the vagina. There is no constant discharge of offensive fluid; for any ovarian fluid which enters the rectum is retained, just as a liquid motion is retained, by the sphincter ani, and it is discharged when the patient pleases. But a dysenteric tenesmus has been occasionally observed, which has proved very distressing, and fatal inflammation has followed entrance of fecal gases into the cyst. It is but a choice of evils, and the surgeon must be guided by the situation and progress of the cyst in each case.

4. *Pressure after tapping* is probably useless. It has been supposed, in some cases, where simple tapping has been followed by a radical cure, that the cure was due to the pressure. But this was from ignorance of the fact, that single, thin-walled cysts, with limpid contents, frequently collapse after simple tapping, and do not refill.

5. *Tapping and the formation of a permanent subcutaneous opening in the cyst-wall.*—It has been proposed to empty a cyst by tapping, and then to make a crucial incision in its wall, or to cut away a piece of the wall, in order that the ovarian fluid might enter the peritoneal cavity and be absorbed as fast as it is formed. Both these plans have been tried, and each with success, in one case. But it is a most hazardous proceeding, for we learn from cases in which ovarian fluid enters the peritoneal cavity in consequence of accidental or spontaneous rupture of the cyst, that, although in some rare exceptions a radical cure has followed, fatal peritonitis is the ordinary result.

6. *Tapping and formation of a permanent opening through the skin, vagina, or rectum.*—A permanent ovarian fistula has sometimes followed simple tapping, and has frequently been produced by securing the canula or an elastic tube in the opening by the skin. This is a most dangerous practice, which cannot be justified by a few rare and exceptional successful cases. The results by the vagina or rectum may prove to be more satisfactory.

7. *Incision into ovarian tumors* can only be justified when it is the only means of affording relief or prolonging life. There are cases where

the contents of the cysts are so viscid that they will not escape through the largest canula; but the patient is being killed by the pressure. Here a free incision through a part of the abdominal wall, or of the vagina, where the tumor is adherent, may give great temporary relief; but, sooner or later, the patient is worn out by the exhausting discharge.

8. *Tapping followed by injection of iodine* may be practised in cases where a cyst is single, or where one cyst is so far developed beyond the others as to be the chief cause of distress. But it is dangerous, and must be useless, in cases of compound cysts or semi-solid tumors. It is difficult to ascertain the proportionate danger of this treatment, as compared with ovariectomy in favourable cases (and it must be remembered that the cases in which it is indicated are those most favourable for ovariectomy); but it would seem to be advisable in cases of large single cysts, where simple tapping has proved useless, or where there is something which forbids ovariectomy.

Fatal cases are on record where iodine was injected into the peritoneal cavity instead of the cyst, either from error of diagnosis, or from the empty cyst having slipped off the canula before the iodine was injected. This danger has been obviated by passing an elastic catheter through the canula to the bottom of the cyst, and injecting through the catheter. With the same object the writer contrived an instrument, consisting of a trocar fourteen inches long and covered by a canula of gum elastic. The trocar is used in the ordinary manner; but as it is withdrawn, the canula is pushed on to the bottom of the cyst. A syringe with a stop-cock, and a graduated glass vessel for the iodine, are so secured that every drop of ovarian fluid may be removed, and the entrance of air is prevented during the escape of the fluid, the entrance of iodine, and the withdrawal of any portion of the iodine. A much simpler elastic tube and bottle is now fitted to his ordinary syphon-trocar.

A strong watery solution of iodine in solution of iodide of potassium appears to be preferable to an alcoholic solution. The symptoms, in some fatal cases, have been those of alcoholic rather than of iodine poisoning. The solution used by the writer is a scruple of iodine and half a drachm of iodide of potassium in an ounce of water.

When a cyst holds from ten to twenty pints of fluid, from one to two ounces of this solution may be left in the cyst. When the cyst holds from twenty to fifty pints of fluid, it would probably be better to inject eight, ten, or twelve ounces of the solution, so that the whole of the lining membrane may be acted on, and then remove the greater portion of the solution.

9. *Ovariectomy* is the only resource when the other modes of treatment enumerated are not likely to be useful, or have failed. It is a dangerous operation, but the results are quite as favourable as those of many other capital operations. In successful cases the patient is restored to perfect health, and if only one ovary has been removed, she may bear children afterwards. All varieties of ovarian tumors, except those of malignant character, may be extirpated, viz. *unilocular cysts*, containing limpid, colourless or serous fluids, tending to rapid reproduction; or those with thick, viscid, gelatiniform, opaque, more or less dark

coloured contents; *multilocular cysts*, filled with albuminous, serous, colloid, gelatiniform fluids, either colourless or dark or whitish; semi-solid or solid tumors; dermoid cysts. But in order to secure a successful result, certain indications in favour of the operation ought to be weighed against the circumstances which would otherwise constitute grave contra-indications.

1. The general health of the patient ought not to have suffered from the local disease to such an extent that she would not be likely to bear the shock of the operation.

2. The patient ought to desire the operation, and she should be convinced of the necessity of its performance.

3. Tumors of moderate size, when free, or even if the adhesions are extensive, provided they are not firmly fixed in the pelvis, justify a favourable prognosis.

4. The more rapidly the cyst grows, the faster the fluid recollects after tapping, and consequently the more deleterious its effects on the patient the more urgent become the reasons against delay.

5. When after a palliative tapping the cyst has refilled to a certain degree, so that another tapping would soon become necessary, ovariectomy ought to be performed, provided the other indications are in its favour.

6. Solid or semi-solid tumors, or multilocular cysts, consisting of many small chambers or trabeculated stroma, with thick and very viscid contents, which could not be diminished in bulk and weight by tapping during the operation, ought to be extirpated if possible while they are of moderate size and will escape through an incision of moderate length.

7. Multilocular cysts with very thin and friable walls and septa, and with viscid or jelly-like contents, occasionally break on the slightest pressure during the operation. Such cysts would have undoubtedly ruptured within a short period spontaneously or from an accidental injury, and brought the disease to a fatal termination, had not the proper moment been seized, and by their removal imminent danger been warded off.

8. When an ovarian cyst has given way, the contents, if fluid, may be absorbed by the peritoneum; if viscid, fatal chronic peritonitis is generally set up, and ovariectomy affords the only hope of recovery.

*Contra-indications.*—1. As a general rule, any existing disease which in its natural course would prove fatal to the patient or would influence her constitution in such a manner as to render her recovery very unlikely, or other serious surgical operations inadmissible, will also forbid ovariectomy.

This operation ought not to be resorted to in individuals suffering from cancer, far-advanced tuberculosis or scrofula, syphilis, diseases of the heart, or in cases where this organ has been displaced by the tumor, and at the same time has been fixed in its abnormal site by adhesions which would retain it in its position even after the removal of the ovary; diseases of the brain and the nervous centres, of the liver, spleen, and kidneys; ulcers of the stomach and diseases of the alimentary canal, which permanently impair general nutrition; intimate connections of the tumor with and serious lesions of the uterus, the bladder, and the alimentary tube; ascites in consequence of liver complaint, of disease of the heart, or

degeneration of the kidneys. Scurvy, anæmia, and other blood diseases, hectic fever, great weakness and extreme emaciation from advanced age or impaired nutrition, would lead, if not to absolute prohibition, to a very unfavourable opinion as to the probable result.

But in few instances will the judgment of the surgeon be so severely tested as in estimating the value and importance of many of the above-mentioned contra-indications, whether any one is by itself so serious as to preclude surgical interference, or is merely a consequence of the local disease. This may be instanced by a case which came under the writer's care, in which all the symptoms of far-advanced tuberculosis were present—cough, hectic fever, high temperature, and rapid pulse—which all disappeared after extirpation of the ovarian tumor. The pulse fell from 108 to 88, the temperature from 101.4° F. to its normal range; cough was no longer troublesome. It may be added, that the cyst contained genuine tubercular deposits, was thin-walled and very fragile.

2. The operation ought not to be performed if well-founded suspicion is entertained of the tumor being cancerous. Cancer of the ovaries is supposed to occur most frequently after the change of life, but the writer has seen one case in a young girl, and others in middle-aged women. Such tumors often form extensive and intimate adhesions, infiltrate the surrounding tissues and attack the neighbouring organs, with which they form at an advanced stage of the degeneration one confluent mass. In most cases their extirpation, if attempted, would meet with insurmountable difficulties; and should the operation be terminated and the patient recover from it, the disease would sooner or later attack some other part or organ. Ascites generally accompanies malignant disease of the ovaries, and both ovaries are usually affected at the same time.

3. Firm, extensive, and vascular adhesions may sometimes render the completion of the operation impossible, but the extent of adhesions alone forms no contra-indication to the operation, so far as they can be ascertained before the operation is commenced, except such close adhesions within the pelvis as would render separation of the cyst from uterus, bladder, or rectum extremely difficult and hazardous. Previous surgical treatment, tapping, injection of iodine, even a preceding extirpation of the other ovary, are not necessarily contra-indications.

4. The presence of ascites need not deter from the operation, provided it be due to escape of fluid from the cyst, or is brought on by the mechanical irritation of the peritoneum by the tumor. If, however, it is caused by disease of heart, liver, or kidneys, these conditions forbid the operation.

5. The individuality of the patient ought also to be considered. Women of extremely nervous and excitable temperament, devoid of self-control and prone to hysterical affections, are very unfavourable subjects for the operation, and still more for the after-treatment.

6. As a rule, the operation ought not to be performed during pregnancy. In some cases miscarriage will be brought on by the contemporary growth of the ovarian tumour. Should the pregnancy go on, it will be advisable to gain time by tapping, if any large cyst can be emptied, but if the ovarian tumor is too solid to be reduced by tapping,



it will generally be advisable to induce premature labour.

The consideration of the indications for and against ovariectomy, as well as the prognosis, were summed up by the writer as follows, some years ago:—

“The probable result of ovariectomy can be estimated with far greater accuracy by a knowledge of the general condition of the patient than by the size and condition of the tumor.” (Vol. xl. of the *Medico-Chirurgical Transactions*.)

When ovariectomy is decided upon, certain precautionary arrangements and preparations will prove useful and assist in securing a favourable result.

If the patient is anæmic, weakened from the progress of the disease, perhaps overtaxed by the fatigues of a journey, or suffering from an accidental indisposition, her general health must be attended to, and the operation postponed until by the observance of general hygienic and dietetic rules she is brought to a fit condition to undergo operation.

The place where the operation is performed ought to be healthy, *cæteris paribus*, the country would therefore be preferable to town. Better results have been obtained in private houses and small hospitals, where the patient occupies a room alone, than in large general hospitals, where she shares a ward with other patients. The sick-room should be well provided with means of keeping up continual sufficient ventilation without producing draughts, and the temperature should be regulated by a fire. In the surgical ward in the Samaritan Hospital one of Mr. Gauntlet's chronometrical thermometers is used, by which the temperature of the twenty-four hours is self-recorded. If the operation be performed in a private house, all unnecessary furniture should be removed from the sick-room. Instead of a bed with heavy draperies, two iron bedsteads on castors should be provided, so narrow that the patient can be reached equally well from either side, and lifted from one bed into the other if desirable. A horse-hair mattress is preferable to a feather-bed, being cooler and firmer. The covering ought to be light. Hot-water bags, a supply of hot water, ice, brandy, champagne, beef-tea, and other comforts of the sick-room, ought to be in readiness. An elastic catheter and a small india-rubber enema-bottle, holding one to two ounces, with an elastic tube, lint, adhesive plaster, cotton wool, small bags of lint about two inches square, filled with some deodorising powder—that made after Dr. Skinner's formula, viz. five per cent. of oil of tar with ninety-five per cent. of powdered calcined oyster shells, is the best which the writer has met with—a spare flannel belt, about half a dozen blanket-pins, scissors, and a pair of dressing-forceps will complete the list of necessities for the sick-room.

The patient ought to have her rectum cleared by an injection of warm water a few hours before the operation, and should not have any food at least four hours previously, in order to avert chloroform sickness. She should wear her ordinary night-dress, a loose flannel dressing-gown, and warm stockings.

The operation should be performed in an airy room, the temperature of which should not be below 65° Fahr., but need not be raised to a degree uncomfortable to either patient or surgeon. Some earlier operators had the room heated and

moistened by steam, but the writer has shown that this is unnecessary and injurious.

The patient should be placed in a horizontal position on a firm narrow couch, opposite a window admitting good light, and well protected by flannel everywhere except the abdomen and face. Her abdomen ought to be covered by a waterproof sheet, with an opening about eight inches long and six inches wide in the middle of the inner surface, with a coating of adhesive plaster of about an inch in width all round the opening, so that it may adhere to the skin and prevent any exposure of the patient, while her body and clothing are kept perfectly dry and clean. A table on which the instruments are laid out is placed near the window and the right hand of the operator.

*List of Instruments.*—Two scalpels, a probe-pointed bistoury, a broad director, a tenaculum, several pairs of artery forceps, scissors, half a dozen bull-dog forceps, a syphon-trocar, clamps of different sizes, an éraseur, large guarded clamps for the use of the actual cautery, straight needles, threaded with fine but strong silk, ligature silk, a needle-holder, and either cautery irons or the gas or galvanic cautery. These will be the most necessary instruments; the emergencies of the case, however, and the individual views of the operator will suggest their choice and modification.

A large vessel for collecting the ovarian fluid, several basins, a sufficient supply of cold and hot water, towels, and soft, perfectly pure sponges ought to be in readiness.

Besides the already mentioned dressing apparatus, some perchloride of iron, either in the solid form or in saturated solution, should be provided, to apply to the strangulated portion of pedicle left when it is decided to trust to the clamp.

The patient should be spared any alarm likely to be caused by the preparations for the operation. When it is to take place in the room in which she has to remain, she should not be brought into it until everything has been properly arranged. The light of the room ought to be subdued, the table with the instruments covered with a towel, and no other persons should be present than the operator, the assistant who gives chloroform, and the nurse.

As soon as the patient is under the influence of the chloroform, the other assistants and visitors are admitted into the room, and each takes his allotted place, having been previously instructed as to his duties. If the operation is performed in an hospital theatre in presence of a large number of students, it would be more humane to narcotise the patient before bringing her into the theatre.

The patient having been placed on a narrow table, her legs covered with blankets, and the waterproof sheet already described properly adjusted, the assistant to whose care the administration of chloroform is entrusted takes his place at the head of the patient. The writer either uses a mask made of muslin or domett stretched over a frame of thick wire, on which the chloroform is sprinkled and which allows a free passage of air, or he avails himself of Mr. Clover's services, who uses his well-known apparatus. But it may happen that the use of chloroform is contra-indicated. In such cases Dr. Richardson's method of producing local anæsthesia by ether spray may be tried. In a case operated upon by the writer in the Samaritan Hospital (see *Med. Times and Gazette*, June 2, 1866) chloroform was considered dangerous,

owing to compression of the lungs and displacement of the heart by the tumor. The incision was made through the abdominal walls, the trocar pushed into and fixed in the cyst, and the fluid emptied without the patient having been aware of anything but the application of the spray. The diaphragm having somewhat descended after the evacuation of the cyst, chloroform could be given with safety, and the operation was terminated under its influence. No peculiarities but those usually due to the effects of the anæsthetic are generally observed during the progress of the operation unless it becomes necessary to sponge out the peritoneal cavity. Then a sudden depression of pulse and respiration, and cold clammy perspiration, often require careful watching, but the patient will soon rally under proper attention, and the narcotism may be safely continued. It is advisable to keep the patient unconscious, until she is placed in bed, after the wound has been dressed. The instruments and all other traces of the operation should be removed before she becomes conscious.

Some surgeons object to the use of chloroform in this operation, being afraid of its depressing effects on the system, sometimes observed after its administration, and of the distressing sickness which it is apt to produce. Sickness and retching after ovariectomy are, however, not always caused by this anæsthetic, but are frequently the symptoms of more or less serious pathological conditions, which will be described when speaking of the after-treatment.

The operator places himself to the right side of the patient, so as to have her abdomen before him, To his left hand, at the same side of the table, stands one assistant whose duty it is to guide the syphon-tube, and to support the weight of the tumor while the pedicle is secured and the tumor separated, and who is ready to tie any vessel which may need a ligature. Facing the operator, to the left side of the table, stands another assistant, whose chief duty it is to hold and keep in apposition the edges of the wound after the peritoneal cavity has been opened, so as to prevent the escape of the intestines or other viscera. Another assistant at the foot of the table, steadies the patient's legs. The nurse is first in charge of the sponges and afterwards of the lint and plaster.

The first step in ovariectomy is

#### *The Incision of the Abdominal Wall.*

The place of preference for the incision is generally the linea alba or a line parallel to the outer border of the right or left rectus muscle. The incision in the median line offers the greatest advantages. No large vessels are in danger, and it answers for the extirpation of either or of both ovaries.

But differences of opinion on this subject refer both to the situation and to the length of the incision. Some of the earlier operators incised the abdominal wall in a line from the sternum to the symphysis pubis, the length of the opening being modified by the size of the tumor. This incision was recommended as offering the advantage of rendering the operation speedy and easy, and permitting the surgeon to see and to avoid the abdominal viscera. The Americans named it very appropriately the "great operation."

The other method is that of William Hunter, called in America the "minor operation." In it an incision of two to three inches in length is only

gradually enlarged during the progress of the operation.

In the present day neither course is exclusively followed, but the length of the incision is varied in proportion to the size of the tumor and the requirements of each individual case.

Different operators have chosen different places for the incision. Mr. King, of Saxmundham, made in one case "a division of about three inches through the integument and the linea semilunaris of the left side a little above a line drawn across the abdomen from the umbilicus." In another operation "a vertical incision was made through the parietes of the abdomen and the linea semilunaris to the extent of about seven or eight inches," and the wound was afterwards "enlarged in the direction of the lumbar vertebræ for about four inches." In a third case he made a similar incision, which towards the termination of the extraction had to be enlarged to about three inches. (*Lancet*, 1836-7, vol. i. p. 586.) Dr. W. L. Atlee describes an operation in the *American Journal of Medical Sciences*, vol. xviii. p. 336, in the following words:—"I made an incision, extending from the symphysis pubis to the middle of the crest of the ilium on the right side. This incision was curvilinear, its convexity presenting downwards. . . . This incision was sixteen or seventeen inches long, and was at once boldly carried down to the surface of the tumor through all the intervening tissues."

Dr. C. T. Haartman performed an ovariectomy in the General Hospital at Helsingfort, in which he made an incision five inches long at the left side of the abdomen, which commenced at the lower border of the ribs about two inches above the middle of the crest of the ilium, and continued in a curve about one and a half inch distant from the anterior and superior spine of the ilium, almost parallel with Poupart's ligament, and terminated at the external border of the rectus. (*Schmidt's Jahrbücher*, vol. lxix. p. 336.)

Dr. J. J. Bühring (*Die Heilung der Eierstock-Geschwülste*, Berlin, 1848) made an incision at the external border of the right external oblique, from the false ribs to the crest of the ilium, two inches from the anterior superior spine backwards, till the yellow shining peritoneum became visible.

Dr. Ephraim McDowell, of Danville, Kentucky, made an incision about three inches from the rectus muscle on the left side, nine inches in length, parallel with the fibres of the above-named muscle. (*London Medical Gazette*, 1844-5, vol. i. p. 745.)

These varieties and modifications of incisions will, however, hardly find many imitators, and those surgeons who have performed the greatest number of operations are now agreed that the incision should be made in or near the median line. It should not pass nearer than two inches to the symphysis pubis, and may commence just below the umbilicus. It may be extended upwards to the left of and around the umbilicus, and continued along the median line as far as may be necessary. The round ligament of the liver passes from the umbilicus slightly diagonally upwards and backwards towards the right side, and would therefore be liable to be wounded if the incision were carried to the right of the umbilicus. As cases are on record in which the embryonal umbilical vein (the round ligament of the liver after birth) had not been entirely obliterated, but



had remained patent, serious hæmorrhage might follow incision or division of the round ligament.

A very large cyst may be removed through an incision three inches long, and an incision five inches long is amply sufficient for the removal of very large tumors, provided each cyst be withdrawn as it is emptied, or groups of smaller cysts be withdrawn one after another. Sometimes, however, the tumor is composed of small trabeculated loculi, filled with a very thick viscid colloid substance. In some such cases it may be possible to diminish the bulk of the tumor by breaking it up internally and pressing out the contents without rupturing the outer or larger cyst; but in other cases it may be preferable to enlarge the opening and remove the tumor entire.

The incision should at first be carried through the skin and the subcutaneous layer of fat, which will be found of varying thickness. Very little bleeding is to be apprehended, and any from unusually large vessels may be easily arrested by bull-dog forceps. As the scalpel divides the deeper layers of the abdominal wall and approaches the peritoneum, greater caution will be required. Then layer after layer ought to be successively raised and a broad director introduced, upon which the incision should be carried upwards and downwards with a probe-pointed bistoury.

If, as is usually the case, the linea alba is the place chosen for the incision, the following anatomically distinct layers will be met with:—

(a) The skin.

(b) The subcutaneous areolar tissue with fat of varying thickness.

(c) The conjoined and interwoven fibres of the aponeuroses of the abdominal muscles, which constitute the linea alba.

(d) The fascia transversalis, which consists of several strata and is rich in adipose tissue. The uppermost stratum firmly adheres to the linea alba. The deepest layer under normal conditions is only loosely connected with the parietal peritoneum.

(e) The peritoneum.

But the surgeon must not always expect to find this normal arrangement. It will often happen that if a greater number of strata must be divided, the several layers of the fasciæ are separated by serous infiltration or other intervening exudations, or there will be fewer strata if they have been agglutinated by previous inflammatory processes.

When the incision has been carried down to the peritoneum, the wound must be carefully cleaned from the blood with soft sponges, and any vessels of which the bleeding has not been arrested by torsion or the temporary application of "bull-dogs," are to be secured by ligatures.

The next step will be the division of the peritoneum with the probe-pointed bistoury or the broad director, as already described. When ascitic fluid surrounds the tumor, some of it may be allowed to escape; but the tumor should be pressed forward by an assistant to retain a sufficient quantity of the fluid till the last as a protection to the intestines.

*Separation of the Cyst.*—Before any further interference with or puncturing of the cyst—and taking care not to rupture it accidentally, lest some of its contents might escape into the abdominal cavity—the right hand of the operator should be introduced between the cyst and the abdominal wall, with the palmar surface against the tumor

and the fingers slightly curved so as to adapt the shape of the hand to the convexity of the cyst. In this manner the outer surface of the tumor may be examined with comparative ease, and any adhesions discovered will, if not too firm, readily yield to semicircular movements of the hand. If they do not yield easily, it is better to empty the cyst before attempting to separate them than to run any risk of rupturing the cyst and allowing the contents to escape into the peritoneal cavity. Adhesions to the omentum or intestines, especially those at the posterior wall of the cyst, are also better left until the cyst is emptied and the adherent viscera can be seen.

Having found that the tumor is free from adhesions, or having freed it from its parietal adhesions, or having decided to empty the cyst, it should be tapped by a large syphon-trocar.

This instrument, with its latest improvements, consists of three separate parts—a tubular trocar, a hooked canula, and an elastic tube. The trocar is a silver tube five inches long and one-third of an inch in diameter, with cutting end made of steel, one and a half inch long. Its whole length will therefore be six and a half inches. It terminates at an angle of  $45^{\circ}$ ; the outline of its edge not representing a circle but an ellipsis, the smaller segment of which forms the sharp point of the instrument. Two inches from its opposite end a thumb-piece is fixed vertically to the side of the tube, which fits into a longitudinal slit of the canula, and serves for pushing the trocar forwards or retracting it.

The outer tube or canula is five and a half inches long, and is furnished with two spring hooks, which, when closed, fit with their five sharp steel prongs into corresponding holes of the canula, two inches from its open end. They serve for keeping the cyst from gliding off the canula while the fluid is running off. From its blunt end a slit wide enough to receive the thumb-piece of the trocar extends two inches in longitudinal direction, and bends in a right angle sufficiently to fix the trocar with its point beyond the canula when pushing it into the cyst. To the blunt end of the canula is fixed a syphon-tube of vulcanised india-rubber about three feet long, through which the fluid contents of the cyst are conducted into foot-pans or pails placed under the operator's table. By this arrangement the fluid is prevented from wetting the patient or her clothes.

The trocar ought to be pushed into the most prominent part of the cyst, if simple; if multilocular, into that chamber which is likely to contain the largest quantity of fluid. After a portion of the latter has been drained off, and the cyst has become more flaccid, the point of the trocar is to be drawn within the canula by means of the thumb-piece, and the cyst drawn higher up over the canula by means of hooks or a tenaculum, and fixed between the prongs of the spring hooks, which, if properly adjusted, will hold the cyst-wall tightly around the canula. After the first loculus has been emptied, a second, a third, and more if necessary, may be tapped successively without removing the canula from its hold, merely by pushing the trocar forward and thrusting it through the septum which separates the emptied from the adjacent full loculus. In this manner the whole tumor may be emptied of its fluid contents and its bulk so reduced that it may be drawn through

the abdominal opening without undue force. In a case where there are several cysts which cannot be tapped one through the other, they must be emptied singly, either by the same trocar or by another. Great care must be taken, if the same trocar be used, lest some remaining fluid should escape through the punctured opening into the abdominal cavity.

Having succeeded in reducing sufficiently the size of the tumor, the surgeon then draws it through the incision, at the same time breaking down any adhesions which have not been separated before. The assistant opposite to the operator now places his hands on either side of the incision, and, by a gentle pressure on the abdominal wall, prevents the prolapse of the viscera by carefully keeping the edges of the incision in close approximation. The assistant at the operator's left hand receives the cyst in a towel or basin, and supports it until it is completely separated. No traction whatever is permitted, and the greatest precaution ought to be exerted in this respect when the pedicle is short, and when there remain undivided adhesions.

In order to relieve the weight of the tumor, cysts which had not been emptied before may be punctured, and secondary cysts, if the septa are thin, may be broken down by the hand. Great care ought to be taken that nothing gravitates into the abdominal cavity.

But it will not be always possible to reduce the tumor at all, or sufficiently to bring it through the original incision. Tumors are sometimes met with which consist of solid or semi-solid unyielding masses, or are divided by trabeculae into small loculi filled with viscid, colloid substance, which cannot be broken down and will not pass through the canula. It will therefore become necessary to enlarge the incision upwards. This is less dangerous than any attempt at squeezing a large tumor through a narrow outlet, a practice which is fraught with double danger: (a) the cyst may burst, and its contents escape into the abdominal cavity. This would be more dangerous if the contents are not fluid and readily removable with sponges, but colloid, viscid, and very adhesive to the peritoneal coats of the viscera. (b) The edges of the wound are liable to be bruised, and the hopes of union by first intention frustrated, or the peritoneum so injured that fatal peritonitis or gangrene results.

The writer was formerly in the habit of having flannels wrung out of water at 96° carefully wrapped round the cyst as it escaped, to protect the peritoneal cavity. But he discontinued this practice, from finding that it was impossible to prevent small filaments of wool separating from the flannel and adhering to the peritoneum.

If, as the tumor is withdrawn, omentum, mesentery, or intestine, are seen to be adherent to it, the adhesions must be carefully broken down with the fingers, or, if very firm, they may be divided with the scalpel or scissors. When intestine is so firmly adherent that it cannot be safely separated, the adhering portion of the cyst should be cut away, leaving it attached to the intestine, but removing the inner secreting lining membrane of the cyst.

Any portion of the omentum separated should be carefully held, to see that no bleeding vessel is returned. Any portion which appears to be much

altered from the natural condition, or torn in the process of separation, should be cut away; and any bleeding vessel should be stopped by torsion or by ligature. If by ligature, the ends may either be brought out through part of the wound, or (which appears to be much safer practice) cut short to the knot, and returned with the omentum. Experiments have shown that silk ligatures may be absorbed. The ligature should not include any portion of omentum—simply the bleeding vessels.

In some cases it will be found that the adhesions are so firm and extensive, and so intimately connected with viscera, that the separation of the tumor would be impossible, or fraught with the utmost danger. The surgeon will therefore be compelled to leave the diseased organ in the abdomen, or only remove part of it. He will close the wound, and regulate the after-treatment as if the operation had been completed. Reference to a former column will show the proportions in which this has occurred in the practice of the writer.

Dr. Eugene Dutoit, in his carefully compiled tables (*Die Ovariectomie in England, Deutschland, und Frankreich*, Würzburg, 1864), furnishes the following statistical information on attempted but not completed ovariectomies:—

	Total	Died (within 7 days)	Recovered	Temporary recovery (death between 20 days— 7 years)
England . .	59	15	33	11
America . .	20	7	9	4
Germany . .	7	4	2	1
Russia (operator, Galenowski)	1	—	1	—
Total .	87	26	45	16

Of those who succumbed to the attempted operation, several suffered from cancer.

Of those who permanently recovered, several bore children afterwards.

The temporary recoveries include patients who recovered from the operation, but died afterwards—(a) from rupture of the cyst; (b) from the effects of other means of treatment; (c) from accidental diseases.

*The Pedicle.*—When the whole tumor has been withdrawn, it will be found to be attached to one side of the uterus by a pedicle, which varies very much in length and breadth, and always contains large blood-vessels.

The pedicle consists of the broad ligament, the Fallopian tube, the ovarian ligament, and sometimes the round ligament. Its blood-vessels are the internal spermatic and uterine arteries and the spermatic veins.

The internal spermatic artery on each side arises from the front of the abdominal aorta below the superior mesenteric artery, enters the broad ligament laterally at the inlet of the true pelvis, and supplies the ovary. Here it inosculates with a branch of the uterine artery, which passes along the tube to the ovary. It sends also small branches to the ureter, to the subserous areolar tissue of the



peritoneum, and to the lymphatic glands in the groin.

The uterine artery, which sometimes may arise from the umbilical artery, is a branch of the anterior division of the internal iliac artery. According to Weber, a small branch, only 1<sup>'''</sup> thick, leaves the uterine artery, before the latter reaches the fundus of the uterus, passes between the folds of the broad ligament outwards, sends twigs to the tube, and enters the ovary at the insertion of the ligament of the ovary, which it exclusively supplies. According to this view, which Theile and Cruveillier endorse, the internal spermatic artery would have no share in supplying the ovary with blood. It is, however, more likely that both arteries conjoin in this office.

The spermatic veins are ramifications of the pudendal and utero-vaginal plexuses, and have no valves.

Besides the arteries and veins, numerous lymphatic vessels, which ultimately, after a devious course and many inosculation, terminate in the lumbar plexus, pass from and between the broad ligament, the ovary and the tube, and are consequently also enclosed in the pedicle.

This anatomical sketch is introduced with the object of showing the great vascularity of the pedicle, and of pointing out the high importance of contriving the division and ultimate separation of the tumor, and of securing the pedicle in such a manner as to prevent effectually any hæmorrhage both during the act of division and afterwards, as well as the ill consequences which might arise from the decomposition of any portion of the pedicle or from inflammation around it.

The principal methods of separating and securing the pedicle are the following:—

1. Acupressure and the wire-compress.
2. Ligature, either of the entire pedicle, or of its vessels only.
3. The *écraseur*.
4. The actual cautery, or cauterisation combined with compression.
5. The clamp.

1. *Acupressure* has never been tried by the writer for securing the pedicle. Sir James Simpson was successful in one case. Sir William Fergusson has tried it, but was obliged to resort to the ligature.

2. *Ligature of the Pedicle*.—The pedicle may be tied with a strong silken or hempen ligature before cutting off the cyst. The slipping of the ligature is best obviated by transfixing the pedicle and tying it in two or more portions; or a clamp may first be applied, the cyst cut away, and the pedicle then transfixed and tied below the clamp. But if this be done the clamp must be loosened before the ligatures are tightened, or the compressed tissues are so held that the knot cannot be tied so tight that it will not slip off as soon as the clamp is removed. If it be desired only to tie the vessels, it may be done by feeling the arteries, and carrying a ligature round them through the pedicle before the cyst is cut away; or after the application of a clamp and removal of the cyst, holding the pedicle carefully with forceps as the clamp is loosened, and tying any vessel which bleeds. The great objection to this plan is, that there is often much loose cellular tissue, rich in small veins, which go on oozing after all the larger vessels have been tied. Whichever may be the plan preferred, the important question

arises, shall the ends of the ligatures be cut off and the wound closed, or shall they be left hanging out through a part of the wound, purposely left open for their passage and that of the slough they embrace when it separates? Dr. Tyler Smith adopts the first plan. Dr. Clay, of Manchester, still advocates the latter practice. The writer has tried it, and with success in about a fifth of the cases only; and he will not willingly adopt it again. In its favour it may be said that it is a method applicable in all cases; that it secures an outlet for serum from the peritoneal cavity, and that after the separation of the ligature and slough no foreign body is left within the patient. But it seems better to have a choice of all these methods and adopt each in its appropriate case than to strive after one method applicable to all cases. The ligature threads act as a sort of seton in the peritoneal cavity, sets up inflammation and excites the formation of the serum for which it is said to provide the outlet. Then, if the patient recovers, there is a great liability to ventral hernia. The cicatrix remains weak at the spot where the ligatures passed out, and it yields before the pressure outwards of the viscera. The writer has seen this in nearly every case where he followed this plan. On all these grounds, if we use one or more ligatures, it appears better to cut off the ends short, and close up the wound completely. Wire has been used for this purpose, but it seems an irrational practice. Silk, if pure, is an animal substance, and experiment proves that it may be absorbed. Wire cannot be absorbed, and it must be more or less of a mechanical irritant. We have to look to the effect on the tissues strangulated rather than the material by which the strangulation is effected. If anything like what goes on outside the body when the clamp is used, or inside when the wound is left open for ligatures, were to go on when the wound is closed, it is difficult to understand how any patient could possibly survive the process. She would almost infallibly be poisoned by absorption of the fetid products of the decomposing stump. But a very different series of changes must go on when the wound is closed and access of air is shut off. At any rate, experience proves that patients do survive the process, and post-mortem examination has shown that ligature and pedicle have been coated by a sort of capsule of lymph. In the writer's own hands this practice has been much less successful than the clamp; and even when patients have recovered, some of them have long remained in a state of semi-invalidism, very different from the robust health which is the rule after successful clamp cases. This plan was originated in 1821 by Dr. Nathan Smith, of Baltimore, who used *leather* ligatures. Dr. Rogers, of New York, in 1830 also cut off his ligatures "close to the knot, and left them to absorption." If the writer uses the ligature, he feels disposed to cut off the ends whenever the patient is in a pretty good condition, and sthenic peritonitis with effusion of lymph may be expected; but if low diffuse peritonitis and effusion of serum may be feared, then it may be better to leave the ends of the ligatures and secure a drain through the wound for the serum. But we should still search for a better method than the ligature.

3. The *écraseur* has been used for the compression and crushing of the pedicle and the final

separation of the tumor; after which the pedicle is dropped into the abdominal cavity and the wound closed. Grave objections, however, against this practice are the possibility of internal hæmorrhage and its accompanying dangers, and the difficulty of finding and securing the bleeding pedicle in the depth of the abdominal cavity after having re-opened the wound. This would be especially difficult if hæmorrhage occurred after some lapse of time. The writer used the *écraseur* once and successfully; but he has not ventured on it again, for fear that it might prove untrustworthy and internal bleeding occur. This danger may be prevented by tying a strong ligature below the *écraseur* chain, before separating the cyst and dropping the pedicle into the abdominal cavity. But then it would be only a modification of the former methods of ligatures, and open to the same objections.

4. The *cautery* alone would almost certainly fail to stop such large vessels as are frequently met with in a pedicle. So might the *écraseur* alone, or the crushing which precedes the division by the *écraseur*. But the combination of the crushing and the cautery is certainly efficacious in a considerable proportion of cases. Mr. Clay, of Birmingham, introduced the practice and carried it out by his adhesion clamp and hot irons, both for dividing adhesions and omentum. The practice has been extended to the pedicle, and it is claimed for it that in most cases it effectually stops hæmorrhage during the operation and prevents it afterwards, leaving only a very thin layer of burnt tissue at the end. The burnt tissue is probably more easily absorbed than the strangulated extremity of the pedicle after ligatures, and is not so liable to produce septicæmia. This method is of most value in cases when the pedicle is broad, thick, and short, under which circumstances the application of the clamp is very difficult, and has sometimes to be abandoned. Notwithstanding these great advantages, which deservedly recommend the cautery, its use is sometimes attended by serious drawbacks. Vessels not unfrequently bleed on opening the blades of the clamp, and a repetition of the whole tedious proceeding or the use of ligatures are necessary before the pedicle can be returned into the abdomen with safety.

The instrument used for securing and compressing the pedicle is Mr. Clay's (of Birmingham) adhesion clamp, modified by Mr. B. Brown, Mr. Harper, and the writer. Having adjusted the clamp and tightly compressed the pedicle between its blades, which are kept closed by means of a screw, the tumor is cut off a short distance above the clamp. The projecting portion of the pedicle is dried, and held with a forceps during the application of the cautery. In order to protect the surrounding parts from the hot iron, wet towels or flannel, placed between the clamp and the abdomen, were first employed; but they often prove insufficient. The writer has lately used two shields made of talcum (neutral silicate of alumina,  $MgO$ ,  $SiO_3$ , a perfect non-conductor of heat), which, when placed around the pedicle, will protect the skin and any part likely to be injured. The cautery-irons, which are wedge-shaped with a blunt edge, should be heated to a dull red heat, and pressed slowly and firmly across the protruding portion of the pedicle, until this is burnt off clean down to the surface of the clamp. This done, the blades are cautiously

opened, the operator and his assistants being prepared to seize the pedicle, and prevent it from slipping into the abdominal cavity, in case any bleeding should occur. Having convinced himself that there is no bleeding, the operator gently disengages the pedicle from the blade, and allows it to drop into the abdominal cavity. Mr. Clover has recently introduced a very useful cautery of pure silver, heated by burning spirit.

Dr. Wright has devised an ingenious clamp, by which, before opening the blades, a succession of steel bars can be lifted by means of screws, and the pedicle thus partially exposed, in order to discover and to secure any bleeding vessel without disengaging the whole pedicle from the grasp of the clamp after the application of the cautery.

5. By far the safest and most simple treatment of the pedicle is that by means of the *clamp*. None of the objections raised against the other methods can be applied to the clamp. It effectually arrests hæmorrhage, secures the end of the pedicle outside the wound, and keeps it continually under the observation and control of the surgeon. But in cases where the pedicle is very short, so that an undue, painful, and dangerous traction on the uterus or broad ligament would be caused by keeping the end of the pedicle with the clamp outside, or when the pedicle is so broad or thick that a clamp of moderate size would prove insufficient, one of the other methods just described should be preferred.

The credit of suggesting and first using a metal clamp in the treatment of the pedicle is due to Mr. Hutchinson, who used a clamp very much like a common pair of carpenter's calipers. The writer at first used a clamp he had contrived like Ricord's fenestrated forceps for circumcision. The instrument he now uses consists of two strong steel bars, one grooved, the other with a rough bevelled blunt edge fitting into the groove. They work on a hinge, and are kept closed by means of a screw acting on a steel arc. The clamp is supplied with two strong handles, one to each bar, fastened by a spring-lock, and easily removed after the operation.

The clamp is passed around the pedicle, and is then compressed by means of the handles and fixed by the screw, care being taken not to enclose anything but the pedicle. The tumor is cut away and the handles removed. The pedicle with the clamp outside the wound comes to lie as near to the lower end of the incision as can be effected without traction, and the edges of the wound are brought in contact around it. Any superfluous portion of the pedicle protruding beyond the clamp is cut off, and the remainder touched with solid perchloride of iron or its solution, by which the tissue is tanned like a piece of leather, and preserved from decomposition.

Most of the objections which have been raised against the extra-abdominal treatment of the pedicle and the use of the clamp are either groundless or trivial. It is said to be very painful; but it is not rare to see a good deal of traction with very little pain, and much more severe pain in cases where the ligature is used than in clamp cases. So with sickness; there has been as much or more after the ligature or cautery than after the clamp. It is said to set up fetid discharge and poison the wound or the patient; and so it does if proper care be not taken. But if the strangulated part of the pedicle which projects beyond the clamp be well saturated



with perchloride of iron, the slough is tanned; it becomes as hard and dry as a piece of leather, and there is an end to that objection. It is said to cause suppuration about the wound, but this again happens quite as frequently, in proportion, after the ligature or cautery. The writer never saw more profuse suppuration of the stitches than in one case where he divided the pedicle with the *écraseur*, and closed the wound with platinum wire sutures. Then, after the wound is closed, it is said to lead to a re-opening each month, and an escape of some menstrual fluid; and this is true in some, perhaps in nearly a third, of the cases. But if the patient be prepared for it, it is not of the slightest consequence. The Fallopian tube contracts completely after a few months, and there is no further escape. The fact that it does escape sometimes is an argument in favour of the clamp; for if menstrual fluid can escape through the partially closed Fallopian tube fixed in the cicatrized wound, so it may escape if the tube be left within the peritoneal cavity, and the result may be a fatal hæmatocele. The writer has known this to occur in cases where the ligature was used and cut off short, and also after the cautery; and he believes it to be one of the strongest objections to these methods, or to any intra-peritoneal method of dealing with the pedicle. As to any fancied impediment to the increase of the uterus in pregnancy and to its contraction during labour, from the adhesion of the tube to the cicatrix, the writer can say that ten of his patients have had children after ovariectomy—two of them two children—and there was no such complaint in any one case. One *real* objection to the clamp is that it may possibly pull on or strangulate intestine (and the writer has seen such a case). But this objection is of little weight if the use of the clamp be restricted to cases where the pedicle is so long that there is not much drag on the clamp. In such cases no better method could be devised. But where there is a broad, thick, short pedicle, or a broad connection between uterus and cyst rather than a distinct pedicle, then one of the other methods of treating the pedicle should be preferred.

When dividing the pedicle and separating the cyst the utmost care must be taken to prevent any of the contents of the cyst entering the abdominal cavity. Should this have happened notwithstanding all the precautions taken to avoid it, the cavity must be carefully sponged and cleaned of all extraneous substance with soft sponges wrung out of warm water.

The omentum, the mesentery, and the situations of the adhesions to the anterior abdominal wall will often be found the seat of hæmorrhage, either from the orifices of large vessels or from capillary oozing. The bleeding must be stopped by tying the vessels with ligatures, the ends of which are to be cut off close to the knot, or by torsion, or by the pressure of a needle passed across.

Before closing the wound the opposite ovary is to be examined. If diseased, it must be withdrawn, its vessels secured, and the diseased organ cut away. If healthy, it is left undisturbed. If small cysts are seen on its surface they may be punctured.

The next step will be to close the wound. In the early practice of the writer this was done by passing gilded hare-lip pins through the whole thickness of the abdominal wall at intervals of an inch. Each pin perforated the skin about an inch, and the peri-

toneum about half an inch, from the incision on either side; so that when the two opposed surfaces were pressed together upon the pin, two layers of the peritoneum were in contact with each other. Instead of the hare-lip pins sutures are now used. Different materials have been tried for this purpose—hemp, twine, silk, silver and steel wire, telegraph wire coated with gutta-percha, and strong horse-hair. After repeated comparative trials thin strong Chinese silk has been found superior to the other materials. The most convenient manner of applying the sutures is the following. Silk about eighteen inches in length is threaded at each end on a strong straight needle. Each needle is introduced from within outwards through the peritoneum and the whole thickness of the abdominal wall at the same distances as when the hare-lip pins were used. The ends of the sutures are held by the assistant who holds up the lips of the wound, until all the deep sutures have been applied. Then the lips of the wound are held apart again, in order that the operator may convince himself that no further bleeding has taken place within the abdominal cavity, which, if required, has to be sponged again. This done, the sutures are tied, and the ends of the threads cut off. If the abdominal wall is very thick, superficial sutures will be required between the deep ones. If the pedicle has been secured by the clamp, a suture should be passed close to the latter, in order to bring the lips of the wound so accurately around the pedicle that the peritoneal cavity is perfectly closed. The inclosing of the peritoneum within the stitches is of the utmost importance for the success of the operation. The two peritoneal layers adhere together very rapidly. At the post-mortem examination of patients who died after thirty-six hours the edges of the peritoneal incision have been found firmly united by first intention. Thus pus and other secretions from the wound are prevented from entering the peritoneal cavity, adhesion of the omentum or intestine to any part of the inner aspect of the wound not covered by peritoneum is prevented, and such firm union is secured that a ventral hernia scarcely ever occurs after recovery.

After the closure of the wound, that part of the abdomen which has been exposed is carefully dried and cleaned, the india-rubber cloth removed, and the wound covered with folded lint and supported by long strips of adhesive plaster. In most cases the false ribs had been pressed outwards by the tumor, and after its removal a deep hollow is left. This must be filled up with pads of cotton-wool. The patient is then gently removed on her bed, where a flannel belt is adjusted around her abdomen. She is kept on her back, her knees supported by a pillow, is covered with light but warm blankets, and provided with hot-water bottles, if she is at all chilly.

The general principles of the *after-treatment* are to secure extreme quiet, comfortable warmth to induce gentle perspiration, and perfect cleanliness of the patient. The catheter is used every six hours during three or four days after the operation, until the patient can move without pain. Pain is alleviated by enemata of laudanum, and sickness generally yields to iced water, soda-water, &c. Should sickness continue, enemata of beef-tea with brandy every two to four hours in most cases prove efficacious, and are also beneficial in

keeping up the strength of the patient. Stimulants, as brandy, champagne, &c., are given when they are called for by failing pulse and other signs of exhaustion. Very little food is required during the first days after the operation; barley-water, toast and water, gruel, bread and milk, or any other light nourishment are often sufficient, but the requirements of the individual case will always be the best guides. Flatulence, often a very troublesome symptom, may be relieved by passing the elastic tube of an enema apparatus up the rectum. An enema of five grains of quinine in an ounce of water, with or without a few drops of laudanum, repeated every four hours, has often relieved flatulence by restoring the tone of the muscular coat of the intestines. The urine often becomes loaded with lithates, or a sediment highly coloured with purpurine forms, in which case citrate of potass may be given freely and with evident advantage.

The stitches are removed on the third or fourth day after the operation, by which time the wound will have united. If the patient is very stout, the union will be slower and the stitches may be left longer. Suppuration around the stitches, which sometimes takes place, causes a little feverishness, but is not of much consequence.

The clamp comes off at varying periods, from three to fifteen days. The patients are often unconscious of it, and it is better not to remove it, unless it is held by some mere shred of dead tissue.

The bowels are kept quiet after the operation, and as long as the patient feels comfortable their action need not be brought on. An enema of warm water or a dose of castor oil will bring on their action if not spontaneous. Accumulation of hard fecal masses in the rectum may cause tenesmus, keep up a spurious diarrhoea, and thus render the patient uncomfortable. Their presence will be discovered by digital examination. They should be broken up with the finger or a spoon, and the bowels afterwards cleared by injecting warm water. If the first motion fatigues the patient and renders her restless, it will be advisable to have it followed by an opiate enema.

An occurrence a few days after the operation often causes apprehension—the so-called unexpected reappearance of the catamenia. This uterine discharge, however, is not the result of the periodical rupture of a Graafian follicle and escape of the ovum arrived at maturity (a fact impossible when the operation has been performed a few days after the cessation of the catamenial flow), but an occurrence generally followed by relief, also observed in some fevers, acute inflammation of some internal organs, and after surgical operations. This uterine discharge has been called by Gubler uterine epistaxis; the writer proposes the use of the term *metrorrhæsis*. After the recovery of the patient an abdominal belt ought to be worn for some months. As a rule, very perfect health follows the operation. No special ill-effect has been observed, even when both ovaries have been removed. The occurrence of disease in the sound ovary left has been extremely rare. Neither pregnancy nor delivery have been unusually troublesome in any patient who has recovered after the performance of ovariectomy by the writer. The statistics of his own practice have been given in a former column. Those of other surgeons are summed up by Mr. Clay, of Birmingham, in his recent prize essay in the following table:—

## GENERAL RESULTS OF OVARIAN OPERATIONS.

	Wells			Keith			Others			Total
	Successful	Fatal	Incomplete	Successful	Fatal	Incomplete	Successful	Fatal	Incomplete	
Ovarian tumors removed . .	138	62	—	31	9	—	374	282	—	896
Uterine tumors removed . .	—	—	3	—	—	—	—	—	19	22
Cases abandoned on account of adhesions	—	—	18	—	—	—	—	—	101	119
Tumors partially removed . .	—	—	3	—	—	—	—	—	26	29
No tumor . .	—	—	1	—	—	—	—	—	6	7
Not stated . .	—	—	—	—	—	—	—	—	1	1
	138	62	25	31	9	—	374	282	153	1074
	225			40			809			

Successful cases of tumors removed . . . 543

Unsuccessful " " " . . . 353

Incompleted cases of ovariectomy . . . 178

Total . . . . . 1074

Since the 200 cases recorded in the above table, the writer has completed the operation in 24 other cases up to the end of July 1867. Of these 4 died and 20 recovered; giving a total of 224 cases, with 158 recoveries and 66 deaths, or a mortality of 29.5 per cent.

T. Spencer Wells.

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[OXALÆMIA. The oxalic acid diathesis (Prout); oxaluria (Auc. Var.). Oxalic acid ( $\text{Ca O. C}_2 \text{O}_3$ ) never maintains a separate existence in the animaleconomy, but is met with very frequently as oxalate of lime. This salt often occurs in minute quantities in apparently healthy urine, or may be the product of its earliest acid fermentation. It is met with also in the blood, and for weeks or months in abnormal quantities in the urine, and is the constituent of one form of urinary calculus. There are well-marked symptoms of an oxalic acid condition of the blood, and it is the exponent of a clearly-defined disease of that fluid. Oxalic acid may be conveyed into the blood and thence into the urine with the diet, and for a long time its occurrence was wholly attributed to this cause, but there are now known to be other sources. It may be produced from substances quite free from the acid, as sugar, an excess of which in the diet is convertible into oxalic acid in the blood and reappears in the urine as oxalate of lime. The vegetable alkaline salts tend to its occurrence, and the use of drinks rich in carbonic acid, alkaline bicarbonates, and everything which can overload the blood with carbonic acid have the same effect. Whenever the respiratory process is diminished and the metamorphosis of matter is deranged, leading to an accumulation of carbonic acid in the blood, the same result may occur. The acid is developed in the blood from two very distinct sources. 1. From the saccharine and lactic acid series of transformations, the sugar conveyed into the blood from the hepatic system being oxidised without being first converted into lactic acid, and its metamorphosis arrested at that stage instead of proceeding to the stage of carbonic acid and water. 2. From the destructive metamorphosis of uric acid and urea, which substances ought to be separated by the kidneys, The uric acid becoming oxidated is converted into oxalate of lime or of ammonia. Whether the oxalates have been absorbed from the alimentary canal or developed in the blood, they may be excreted by the kidneys as rapidly as they are formed, and no manifest symptoms of disease may result; but should the kidneys fail to perform this function completely, they have a tendency to accumulate in the blood, and general symptoms result. It is the powerful affinity of oxalic acid for lime and the insolubility of the



oxalate of lime which protects the system from the more violent pernicious effects of the oxalic acid.

Oxalic acid has been detected in the blood by Dr. Garroil in a case of albuminuria; also by Dr. Schmidt, who considers that it exists as a triple soluble salt, a combination of oxalic acid, lime, and albumen. Oxalates are frequently found in the urine of persons recovering from severe diseases, as cholera. (*Walshe's Monthly Journal of the Medical Sciences*, January 1849.) They co-exist with various skin diseases, and have been observed especially in patients affected with boils and carbuncles. They often also coincide with disease of the kidneys, but whether this is produced by the irritation of large quantities passing through the organ, as appears to be shown by the experiments of Wöhler, is still uncertain. During various acute and chronic diseases it makes its appearance transitorily, and is of very little importance.

After the use of articles rich in oxalic acid, of sparkling wines and of strong beer, or the medical injection of the acid or its compounds, a temporary deposit of oxalate of lime takes place in the urine, and the long-continued use of such food has an injurious tendency. Sediments of oxalate of lime in the urine occur very frequently in chronic diseases; in fact it was laid down by Dr MacLagan that in such cases a total absence of the salt is rather the exception than the rule. They occur also in diseases attended with disturbed respiration or disturbed digestion; also in anæmic and chlorotic cases, in convalescence from severe illnesses, as a result of frequent pregnancies, protracted lactation, spermatorrhœa, and excess of venery, and also in diseases dependent on malaria, all referable to an altered condition of the blood, in which the respiratory changes are not duly maintained. In the same way also diseases of the brain and nerves lead to oxaluria, and in diseases especially in which there is an impairment both of respiration and digestion. It is observed in violent attacks of apoplexy, melancholia, and mania. It is never found in the first stages of typhus, in acute rheumatism, certain stages of tuberculosis, intestinal catarrh, dysentery, pharyngitis, and many cutaneous diseases, and it occurs only transiently or under particular circumstances in puerperal conditions, morbus Brightii, disease of the heart, affections of the liver, epilepsy, various diseases occurring in paroxysms, paralysis with debility, and perhaps diabetes. (*Studies of Oxaluria*, by Dr. Moritz Swaber, of Pragal. *Dublin Med. Journal*, vol. xxxii. p. 229, 1860.)

Oxalate of lime occurs in the urine under a great variety of circumstances. Dr. J. A. Easton detected it in large quantities in cases of neuralgia generally and of sciatica in particular (*Glasgow Med. Journal*, vol. vi. p. 258), and he refers it to the oxidation of uric acid in a gouty condition of the blood, in proof of which Wöhler and Frerichs are quoted as having found that the introduction of uric acid into the organism was followed by the presence of oxalate of lime in the urine, and Golding Bird, who witnessed the production of the same salt from the decomposition of uric acid in blood serum. The oxalate in some patients also is occasionally associated with or replaced by uric acid and urates, and the neuralgia in these cases and the pain in many cases of hemicrania are regarded by Dr. Easton as manifestations of the

materies morbi of gout thrown out from the blood in the sheath of some particular nerve.

There are two points of view in which oxalæmia has to be regarded by the surgeon. 1. As a disease of the blood. 2. As the origin of a renal or vesical concretion of oxalate of lime or the mulberry calculus.

1. Oxalæmia is associated with symptoms of dyspepsia, of nervous erythism, and of morbid sensibility, and it is attended with a train of symptoms referable to the heart and nervous system.

2. The appearance of the oxalates as a urinary sediment, and as the immediate exciting cause of a fit of the gravel, or as a concretion, indicates that oxalic acid is being produced in an abnormal manner in the organism, and that the blood is or has been affected with oxalæmia. The elective affinity of the kidneys for this salt unduly developed or introduced into the blood may protect the system from any other consequence except the formation of a calculus, but this is often a very serious result. (Vide art. URINARY CALCULI.)

To determine the existence of oxalic acid in the urine, according to Dr. Swaber (*lib. cit.*), is of considerable value in prognosis, in reference to the violence and danger of pneumonia.

The symptoms associated with the occurrence of oxalate of lime in the urine are described as follows by Dr. Begbie. They occur chiefly in patients of the sanguine or melancholic temperament, in the prime of life, and in males of the upper classes, unaccustomed to laborious exertion, who indulge in the luxuries of the table. They occur less frequently in females. Indigestion from its mildest to some of its most aggravated forms, often with no disorder apparently but the uneasiness arising therefrom, with languid assimilation. There is a sense of load at the pit of the stomach, with flatulency and palpitation some hours after a meal; often sufferings of a more severe kind influencing very seriously the nervous system and threatening the mental condition. The patient is usually peevish, sensitive, and irritable, or dull, desponding, and melancholic; at times full of gloomy fears and dark forebodings; painfully distrustful of his own powers; suspicious of some lurking disease, especially pointing to consumption or disease of the heart. From the dread of some threatened evil he is not infrequently hurried to the brink of mental derangement. In the milder forms there is an anxious countenance and the aspect of ill health, a loaded tongue, a dry skin, and an irritable pulse. In the more confirmed, a dingy, dark complexion, perhaps a red, tender, and occasionally quivering tongue, emaciation, falling off of the hair, eruptions of a scaly kind, sometimes boils or carbuncles, pain of a dull but deep-seated kind in the back and loins, hæmorrhage from the bowels or bladder, incontinence of urine, and complete prostration of the virile powers. The progress of these symptoms may be varied and slow; "under diet and regimen with pure country air it may be checked and controlled; under medicine it may be entirely arrested; but if neglected or maltreated, the malady will finally subject its victim to the sufferings and perils of stone in the kidney or bladder, or the still more serious consequence of malignant organic disease." (*Edinb. Monthly Journal*, vol. ix. p. 943, 1849.)

Dr. Begbie refers these symptoms to "a poison generated during the process of digestion and assimilation," and carried into the blood through

the ordinary channels, but limited in its consequences by the agency of the kidneys, the poison appearing in the urine in the form of oxalate of lime. These views are in accordance with those of Prout and Golding Bird. The cases given by Dr. Begbie illustrate finally the necessity of careful examination of the urine in every case of dyspepsia.

When oxalic acid or its compounds act as a poison it is probably by the development of carbonic oxide gas.

On the principle that oxalæmia is owing to defective oxygenation, nitro-hydrochloric acid, the most powerful oxidising substance known, is indicated theoretically as a remedy, and it has been found in practice the most efficient. It may be supposed to oxidise the *materies morbi* completely and convert it into carbonic acid and water. (*Headland on the Action of Medicines*, 1854.)

*The Treatment.*—In this, as in all the altered conditions of the blood dependent upon defective oxygenation, remedies which promote oxygenation are indicated. The nitro-hydrochloric acid may be given in doses of twenty minims three times a day in the infusion of calumba or some other bitter. The bowels have to be cleansed occasionally with gentle laxatives. Saccharine materials should be excluded as much as possible from the diet, and milk, farinaceous vegetables, and animal food enjoined; warm clothing and tepid sponging.

R. Acid. nitr. dil., acid. hydrochl. D., syrup auratii, aa  $\mathfrak{zss}$ ; aquæ  $\mathfrak{ziss}$ . Misce. A teaspoonful mixed with a wineglassful of water before meals.

H. Ancell.

**OZÆNA.** (From  $\delta\zeta\eta$ , a stench.) An ulcer situated in the nose, discharging a foetid purulent matter, accompanied with caries of the bones. The constitutional disease upon which ozæna depends must be relieved before the cure of the local effect can be expected. Tertiary syphilis is usually the cause of this affection, but it may arise from scrofula or from any other disease or injury occasioning caries of the bones and ulceration of the fibro-mucous membrane of the nostrils. The internal medicines which may be necessary are preparations of mercury and antimony, iodine, hydriodate of potash, sarsaparilla, cod-liver oil, quinine, preparations of steel, elm bark, Peruvian bark, muriated barytes, and muriate of lime. The best local applications are lotions of the sulphate of copper, zinc, nitrate of silver, kresote, lotions of the chloride, or of the bichloride of mercury and lime water, or of diluted sulphuric acid. (See *Venereal Disease*.)

**PALATE, FISSURE OF.** [There are few defects of the human body which are attended with more inconvenience to the individual afflicted, than cleft palate, whether we consider it as affecting the utterance of articulate sounds, or whether we consider the unpleasant suspicions as to its cause which may sometimes arise.

Few defects have more successfully baffled the skill of the surgeon, and few, when effectually relieved, more amply reward his skill.

Cleft palate may be either congenital or accidental, and in either case it may be either simple or compound; that is, it may be confined to either the hard or soft palate, or it may extend through both. It may vary in degree from the mere bifurcation of the uvula or an opening in the hard palate no larger than the smallest probe-point, to

the entire absence of the velum, of the palatine processes of the palate and maxillary bones, and of the intermaxillary bones. Frequent reference is made to cleft palate by the older authors, but the only remedy suggested by them is an obliteration of the aperture by some foreign body, and this we may infer from the plates and descriptions on record must have been most imperfectly accomplished.

The first operation appears to have been performed about the year 1760 by a French dentist, M. Le Mounier. "A child had the palate cleft from the velum to the incisor teeth; M. Le Mounier attempted, with success, to reunite the two edges of the cleft, first making several points of suture to hold them together, and then refreshing them with a cutting instrument."

Velpeau mentions that "in 1813, experiments upon the dead body were made by Colombe, and that he was desirous of repeating them upon a patient in 1815, who, however, refused."

From this date the operation was frequently performed, both on the continent and in America, by men with whose names all must be familiar—Graëfe, Etel, Roux, Dieffenbach, Doniges, Velpeau, Hosack, Multee, Warren, and many others.

In the year 1821, Mr. Alcock performed staphyloraphy for the first time in England. But the operation was attended with such difficulty, and the results were so uncertain, that even amongst the best surgeons it was generally believed that but few cases were suitable for it. In Syme's *Principles of Surgery*, published in 1832, we read, "Fissure of the soft palate may be united, in favourable cases, by an operation similar to that for hare-lip, but which is exceedingly difficult of execution, owing to the situation of the parts, &c."

Mr. Liston, in his *Operative Surgery*, published 1840, says:—"The operation should not be commenced before the patient has arrived at years of discretion, so that he may afford every facility for its accomplishment. An attempt may now be made to close the fissure by adhesion of its margins. But it is only in very favourable instances that this velosynthesis should be attempted."

Sir W. Fergusson, in 1844, presented a paper to the Medico-Chirurgical Society on cleft palate and on staphyloraphy, in which he pointed out an improved mode of performing the operation. He says:—"Up to a recent period the results have been so unsatisfactory, that I have had little confidence in recommending the operation." Up to this period the operation had been performed very much in the same way by all surgeons, slight differences of opinion existing only as to whether the sutures should be carried through the velum first, and then the edges pared, or whether the edges should be pared first, and then the sutures passed; and whether the edges should be pared with a knife or scissors. But with the exception of these, or equally unimportant differences, the operation performed by all was the same. Thus, from 1760 to 1840, little or no real advance had been made in the operation for fissure of the soft palate. Mr. Liston, with his skill as an operator, pursued, with very little modification, the same plan as that devised by Mounier, the French dentist, nearly a century before.

Up to this date no one had even attempted to operate upon fissure of the hard palate. Mr. Syme writes, in 1832:—"Split palate does not admit of any remedy for the division of the hard part, except the closure of the communication between the nose



and the mouth by a piece of silver, enamel, or other substance, so fitted as to remain in it without shifting." Mr. Liston, in his *Operative Surgery*, published in 1840, appeared to consider it so entirely out of the province of the surgeon, that he did not even refer to it; his remarks on split palate being entirely confined to fissure of the velum pendulum palati.

Sir W. Fergusson, in 1844, says:—"Until a recent date, the cleft in the hard palate has been deemed beyond the reach of surgical skill, but Dr. Mason Warren, of Boston, has recently, by a proceeding strictly surgical, closed the fissure here as well as in the soft parts. I have resorted to the operation in several instances, but without success. The process is exceedingly difficult."

The history of the surgical treatment of the hard palate dates from this period. Since Dr. Warren's paper, which appeared in the *New England Journal* for 1843, many surgeons in this country, as well as on the continent and in America, have performed the operation with success.

We proceed first to describe the operation on the soft palate, called staphyloraphy, as performed at the present day. The first step is the improvement recommended by Sir William Fergusson, the division of the levatores palati, and the palatopharyngei muscles. One great obstacle to the success of this operation, previous to Sir William Fergusson's paper, was the violent muscular action which the irritation of the operation appeared to provoke; this, Sir William was induced, after dissecting a cleft palate, to attribute to the combined action of the before-mentioned muscles, and therefore he divided them, rather than, as had hitherto been the fashion, inflict sundry empirical gashes upon the soft palate with the object of relieving tension, and paralysing the muscular action of the part. The result of this more reasonable practice has been to make the operation more frequently successful. After this step has been taken, the edges of the fissure should be pared with a probe-pointed bistoury, and then brought together and retained in apposition by means of two or three interrupted sutures. All motion of the parts should be guarded against as much as possible. Fluid food should alone be taken for the first forty-eight hours, and this but sparingly. The stitches should be carefully cut out on the second or third day.

The surgical treatment of the hard palate is, as has been already said, of very recent date. Dr. Mason Warren must be considered as the originator of this operation, which consists in dissecting the soft tissues from the bones of the palate, by means of knives with short angular blades contrived for the purpose (*Med. Chirurg. Trans.* vol. xxxix.), so as to form two flaps, falling downwards towards the tongue, the edges of which shall meet in the mesial line; these edges are then to be pared, so as to present clean-cut raw surfaces, which are to be kept in contact by means of the interrupted suture, until union has taken place. In those cases where the fissure extends through both hard and soft palates, the operation must be divided into two, three, or even more parts, as, for several reasons, it is injudicious to attempt the union of a large surface at once. In these cases the operator generally selects the anterior extremity to commence upon. Of the propriety of performing this operation many surgeons

have grave doubts. Fergusson says:—"In the generality of such cases, I believe that the patient had better remain satisfied with an obturator." Erichsen, in his *Science and Art of Surgery*, 1853, says:—"This operation has not been hitherto successful, I believe, in this country. Fissures of the hard palate usually require to be closed by means of an obturator."

Miller, in his *Practical Surgery*, 1852, says:—"If the aperture be large, the deficiency can only be supplied by mechanical contrivance. If, however, it resembles merely a fistulous opening, closures of the mucous membrane may be obtained by the occasional application of a heated wire."

The late Mr. Avery, of Charing Cross Hospital, appears to have been the first English surgeon who obtained any encouraging measure of success in this operation.

Mr. Pollock records, in a paper published in the *Medico-Chirurgical Society's Transactions*, 1856, two cases successfully treated by that gentleman. Mr. Pollock enjoyed the benefit of Mr. Avery's friendship, and assisted him in some of his operations on the hard palate, and to this circumstance he attributes, in some measure, his own success in this operation, which appears to have exceeded that of others. Some part of his success also he attributes to the instruments he uses, which have been made according to his own directions. On this point he remarks:—"The first consideration must be paid to the instruments which are necessary in these operations; a consideration of the utmost importance; as much so, indeed, as any other point in connection with the treatment of these cases. The broader cutting edge should be chiefly employed, in preference to the narrower blades, as it secures greater expedition with less chance of bruising the soft parts. I prefer, throughout the detaching process, the broadest-edged blade that can be conveniently used. I have had several new knives constructed." In this paper Mr. Pollock records two cases of his own which were successful, and since that paper was read he has reported in the journals other cases in which he has operated successfully, but the writer has yet to see a case in which, where union has been complete, any marked improvement in the power of articulation has followed. This strange fact has also been noticed by others. Some three years since M. Nélaton published his determination never again to subject a patient to the risks and pain of this operation, because he had not, in any instance, found a satisfactory improvement in the power of enunciation follow.

We will now proceed with the history of the mechanical treatment of cleft palate. Since the first surgical attempt to remedy this defect dates only as far back as 1760, we may expect to find the help of the mechanic invoked to overcome the most disagreeable and inconvenient effects of cleft palate, and accordingly, in all the oldest works on surgery the writer has had time to examine, when reference is made to this condition of the mouth, obturators are spoken of as the only remedy. Thus, James Guillemeau, 1598, Ambrose Paré, 1665, Neister, 1756, and others, speak of and describe artificial palates for this defect. Although these old writers speak of gold and silver plates being made for the relief of these cases, yet it is evident that they could have been of little or

no use, inasmuch as they were made by goldsmiths who worked without a model of the mouth to guide them, and of course it is most necessary that the plate, to be of any real use, should fit the mouth with the utmost exactness. Thus, then, the real history of the mechanical treatment of cleft palate dates from a recent period. The first Englishman who distinguished himself as a maker of obturators was Mr. Snell, a surgeon of London, who published, in the year 1828, an interesting book on the subject. This gentleman appears to have been singularly successful in his attempts to remedy this defect. He was the first to obtain a correct model of the mouth upon which to work up the plate, for he pointedly speaks of commencing his treatment by obtaining a *correct* model of the defective parts. Upon the plate so worked up, he fitted, when the vomer was deficient, a piece of ivory to the superior or convex surface, which was filed up to a shape which represented this bone; when the soft palate was fissured, he attached to the posterior margin of the gold plate a curtain of india-rubber, which was made at once both stiff and flexible by a gold spring attached to it. The construction of such an apparatus could only be accomplished by the man who first designed it, and hence we find that, a few years later, the then best known author on dental surgery, Fox, says:—"Fissure of the hard palate is generally easily remedied, but where there is a loss of the velum pendulum palati the successful use of any substitute, however ingeniously contrived, is very doubtful."

During the year 1845, four articles appeared in the *Lancet*, by Mr. C. H. Stearn, a surgeon of London, on "congenital deficiency of the palate," in which he described a most ingenious apparatus which he had contrived to remedy a congenital fissure of the soft palate in the person of a near relative of his own. He first fitted a gold plate to the roof of the mouth; to the upper and posterior margin of this plate, a flat, spiral spring was attached, which could vibrate backwards and forwards; to the free extremity of this spring, an artificial, flexible velum was attached. This velum, made of india-rubber, consisted of a body and two wings. The body, which consisted of three pieces overlapping each other, was made the shape and size of the fissure when the parts were at rest; and the wings, each composed of a single piece, projecting forwards and outwards from each lateral margin of the body, were made to conform to the shape of the columns or fleshy sides of the fissure, and to rest upon their anterior surfaces. In like manner, from each lateral margin of the body, there projected obliquely backwards and outwards a flange, which rested on the posterior surface of the sides of the fissure. In this way the wing and the flange of the same side together formed a groove fitted to receive the movable sides of the fissure, and therefore, when the muscles acted and the fleshy columns of both sides tended to approximate, as in the act of deglutition, the three parts of the body being pressed upon laterally, glided one over the other, and thus the extent of the surface of the body was diminished. This apparatus succeeded in perfectly restoring to the gentleman for whom it was made, the power of distinct articulation, and thus the fact was at once established that congenital deficiency of both the hard and soft palate could be effectually relieved by mechanical means. It now only remained to

simplify the apparatus, in order to render the mechanical treatment of this defect successful, even in the hands of men less ingenious than Mr. Stearn.

The writer, without any knowledge of what had been previously done in this field of labour, was called upon, about twelve years ago, to treat a very extensive congenital fissure of hard and soft palate. His first step was to obtain an accurate model of both hard and soft palate; over the former he fitted, with the most exact precision, a gold plate, which was carried back to the posterior margin of the palatine processes of the palate bones, and to which was attached a flap of thin vulcanised india-rubber. This was found, as soon as moistened with the saliva, to adhere to the pillars of the fissured soft palate and to follow them in all their movements, and thus, by this simple arrangement, an artificial velum was obtained, which possessed all the movements of the natural velum.

As this flap would be liable to undergo decomposition, it only remained to make the attachment of it to the gold plate so simple that it might be readily removed and replaced by the wearer, to render it practically indestructible. This was effected by means of two gold arms working on hinges and bolted together by a single pin; when the pin was withdrawn, the arms opened, and the flap fell out. From a sheet of ordinary vulcanised india-rubber, another flap can be readily cut, an exact pattern of the original one (which must be designed by the maker of the apparatus, for no two cases are exactly alike), and attached to the gold plate. But to get rid of the peculiar nasal character of the voice in this defect, it was found necessary, not merely to bridge the fissure, but to fill it up, and this appears to throw some light on the cause of the imperfection in articulation before alluded to, in those cases in which the surgeon had succeeded in completely closing the fissure. This was effected by attaching to the upper or convex surface of the gold plate, a crest, originally of gold, now of vulcanite (which is india-rubber vulcanised to hardness, and in this state not prone to decay), which was carried into the fissure, *care being taken that it did not actually touch its margins*, to form the floor of the nares. The apparatus thus made, combining, as the writer claims for it, simplicity, durability, and a wide adaptability, has succeeded beyond his expectations, in relieving numerous cases of congenital deficiency of the hard and soft palate.

In illustration of the amount of success which has attended this mode of treatment, the following cases are appended:—

*Case I.*—A lad between 16 and 17 years of age, with a fissure extending from the uvula to half-way through the hard palate, was fitted with an artificial velum and hard palate; his power of distinct enunciation became so perfect, that after finishing his University career, he resided as tutor with a family of distinction, and has subsequently taken Holy Orders. There is not the smallest trace of the characteristic nasal sound in this case.

*Case II.*—A young lady, with a fissure very similar, in extent, to the preceding case, gained, by the use of an artificial palate, so distinct an enunciation, that she sought the writer's opinion as to whether she ought to reveal her natural defect to a gentleman who had made proposals of marriage to her in ignorance of its existence.

*Case III.*—A gentleman, with a fissure extending from the uvula to the lip, was fitted by the writer



with an artificial palate. After wearing it a few months he went to reside with a nobleman, a cousin of his, and remained in his house three years without any member of the family discovering his defect. He subsequently went to New Zealand, and though he has been there for several years, the writer hears from him that he has never been inconvenienced by being so far removed from his help.

*Accidental deficiencies of the Palate.*—Accidental deficiencies of the palate may be grouped into two classes, one where the defect is the result of injury, the other where it is the result of disease. Gunshot wounds are the most common and the most serious causes of injury; while syphilis supplies by far the largest number of cases the result of disease. As there is no law to regulate the amount of mischief which may be inflicted either by accident or disease, so no general description of these cases can be given, and the writer thinks he can best illustrate the misery caused by them, and what can be accomplished by art for their relief, by relating the particulars of an extreme instance of each class in which he has had the satisfaction of affording complete relief.

Cases, the result of injury, are scarcely sufficiently numerous, nor is the damage done exact enough in its extent, to admit of their being grouped under different heads; but those, the result of disease, may very conveniently be spoken of as deficiencies of the hard palate, the soft palate, and of both combined; the extent of injury in these latter cases varying from the smallest perforation to the loss of almost all the parts of the maxillæ and their appendages. The remarks may be premised by saying, that though a very small perforation may exist in either hard or soft palate, it will effectually destroy distinct enunciation, and banish the sufferer from society. In such case, however, a much less perfectly adapted instrument than is necessary for a congenital case will succeed in immediately restoring a clear enunciation.

The great impediment to the successful treatment of these cases of accidental deficiency of the palate arises from the difficulty to be overcome in getting a correct model of the injured mouth, in consequence of the great contraction that most commonly follows the healing of the ulcerations that have before existed. The operator's utmost ingenuity will often be taxed to effect this, the first stage of treatment.

*Case I.—Gun-shot wound.*—An officer of the British army, serving in the Crimea, was wounded by a Russian who fired at a distance of fifty yards. The ball, about an ounce in weight, struck him on the upper lip about the position of the right canine tooth, and travelled obliquely backwards, removing every tooth in the upper jaw save one, the right upper wisdom tooth, and destroying the roof of the mouth.

After many months of suffering, the parts healed, leaving the sufferer quite unable to make himself understood, in consequence of an opening into the nares, about the size of a florin.

Great difficulty was encountered in obtaining a model of the mouth, owing to the injury that had been inflicted on the levator muscles, which, when healed, more resembled cartilage in their immobility than muscular fibre.

Having obtained a model, an apparatus was readily constructed, which immediately restored so perfect an enunciation that there was no impedi-

ment to his holding the command of his regiment, which, but for this timely help, he would have had to resign.

*Case II.—Entire absence of the soft palate, the result of syphilis.*—Here again a British officer was the sufferer. The disease assailed the velum—to which happily its ravages were limited—which it so completely destroyed that but a few muscular fibres remained, and these were firmly adherent to the superior constrictor of the pharynx. The sufferer could only make himself partially understood by holding his nose while speaking, and under those circumstances he had completely withdrawn from society.

The writer applied an artificial soft palate with so good a result that the wearer mixes in society as of yore, and without any marked defect in articulation.

*Case III.—Loss of hard palate, the result of syphilis.*—A married lady was in this instance the victim of disease, which assailed the bones of the hard palate. Considerable exfoliation took place, leaving in fact only the antrum on either side, the palatine processes of the maxillæ, and what may be described as the inter-maxillary bone being lost.

With an artificial restoration of the lost parts, this lady was enabled to mingle in society with perfect comfort to herself.

*Case IV.—Loss of hard and soft palate, the result of syphilis.*—This case has been described at length in vol. xxxix. of the *Medico-Chirurgical Transactions*, but may be briefly recapitulated here. The disease broke out in the hard and soft palate simultaneously, and, prolonged over several years, committed frightful ravages, not only within the mouth, but on the face and neck, so much so that when the disease was arrested and the wounds healed, the contraction that followed shortened the face fully an inch and a half. The loss of parts in the interior of the mouth was enormous; the naso-oral cavity, for the two were thrown into one, formed what may be described as an isosceles triangle, the base of which was the tongue, the apex, the cribriform palate of the ethmoid bone. Not a vestige of the soft palate remained, and of the hard, only the walls of the antrum of Highmore on either side, forming, together with the turbinated bones, the sides of the triangle.

In this case the loss of articulation was so complete that the sufferer wrote on a tablet his wishes, just as a dumb person may do. Two years of constant labour ended in the construction of an apparatus, by the use of which articulation was so far regained that the patient was enabled to resume his duties as a clergyman, and has continued to do so to the present moment, a period of twelve years.

Edwin Sercombe.

**PANNUS.** When two or three pterygia of different sizes occurred on the same eye, with their points directed towards the centre of the cornea, where they met, and covered all the surface of this transparent membrane with a dense pellicle, the ancients named the disease *pannus*. (*Scarpa*, chap. 14.) At present, the term is applied to any opaque thickening of the layer of the conjunctiva covering the cornea.

The term *pannus trachomatosis* is used by some to distinguish pannus caused by granulations, from the one caused by other morbid changes, e. g. herpes of the cornea. In slight degrees of pannus (so-

called *pannus tenuis*) we find (microscopically) a great increase of the thickness of the layer of epithelial cells of the cornea, with blood-vessels and fusiform cells upon and beneath the anterior elastic lamina, which itself may appear intact. In higher degrees, portions of the anterior elastic lamina disappear, and connective tissue and blood-vessels are mixed up with the thick irregular layer of epithelium. The bulk of the cornea often remains transparent, though its surface may be covered with opaque tissue and blood-vessels.

The opacity, if such exists in the cornea, rarely occupies its entire thickness, and is situated beneath the anterior elastic lamina. It consists at first of capillaries, followed by numerous closely packed fusiform cells, with very little inter-cellular substance. They seem to be the result of division of the nuclei within the cells of the cornea, and subsequently of the cells themselves. The rapid increase of these cells leads to a disappearance of the inter-cellular substance. The more numerous these cells are, the greater is the opacity. The cells of the cornea are larger and more numerous close to the opaque part.

Ulcerations or purulent infiltrations of the cornea, followed by perforation, or dense opacities, frequently occur during acute attacks of granular ophthalmia.

The surface of the cornea in severe cases appears covered with a grey or red and opaque vascular, somewhat granular, substance, which is continuous with the swollen ocular conjunctiva, and which is termed *pannus grassus*; it may continue for years before it changes into loose opaque connective tissue. The treatment of pannus is included under the treatment of granulations. (See CONJUNCTIVA.)

C. Bader.

**PARACENTESIS.** (From *παράκεντρώ*, to perforate.) The operation of tapping, or making an opening into the abdomen, thorax, or bladder, for the purpose of discharging the fluid confined in these parts in cases of ascites, empyema, hydrothorax, or retention of urine. A similar operation is often practised for the relief of hydrocele and ovarian dropsy. Effused blood may also require an opening to be made into the chest; and so may confined air in the instance of emphysema.

#### TAPPING, OR PARACENTESIS ABDOMINIS.

When the swelling extends equally over the whole abdomen, the fluid is usually diffused among all the viscera, and is only circumscribed by the boundaries of the peritoneum (ascites). The water is occasionally included in different cysts, which are generally formed in one of the ovaries (ovarian dropsy), and in this case the tumor which is produced is not so uniform, and the fluctuation not so distinct, as in peritoneal dropsy, at least, while the disease has not made great progress. The difference also in the consistence of the fluid in ovarian dropsy may render the fluctuation more or less difficult of detection. When the water is contained in different cysts, it is frequently thick and gelatinous; but when it is uniformly diffused all over the cavity of the peritoneum, as in ascites, it is generally thin and even quite limpid. Sometimes a considerable number of hydatids are found floating in the fluid. With regard to the symptoms of common ascites, the disease is attended with great

uneasiness, from all kinds of pressure on the abdomen; a gradual swelling of this part of the body, not inclining more to one side than the other; a fluctuation perceptible when the surgeon lays his hand on one side of the tumor, and gently taps on the opposite side of it; considerable difficulty of breathing, caused by the collection of fluid interrupting the action of the diaphragm, and obliging the patient to lie with his chest very much raised; constant thirst, &c. The abdomen usually begins to swell very gradually; the swelling is uniform, beginning from the pubes and by degrees extending as high as the ensiform cartilage. As the fluid accumulates in greater quantities, the parietes of the abdomen yield very much in the direction forwards, and also downwards, so that, in some instances, the swelling descends considerably beyond the os pubis. The fluid of ascites consists of serum, exhibiting various shades of colour from a light citrine to a deep brown. Occasionally the serum is mixed with pus, and not unfrequently it contains flocculi of coagulating lymph; a circumstance denoting that there has been inflammation of the peritoneum. (See *Darwall in Cyclop. of Pract. Med.* art. *Ascites*.)

One common cause of ascites is disease of the liver, which has the effect of impeding the circulation of the blood in the vessels of most of the other abdominal viscera. Sir Astley Cooper enumerates, as other causes, an enlargement of the spleen, which presses upon and irritates the peritoneum, so as to determine an increased flow of blood to it, and an effusion of serum; great debility of the system, induced by fevers or other debilitating causes; diseases of the heart and lungs, in which cases the ascites is generally combined with hydrothorax. To distinguish pregnancy from dropsy, nothing more is usually required than an accurate knowledge of the signs of the former, but sometimes ascites is complicated with pregnancy. In this case, as Scarpa observes, the regular form and body of the uterus are not evident to the touch, principally from the enormous distention and prominence of the hypochondria. The urine is scanty and lateritious; the thirst is constant; the abdomen upon percussion presents a fluctuation, obscure in the hypogastric and iliac regions, but distinct in the hypochondria. The previous history of the case, with a proper examination of the neck of the uterus, will enable the practitioner to form a correct judgment. (See *Darwall, Op. cit.*)

Whatever may be the efficacy of bleeding, digitalis, mercury, diuretics, and calomel, elaterium, squills, iodine, iodide of potassium, and other medicines, in ascites, they are rarely of any service in local and encysted (ovarian) dropsies. When such swellings continue to enlarge, notwithstanding the adoption of a few measures which will presently be suggested, and produce much oppression and functional disturbance, perhaps the sooner the fluid is evacuated the better. It is also well-known that all efforts to produce a radical cure, even of dropsies which are not encysted, too frequently fail. Dr. Fothergill believed that physicians would meet with much more success in the treatment of ascites if they were to recommend paracentesis to be done sooner than they generally do. On the commencement of an ascites, this celebrated practitioner advises the trial of diuretics and other evacuants. He then adds, that "if, by a reasonable perseverance in this course, no considerable



benefit accrues; if the viscera do not evidently appear to be obstructed and unfit for the purposes of life; if the complaints have not been brought on by a long habitual train of intemperance, and from which there seems little hope of reclaiming the patient; if the strength and time of life are not altogether against us; I desist from medicine, except of the cordial kind; and let the disease proceed, till the operation becomes safely practicable. When this is done, by the moderate use of the warmer diuretics, chalybeates, and bitters, also the preparations of squills, in doses below that point at which the stomach would be affected, I endeavour to prevent the abdomen from filling again." (*Med. Obs. and Inq.* vol. iv. p. 112.) Desault used to tap dropsical patients once a week, and in many cases, after he had performed the operation two or three times, the disease was stopped.

However, with respect to early tapping in ascites one fact mentioned by Sir A. Cooper, in his lectures, ought to be known, namely, that dropsy arising from the debility caused by fever or a course of mercury, and not attended with diseased liver, spleen, or disorganisation of other important organs, may often be cured by medical treatment, without any operation at all; and he therefore disapproves of paracentesis in such cases, so long as the fluid is not sufficiently copious to hinder the risk of the bowels from being hurt by the trocar. When this risk ceases, however, the practice seems commendable, because it will rather promote than retard the good effect of any other means which may be deemed advisable. At the same time I ought to mention the opinion of the above distinguished practitioner that the operation itself will never bring about a cure, except where the disease has proceeded from the debility left by some kind of fever, or other temporary cause of weakness.

Since Fothergill's time the operation of paracentesis seems to Dr. Darwall not to have increased in reputation. His own experience is decidedly against it. He has frequently had patients tapped when the effusion was very considerable, and had existed but a short time. Every care was also taken after the operation to prevent inflammation. In all these instances, however, the effusion rapidly recurred, and upon examination of several after death, the bowels were found adhering by old depositions of coagulating lymph. Though he admits that a cure sometimes follows tapping, he believes that it often increases the tendency to effusion. He excepts the example of dropsy complicated by pregnancy, where he deems the discharge of the fluid advisable. After all, however, the great oppression of the breathing, the suffering from distention and the functional disturbance, frequently after a time render paracentesis absolutely necessary, whatever may be the conclusion respecting the practice of Fothergill and Desault.

The great number of times that the operation has been repeated in some individuals is surprising; for instance, twenty-nine times (*Schnucker, Wahrnehmungen*, b. ii. p. 102); forty-one (*Med. Communications*, vol. ii.); fifty-two (*Schnucker*, vol. cit. p. 187); sixty-five (*Mead*); one hundred (*Callisen, Syst. Chir. Hodierna*, vol. ii. p. 55); one hundred and fifty-five (*Phil. Trans.* vol. 69); and if it be possible to credit Bezaud, even six hundred and sixty-five times upon one woman in the course of thirteen years. When the patient

died, the peritoneum was found to be three lines in thickness. The omentum, mesentery, and even the liver, gall-bladder, spleen, pancreas, kidneys, and bladder, had almost disappeared, a scirrhus mass containing pus occupying their place towards the right side. (*See Bulletin de la Société Méd. d'Emulation*, No. xii. Dec. 1815.) Some of these cases were certainly ovarian dropsies.

I have already noticed the practice inculcated by Fothergill of tapping in the early stage of ascites. This plan, I think, should never be adopted in acute cases, or those dependent upon increased effusion from inflammatory action. I find another advocate for the early performance of paracentesis in M. Dupasquier, who finds that the discharge of the fluid promotes the action of diuretics, which previously often have no effect; and he lays it down as a fact, that the action of diuretics is always in an inverse ratio to the quantity of fluid collected in the peritoneum, and the irritation of the gastro-intestinal organs. (*See Journ. Chir. des Hospitaux de Lyon*, vol. i. p. 355, 8vo. 1830.)

Experience has repeatedly proved, however, how frequently the function of the kidney cannot be re-established, though the fluid be discharged early; nor when we reflect upon the visceral, renal, and other organic affections often concerned as causes of ascites, how can any other expectation be entertained in a large number of cases? The following is Mr. Liston's advice:—"It becomes necessary when medicines which promote the secretion, more especially from the kidneys, have failed to give relief, and when the distention is very great, causing interruption to the functions of the viscera, particularly of the chest, and to great anasarcaous swelling of the lower extremities, to draw off the fluid by surgical operation." (*On Practical Surgery*, p. 426.)

Whenever a considerable quantity of fluid is suddenly let out of the abdomen by tapping, the quick removal of the pressure of the water off the large blood-vessels and viscera may produce swooning, convulsions, and even sudden death. These consequences led the ancients to consider paracentesis as a dangerous operation, and, when they ventured to perform it, they only let out the water gradually and at intervals.

Dr. Mead, after considering what might occasion the bad symptoms resulting from too sudden an evacuation of a large quantity of fluid from the abdomen, was led to try whether external pressure would prevent such consequences. It was conceived that, in this way, the same degree of pressure which the fluid made on the viscera might be kept up. The success attending this plan fully justified the opinion Dr. Mead had entertained; for when the compression was carefully made, the whole of the water contained in the abdomen of a dropsical patient might be safely discharged. For this purpose, however, the whole abdomen must be equally compressed, and the pressure maintained as the evacuation is taking place. While the water is flowing out, the pressure is usually made with a sheet or round towel, which is put round the abdomen. Two assistants who hold the ends of the sheet or towel gradually tighten it in proportion as the fluid is discharged. But in the present day all necessity for such compression is avoided by tapping patients in the recumbent position. Immediately after the operation some folded flannel, sprinkled with spirit of wine, is laid over the whole anterior part of

the belly, and covered with a broad linen or flannel roller applied with due tightness round the body. Dr. Monro invented a particular kind of belt for the purpose. Previously to tapping, some surgeons surround the abdomen with a broad band of flannel, the ends of which are split. The middle, which is made to fit better to the convexity, above and below, by triangular pieces being cut out, and the edges joined, is placed over the forepart of the abdomen, and the ends are crossed behind, and intrusted to assistants. The umbilicus is felt for, and openings cut in the bandage a little below it. (*Liston on Practical Surgery*, p. 426.)

The instrument used for tapping the abdomen is called a trocar. (See TROCAR.) Of this there are several varieties; but the generality of experienced surgeons give a decided preference to the common trocar. Most of the modern alterations which have been made in the construction of trocars have only been deteriorations. There are no grounds for the ordinary objection that the common trocar cannot be introduced without considerable force. If the part into which it is about to be passed be made tense, very little force will be necessary. Richter condemns the trocar with a double-edged point as a bad instrument. The proposal of Mr. Cline, to make a puncture with a lancet first, and then to introduce into it a blunt-pointed trocar, is superfluous. Nay, these innovations are declared to be worse than useless. A cutting instrument is liable to injure blood-vessels, and bring on hæmorrhage; and the wound does not heal so readily as that made with an ordinary trocar. That sharp-edged instruments are attended with the inconvenience of being apt to wound enlarged veins, and produce an unpleasant degree of hæmorrhage, is a truth of which I have myself met with a convincing example. A female, who had a strong aversion to being tapped with a trocar, prevailed upon me to make the opening with a lancet. The puncture was made in the linea alba, about three inches below the navel. A stream of dark-coloured venous blood continued to run from the wound the whole time the water was flowing out of the canula, and did not cease until a compress was applied. The quantity of blood lost could not be less than a pint, or a pint and a half. In many cases this loss of blood would prove fatal to dropsical patients, and is what one would always feel anxious to avoid. It is only in doubtful cases of encysted dropsy (see *Liston, Op. cit.* p. 427), or when the front of the abdomen is covered with a very thick stratum of fat, that I would make a preliminary incision. A man was under me in University College Hospital with ascites, and I introduced a trocar nearly up to the rim of its canula without reaching the fluid. Having procured a longer trocar, I repeated the puncture on the following day, and with this instrument was only just able to get about a quarter of an inch of the canula within the peritoneum, so great was the quantity of fat in front of the abdomen. In another such case I would make a previous incision. The patient, directly before the operation, should empty the bladder.

The position commonly selected for the operation is that in which the patient sits in an arm-chair. However, weakness and other circumstances frequently make it necessary to operate on

the patient as he lies on his side sufficiently near the edge of the bed; and this posture has one decided advantage, viz. that it tends to prevent the alarming syncope which the sudden removal of the pressure of the fluid from the diaphragm and abdominal viscera often brings on, in such a patient, in the erect position.

[The surgeon should remember that the small intestines, being movable and containing air, will float on the surface of the ascitic fluid, and that it would consequently be unsafe to tap a patient in the linea alba while in the supine position. Even when the patient is lying on his side, before introducing the trocar the operator should by percussion assure himself of the position of the small intestines. In the sitting posture there can be no danger of wounding them, as they will be floating far above the umbilicus.]

Formerly, the place in which surgeons used to puncture the abdomen, in cases of ascites, was the centre of a line drawn from the navel to the anterior superior spinous process of the ilium, and on the left side, which was preferred, in consequence of the liver not being there. The place for the puncture was usually marked with ink, and was supposed to be always situated just over a part of the linea semilunaris, where there are no fleshy fibres, nor any large blood-vessel, exposed to injury. This calculation, however, was made without considering that, in dropsy, the parietes of the abdomen do not yield equally in every situation. On the contrary, it is known that the front is always more distended than the lateral parts, and that the linea alba and recti muscles, in particular, are sometimes very much widened. In consequence of these alterations attending the disease, no dependence can be put on any measurement made with the view of ascertaining the precise situation of the linea semilunaris. The surgeon who trusts to his being able to introduce the trocar exactly in this place from any calculation of the above kind, will frequently wound a great thickness of muscle, instead of a part where the abdominal parietes are thinnest. But a still stronger objection is to be urged against the practice of attempting to tap in the linea semilunaris. Men well acquainted with anatomy have frequently been deceived in their reckoning, and, instead of hitting the intended line with their trocars, they have introduced these instruments through the rectus muscle, and wounded the epigastric artery. Patients have died from this error, with large extravasations of blood in the cavity of the peritoneum. In a dropsical person, who has been tapped, it is to be observed also that an effusion of blood in the abdomen will of course more readily take place, in consequence of the parts not being in the same close, compact state in which they are in the healthy condition.

Henceforth, therefore, let every prudent practitioner abandon the plan of tapping in the linea semilunaris in cases of ascites; and he may the more easily make up his mind to do so, as there is another place where the operation may be performed with the utmost facility and safety. The linea alba is now preferred; because here no muscular fibres need be wounded, the place can be hit with certainty, and no large blood-vessel can be injured. About the middle point, between the navel and pubes, is as good a situation for making the puncture as can possibly be chosen. The surgeon should introduce the trocar in a



steady, firm manner, never in an incautious, sudden way, lest parts contained in the peritoneum should be rashly wounded. For the same reason, immediately the point of the trocar has entered the abdomen, a thing always known at once by the sudden cessation of resistance to its passing inward, it should be introduced no further, and its office of making a passage for the canula is already accomplished. The surgeon, consequently, is now to take hold of the canula with the thumb and index finger of his left hand, and gently insinuate it further into the cavity of the peritoneum, while with his right hand he is to withdraw the stilet. [The extreme caution here recommended is most judicious when any doubt exists as to the proximity of the viscera to the surface; but in ordinary cases the layer of fluid which covers them is several inches in depth, and the trocar may, without danger, be plunged into it. This latter mode of operating is now usually adopted as less painful and equally safe.] The fluid now gushes out, and regularly as it escapes, the sheet, or other bandage round the patient's body, is to be tightened. All the water having been evacuated, a piece of flannel and a roller are to be immediately applied, as above explained, a piece of lint and soap or adhesive plaster having been previously put over the wound.

It is not uncommon for the water suddenly to stop long before the full quantity is discharged. Sometimes this happens from a piece of intestine or omentum obstructing the canula. This kind of stoppage may be removed by just introducing a probe or director, and holding the portion of bowel back. When the water is viscid, the only thing we can do is to introduce a large trocar, if doing so should promise to facilitate the evacuation. Also, when hydatids obstruct the canula, a larger instrument, or the enlargement of the opening, would allow them to escape. In encysted dropsies the practitioner, of course, can only let the fluid out of those cavities which he can safely puncture. According to Sir Astley Cooper, the water of encysted dropsy is at first contained, not in a single bag, but in several, the partitions between which are in time gradually absorbed, and the number of distinct cavities consequently diminished. Hence another reason why the fluctuation becomes more evident as the disease advances. (*Lectures, &c.*, vol. ii. p. 373.) The fact, if established, should also influence the surgeon not to make too early a puncture, which could only discharge the fluid from one cyst, while several others, not having yet any communication with it, would remain distended.

The abdomen of a female was tapped by Dr. Andrew Buchanan through the fundus of the bladder, for which purpose a tube with a stilet was introduced by the meatus urinarius. The method was adopted chiefly for the purpose of trying what would be the result of maintaining, in ascites, a communication between the cavity of the peritoneum and that of the bladder. In the case referred to the water was discharged; but success did not attend the endeavour to keep the puncture in the fundus of the bladder open. (*Buchanan, in Glasgow Med. Journ.* vol. i. p. 195.) It seems to me that any means calculated to perpetuate the opening would be likely to cause peritonitis. The continuance of an opening between the cavity of the bladder and that of the abdomen, or of the

cyst, owing to the irritating qualities of the urine, can hardly be viewed as free from serious risk. There is an analogy between this suggestion and that of Mr. Guy, of Chichester, who proposed leaving the canula in the wound, and occasionally letting the water flow out after the ordinary mode of paracentesis; a plan, however, which is attended with considerable though less risk, but has sometimes been followed by a cure. (See *Sir Astley Cooper's Lectures*, vol. ii. p. 383.)

When dropsy of the ovary is large, it also admits of being tapped in the linea alba; but in this particular case it is generally best to make the puncture where the swelling is most prominent. In this disease the ovary is either converted into one large cavity (unilocular) filled with fluid, or else there are several distinct cysts (multilocular). Under the name of ovarian dropsy have also been included simple serous cysts, formed in the broad ligaments and Fallopian tubes. "All these confounded together" (as Dr. Seymour observes) "under the name of hydatids, are distinguishable from the latter, by being nourished by vessels supplying them from the parts in which they are formed; vesicles to which the name hydatid is attached being nourished by their own blood-vessels, or in other words, having an independent life." (*On Principal Diseases of the Ovaria*, p. 45.) In the early stage the tumor is situated towards one side of the abdomen, just above Poupart's ligament, and seems to ascend out of the pelvis. This at once distinguishes the disease from a common ascites, which is attended, from the first, with an equal, gradual, universal swelling of the abdomen.

The magnitude which the disease may attain may be judged of by the fact, that twelve or fifteen gallons of fluid have sometimes been contained in the cavity or cavities of the cyst. The cyst of the ovary, when it has attained a large size, generally adheres, in different places, to the inner surface of the peritoneum, and in this state the whole abdomen often seems uniformly swollen, in consequence of the immense magnitude of the disease. (See *G. D. Moitz, De Structura, Usu, et Morbis Ovariorum*. 4to. Jenæ, 1788.) It is an observation made by Sir A. Cooper that one of the principal differences between ascites and ovarian dropsy is that the latter is in itself quite a local disease, just like a hydrocele. This observation, I believe, is perfectly correct; and though great illness frequently arises, it is generally the result of the pressure made by the swelling on the parts within the abdomen and pelvis. The impairment of the health, arising from the pressure of the viscera and interruption of their functions, and the great difficulty of breathing produced by the pressure of the diaphragm, indeed frequently make it absolutely necessary to let out the fluid. The disease may be attended with an almost total stoppage of the secretion of urine. (See case by *Barlow, in Prov. Med. Trans.* vol. iv. p. 403.) Sometimes the urine is duly secreted, but a retention occurs, and the use of the catheter becomes indispensable.

The symptoms of ovarian dropsy differ in different instances, but are generally not severe, and principally depend upon the pressure of the tumor on neighbouring parts, or accidental inflammation of the interior of the cyst. "Where the increase

of the disease is slow, the patient often suffers no other inconvenience than from swelling of the leg on the side on which the tumor is largest, or from the unsightly bulk of the abdomen, which she is unable to conceal. In some rare cases patients have lived in this manner thirty or forty years, with a very considerable enjoyment of the comforts of life, and even the pleasures of the world, the accumulation of fluid rendering it necessary from time to time to perform the operation of paracentesis. In the majority of cases of this kind of dropsy, however, symptoms dependent on unusually rapid increase of bulk, or pressure on any particular organs in the abdomen, occur. Thus, heartburn, vomiting, and purging, difficulty of passing urine, or violent and severe headache, are met with, which are entirely removed if the bulk of the tumor be reduced. There is a case now under the care of Mr. North, where the patient has for many years been unable to pass her urine, except by the daily use of the catheter; and this appears to arise from the natural situation of the bladder being altered by pressure, and, perhaps, by the adhesion of the tumor. When both ovaries are diseased in this way, the catamenia are always absent; when only one ovary is affected, they are sometimes irregular, sometimes absent altogether. In many cases the diagnosis is free from difficulty. Pain has been felt in either iliac region, succeeded by a tumor, which can be traced low down in the pelvis, and the uterus is found, on examination, dragged upwards by the morbid growth. The history likewise assists us; it has followed miscarriage, or delivery; at other times it occurs in females where pregnancy is out of the question, or at a time of life when it is impossible, and yet where the unbroken health renders ascites a very improbable occurrence." (*Seymour's Illustrations of Dis. of the Ovary*, p. 50.) The circumstances distinguishing it from ascites and pregnancy, and the fact of its being sometimes complicated with pregnancy or ascites, should be recollected.

In ovarian dropsy the swelling does not, like that of ascites, begin from the lower part of the abdomen; nor is it uniform, one side or the other being most protuberant. If several cysts exist, the dropsy is called multilocular, and the parietes of the abdomen often feel lobulated. When the patient turns herself in bed, a sensation of a heavy weight within the abdomen falling to the lower side is experienced. Patients generally lie on the side on which the tumor has originated. In some cases a hard tumor is remembered to have preceded the distention of the abdomen. When, however, the cysts are few and very large, or unilocular, the distinction may be difficult. Cysts, containing abundance of hydatids, are frequently met with connected with the liver or spleen. Such disease, in its earliest stage, is not likely to be mistaken for ascites; but, as the parietes of the abdomen become thinned, the presence of a soft swelling, and sometimes exhibiting a slight degree of fluctuation, may be traced. In ascites the swelling proceeds from below upwards; while in encysted dropsy of the liver its progress is from above downwards. A greater prominence may be perceived on the right side, in hydated cysts of the liver. As in ovarian dropsy, the general health is little affected, at all events till the swelling has attained magnitude; the urine is passed in the natural quan-

tity, and no serous effusion in the cavity of the peritoneum, nor any anasarca of the lower extremities, occur till a very late period of the disease. (See *Darwall*, in *Cyclop. of Prac. Med.* art. *Ascites*.) In a case where the abdomen contained a cyst of this kind, filled with four gallons and a half of serous fluid and hydatids, the abdomen was so uniformly distended, and the fluctuation so plain, that I introduced a trocar; but the canula became obstructed by the hydatids, and hardly any part of the contents of the cyst were evacuated. The man, who was in a most debilitated state, lived ten days after the operation. The cyst is placed in the museum of University College. I have since heard of cases in which the opening was enlarged with a probe-pointed bistoury, and the hydatids discharged. In one instance, thus treated, a cure was the result.

With few exceptions, tapping can only be regarded as a palliative measure; the water collects again, the same grievances recur, and the operation must be repeated. While an ovarian dropsy is recent, and even after it has been tapped, some attempts may be made to effect a radical cure. But I believe this is not to be accomplished with mercury, iodine, or any other medicine yet known. As Dr. Seymour remarks, in simple ovarian dropsy it would seem reasonable to diminish the quantity of fluid secreted in the cyst, by exciting some increase of the excrementitious fluids, more especially of the urine; but experience does not show that such an effect can be produced by those remedies which are found very powerful in serous accumulation in the natural cavities of the body. Dr. Withering found digitalis completely fail. But where ovarian dropsy is combined with ascites, relief may be derived from the infusion of digitalis and *pyrola umbellata*. (*Seymour's Illustrations of Dis. of the Ovary*, p. 90.) Emetics were recommended by Abernethy to promote the absorption of the matter of chronic abscesses, and by Dr. Percival for the dispersion of ovarian dropsy. (*Essays*, vol. i. p. 375.) I believe that few practical men have now any confidence in their use for these purposes. Blistering the surface of the abdomen, keeping up a discharge with the savine cerate, and applying a tight roller, have been known to do good. Long-continued frictions are stated to have lessened an ovarian swelling; but, as is added, only temporarily. (*Seymour, Op. cit.* p. 97.)

Various operative plans have been tried for the radical cure of ovarian dropsies. 1. A considerable incision into the cyst, and keeping a canula, or bougie, afterwards in the opening, to prevent another accumulation of fluid, and thus promote the contraction of the cyst. 2. Injections into the cyst. 3. Removal of the cyst. A very remarkable and successful instance of the first kind of practice, and perhaps the earliest, is related by Dr. Houston, in the 33rd vol. of the *Phil. Trans.*, the particulars of which may also be read in Dr. Seymour's work.

In France, Le Dran laid open the cysts of ovarian dropsies. His patients did not die of the consequent inflammation, and the dropsy, indeed, was cured; but there remained either a sarcomatous enlargement of the ovary, which continued to increase till death, or else incurable fistulae, leading into the cyst. The great size of a wound necessary for this purpose, the danger of inducing, in-



inflammation in so extensive a surface as the cyst of a large ovarian dropsy, and the events of Le Dran's cases, are considerations against this practice.

Attempts have been made to cure ovarian dropsies by injections, like hydroceles. I formerly saw two cases in which port wine and water were injected by the late Mr. Ramsden, of St. Bartholomew's Hospital; one patient died very soon afterwards of inflammation, and the other perished more lingeringly from the same cause. Setons have also been tried without success. Leaving in the canula, or bougie, after paracentesis, has been frequently tried. Mr. Key has notes of three cases: the results were not favourable. (See *Seymour on Dis. of the Ovary*, p. 103.)

In the *American Recorder* a case is published in which a cure was effected by the excision of the sac. Dr. N. Smith also performed such an operation with success; after exposing the tumor by an incision, and discharging seven pints of a dark ropy fluid, with a trocar, he extracted the whole cyst, and the patient recovered. (See *Edinb. Med. and Surg. Journ.* No. lxxiii.) The sac brought out with it a considerable portion of adherent omentum, which required to be separated with the knife, and two bleeding vessels were tied. The omentum was then reduced, and the adhesions of the sac to one point of the parietes of the abdomen also separated partly with the scalpel, and partly with the finger. These few particulars prove that though the operation may be practicable, and even end well, it is liable to great difficulties in its execution, and dangerous and fatal consequences in its result. In fact, one surgeon, mentioned by Sir A. Cooper, who began an operation of this kind, was prevented by the extent of the adhesions from completing it. Whenever the attempt is made, it ought to be while the cyst is of moderate size. An instance in which the operation was attempted, while the disease did not exist, has been fairly and candidly laid before the public by Mr. Lizars, with other interesting observations and cases in favour of the practice of extirpating diseased ovaries. (*Edinb. Med. Surg. Journ.* No. lxxxi.)

Some other cases, in which the object was truly and successfully accomplished, have also been published by the same practitioner. (*On Extraction of Diseased Ovaria*, fol. Edinb. 1825.) Dr. David L. Rogers, of New York, on September 14, 1829, removed a large ovarian cyst and solid tumor. The following particulars are taken from Dr. Reese's American edition of this Dictionary:—

"The abdomen began to swell; first, on the left, and then extending to the right; her stomach became affected, and although unmarried, her friends accused her of being pregnant. In consequence of this impression the disease was allowed to proceed without any medical advice, until time had satisfied her friends to the contrary, when a physician was called, who pronounced the disease a dropsy, and recommended her to be tapped. A large quantity of water was drawn off, but in two months it had reaccumulated, and the operation was repeated five times previous to my seeing her. It is computed that within the two years eighteen gallons of fluid were drawn off.

"I observed (says Dr. Rogers) in this case, what I have remarked in several others, that the fluid discharged differed from the water in common ascites. It is much more mucilaginous; of the

consistence of honey; of a milky colour, and differs from any other secretion that I am acquainted with. After deliberately examining the tumor, and as far as possible ascertaining its character and connections, I suggested to her the possibility of its being cured by an operation, at the same time stating the great risk of life attending the performance, and the slight chance of her recovery. I likewise requested Professor Mott, who was consulted in this case, to make a similar statement. Her good constitution and general health all urged the obligation of making an attempt to save her. After the first suggestion, nothing could alter her determination to forego the chance of relief which even so desperate an operation might afford, and, as she expressed it, 'I would rather die than live in my present situation.'

"On September 14 she was laid on a table of convenient height, and with a large scalpel I commenced an incision a little below the ensiform cartilage, carrying it parallel with the linea alba, and terminating at the symphysis pubis. The integuments being divided, the dissection was continued through the tendon of the linea alba to the peritoneum. This was at first supposed to be much thickened; but by a cautious dissection through a membranous texture to the depth of a quarter of an inch, the water gushed out with considerable force. With a probe-pointed bistoury the opening was enlarged to the full extent of the external incision, and to our surprise we found that a sac was opened which appeared to fill the whole circumference of the abdomen, and at first its attachment appeared commensurate with its size. It lay in connection with the liver, stomach, spleen, and bladder. By pulling up the sac it was found that the adhesions were much less than at first expected. It was determined, therefore, to dissect them from the peritoneum and omentum: some of the adhesions were so slight as to be separated by the finger, others by the handle of the scalpel, but the greater part required to be separated by a tedious dissection, and in some parts the adhesions were so close that portions of the peritoneal membrane were removed. These adhesions extended for three or four inches around the umbilicus. After completing this part of the dissection, the tumor was drawn out and supported by an assistant, and the dissection continued: separating it from the ovarian ligament, which required much care, from the large and numerous vessels going to it from this source; the largest was at least the size of a goose-quill. After occupying two hours in the operation, this huge mass of disease was safely removed, and laid on the table. The ligatures were all cut close to the knot, and left to absorption. The wound was closed by sutures, dressed with adhesive straps, lint, a compress and a bandage applied firmly to the abdomen. I place some confidence in the close application of a bandage, as it brings the divided surfaces in contact for the purpose of adhesion, and likewise as an important auxiliary in preventing inflammation. She was then removed to bed; her pulse at this time was feeble, but regular. In the course of the evening considerable reaction came on, with some heat of skin."

Without pursuing the detail of the progress of the case, it will be only necessary to add that the patient progressed without any untoward symptom, and in six weeks from the period of the operation

her catamenia had returned and her health entirely recovered.

"The tumor was composed of a large sac, which had contained the fluid drawn off in different operations by tapping. One-third of the tumor was solid, containing a fibro-cartilaginous substance. It weighed three-and-a-half pounds."

In offering this case, it may be proper briefly to sum up a history of the operations for diseased ovaria: it may assist others in forming an opinion of the relative chance of success in future cases. The removal of these tumors by an operation had its advocates in the last century; but the authority of De Haen and Morgagni was raised against them, as doubtful in their results, and impossible in their execution. The first attempt to remove them by an operation was made in 1776, by L'Aumonier, surgeon-in-chief of the hospital of Rouen, and is reported as a successful case. (See *Good's Study of Medicine*, vol. iv. p. 325, ed. 4.)

Dr. McDowell, of Kentucky, has reported three cases in which he operated successfully for tumors in the abdomen, ovarian and hydatid. A doubt exists in relation to these cases; and certainly the mode of describing them is calculated to confirm that doubt. We are bound, however, upon the authority of others, to believe them, notwithstanding the improbabilities connected with their details; and it is much to be regretted that a more circumstantial account of these cases has not been given to the profession. (See *Med. Chir. Rev.* vol. v. p. 216.)

Professor Smith, of Yale College, has given an interesting case of the successful removal of an ovarian dropsy by an operation. The tumor was small, weighing from two to three ounces, and requiring an incision of three inches in length. (See *Am. Med. Rec.* 1822.)

"In the *London Medical Gazette*, for 1829, Dr. Hopfer, of Biberback, has reported three cases of extirpation of diseased ovaria, by Carysman. The first was performed in 1819, and proved fatal in thirty-six hours after the operation. The second in 1820. This case was successful, and the woman has since borne children. The third case occurred in the same year, and never recovered from the shock of the operation. Thus, of the three cases, but one recovered." (See *Reese's American Edition of this Dictionary*.)

Mr. Jeaffreson, of Framlingham, Suffolk, has published the particulars of a case, in which he removed an ovarian cyst. It appeared to this gentleman that the danger and difficulties of operations of this kind might be lessened by performing them before extensive adhesions had taken place between the cyst and the surrounding parts, and as soon as the cyst was sufficiently distended to press firmly on the sides of the abdomen. He had an opportunity of trying on the dead body of a lady what could be done with an ovarian sac; and "accordingly exposed it by an incision of about an inch; then evacuating its contents with the trocar, I was enabled to draw out the whole of it, together with a great portion of the Fallopian tube attached, which produced full conviction on my mind, that had her disease been confined to the ovary, her life might have been saved by an operation." On May 8, 1836, he tried the foregoing plan on Mrs. B. "In the presence (says he) of my friend, Mr. King (of Saxmundham), I made an incision, of between ten and twelve lines in the course of

the linea alba, midway between the navel and the pubes; and having thus carefully exposed the sac, I evacuated by the trocar about twelve pints of clear serum. During the flow of the serum, a portion of the sac was secured in the gripe of a forceps, to prevent its receding; and I afterwards gradually extracted the sac entire from the cavity of the abdomen, together with another sac, containing two ounces of fluid, and indeed the entire ovary; having only to cut through a slight reflection of the peritoneum and ovarian ligament, which, with a small portion of the fimbriated extremity of the Fallopian tube, are the only natural attachments of the ovary to the uterus. But, as this part was the medium of vascular supply to the sac, and the vessels on the surface of the sac were unusually large, we thought it right to include it in a ligature previous to returning it into the cavity of the abdomen. The ends of the ligature were cut off close to the knot. A very small portion of omentum protruded with the sac, but was very readily returned. The external wound was closed with two sutures, adhesive plaster, and a compress of lint." The result was a perfect cure. Further, it appears from Mr. Jeaffreson's statement, that Mr. King, of Saxmundham, has repeated this operation on a lady, where the ovarian sac was more distended, and having discharged twenty-seven pints and a half of fluid, he extracted it entire, together with a tubercular tumor of the size of a turkey's egg. The patient recovered without any bad symptom. Mr. Jeaffreson considers that his method of operating is preferable to that of Mr. Lizars, whose plan, on account of the greater extent of the incision, must prove hazardous. The same objection, he thinks, is applicable to the case recorded by Dr. C. F. Quittenbaum, which, however, ended successfully. (See *Comment. de Ovarii Hypertrophia*, &c.; and Jeaffreson, in *Prov. Med. Trans.* vol. v. p. 239.)

An example is mentioned by Dr. Granville, in which several encysted tumors of the right ovary (one as large as a full-grown foetus's head) were discharged with a collection of matter, through an ulcerated opening in the parietes of the abdomen. (See *Med. Phys. Journ.* June, 1822.)

Though the disease, when once formed, mostly continues throughout life, it occasionally disappears. An adhesion may be formed between the tumor and some portion of the great intestine, and a very large quantity of the most offensive purulent fluid, of various consistence, be passed by stool; in such cases the patient often recovers. At other times the same takes place by discharge through the vagina; and several cases are on record in which the discharge could be accelerated by pressure made on the tumor. Occasionally, after adhesion between the cyst and the parietes of the abdomen, spontaneous rupture takes place at the umbilicus, and the contents of the cyst are discharged through the aperture, and a perfect cure may be the result. (*Seymour, Op. cit.* p. 52.)

The disease is alleged sometimes to have ended in the cyst bursting, and its contents being discharged into the peritoneal cavity, whence they were absorbed. In the event of such a change in the situation of the fluid taking place, there must always be, however, a risk of a fatal attack of peritonitis. The bursting of the cyst into the cavity of the abdomen has been fatal in three instances



within Dr. Seymour's knowledge. Occasionally the complaint has disappeared after the receipt of an accidental blow; and, as a case related by Dr. Blundell tends to prove, the cure may here arise from rupture of the cyst, and effusion of the fluid in the cavity of the peritoneum, followed by absorption of it.

I have tapped several ovarian cysts, and discharged from them, at repeated operations, incalculable quantities of fluid. In a case, recorded by Mead, a lady was tapped sixty-seven times in five years and a half, and 1,920 pints of fluid discharged. In another instance, detailed by Martineau, the patient lost, by tapping, 6,631 pints of fluid in the course of twenty-five years.

Sir A. Cooper has known several examples of the spontaneous cure of ovarian dropsy. In one case, the fluid was for a long time voided through an ulcerated opening at the umbilicus. He has also known the water to be discharged by the Fallopian tube; and he attended a lady in whom an ovarian cyst burst into the intestinal canal: for several years afterwards, she was subject to occasional returns of the disease, but ultimately recovered. (*Lectures*, vol. ii. p. 384.) In the year 1836, a woman was under my care at the Bloomsbury Dispensary, with an ovarian cyst of immense size, filling the abdomen, and protruding partly at the navel, where ulceration had formed an opening into it, from which a pint or two of glutinous fluid was discharged every day. She lived in this state about three months, and was seen by the students of University College Hospital.

Dr. Addison has recorded an instance in which an ovarian cyst was burst by an accidental blow, and a cure followed. The first symptoms were those of peritonitis. Bleeding, fomentations, calomel, antimony, and opium, were the means employed. (See *Guy's Hospital Reports*, vol. i. p. 41.) The passage of the fluid of an ovarian cyst into the cavity of the peritoneum may prove fatal in a few hours, occasioning sickness, vomiting, giddiness, colliquative sweats, and extreme prostration. A case, related by Dr. Barlow, in which paracentesis had been delayed too long, and the ovarian fluid escaped through an ulceration of the cyst into the cavity of the peritoneum, fully exemplifies the foregoing statement. (See *Prov. Med. Trans.* vol. iv. p. 402.)

[The subject of ovariectomy will be found fully treated by Mr. Spencer Wells in a separate article in this dictionary. Some of the matter here introduced under the heading paracentesis might therefore have been omitted. The very interesting historical sketch, however, given above by Mr. Cooper of ovarian dropsy and its treatment during his time, has induced the editor to retain it.]

#### PARACENTESIS OF THE THORAX.

The necessity for this operation is indicated when the heart or lungs are oppressed by any kind of fluid confined in the cavity of the chest. Everybody knows that the free and uninterrupted performance of the functions of these organs is essential to the support of life. When their action is perilously disturbed by the lodgment of fluid in the thorax, no internal medicines can be much depended upon for procuring relief. The only means from which benefit can be rationally expected, is letting out the fluid by making an opening in the parietes of the chest.

The nature of the effused fluid can make no difference, in regard to the propriety of discharging it in this manner; and though some authors describe this operation as only applicable to cases of hydrops pectoris and empyema, it may also be of the greatest service when air is confined in the chest. (See EMPHYSEMA, and PNEUMOTHORAX.) It is now seldom executed for blood extravasated there. (See WOUNDS OF THE THORAX.) The case in which it is least likely to be followed by a perfect recovery is hydrothorax; and Sir A. Cooper, in his vast experience, has not known more than one operation performed for it which proved successful. This he considers by no means surprising, as the collection of fluid is the effect of disease of the thoracic viscera, the heart or lungs, &c. (*Lectures*, vol. ii. p. 385.) A case of success, however, is mentioned in the references at the end of the present article; and in the *Berlin Med. Trans.* a case is recorded, in which a cure was effected by an accidental wound of the chest, by which the whole of the water escaped at once. (*Act. Med. Berol.* t. x. dec. 1, p. 44.) A case of successful paracentesis of the thorax is recorded by Dr. Archer, where eleven pints of an inodorous fluid were drawn off, and in a few weeks the patient was quite convalescent. (See *Trans. of King's and Queen's College of Physicians, Dublin*, iii.) A patient, under Dr. Croker, of Dublin, was operated upon by Mr. Crampton, and fourteen imperial pints of pus were discharged. (See EMPYEMA.)

The idiopathic form of hydrothorax, or that case in which it constitutes the original disease, is set down by Laennec as very rare. He has often known hypertrophy of the heart, aneurism of the aorta, irregular consumption, and even scirrhus of the stomach or liver, mistaken for this disorder, when there was no coexisting effusion in the pleura, or at least none except what took place immediately before death. Symptomatic hydrothorax, he admits, is frequent. (*On Dis. of the Chest*, p. 484, ed. 2.) In this work the learned translator, Dr. Forbes, recommends the use of the stethoscope for discriminating diseases of the heart from hydrothorax, as the means adapted to the relief of dropsy of the chest would be useless with regard to them.

In this place I shall content myself with describing the methods of performing paracentesis thoracis, referring the reader to the above articles, and the valuable work of Laennec, for the particular symptoms and circumstances which may render the operation proper, and the rest of the surgical treatment peculiar to each affection.

It has been the common maxim to recommend the space between the sixth and seventh true ribs as the safest and most convenient situation for making an opening into the chest on either side, as circumstances may render necessary. The surgeon should always recollect that the two cavities of the pleurae are completely distinct from each other, and have no communication whatsoever; so that if fluid were contained on the left side of the thorax, making an opening into the right cavity would not serve for discharging the accumulated matter. The practitioner should also remember that, when there is a fluid on both sides of the chest, paracentesis must never be done for the relief of the two collections, at the same time; because there is great reason to believe that, as the lungs on one

side usually collapse when there is a free communication between the air and the inside of the thorax, they would do so on both sides, were an opening made at the same time into each pleural sac. It is hardly necessary to remark that in this condition the patient could not breathe, and would die suffocated. [The following description of the operation performed in Mr. Cooper's time, is now superseded by the use of the trocar either with or without an attached syringe. This latter mode of operating will be presently described.] The operation consists in making an incision, about two inches long, through the integuments which cover the space between the sixth and seventh true ribs, just where the indigitations of the serratus major anticus muscle meet those of the externus obliquus. Here it is unnecessary to divide any muscular fibres, except those of the intercostal muscles, and, by putting the patient in a proper posture, the opening will be depending enough for any purpose whatsoever. The surgeon, avoiding the lower edge of the upper rib, where the intercostal artery lies, is then cautiously to divide the layers of the intercostal muscles, till he brings the pleura into view, when this membrane is to be very carefully divided with a lancet or bistoury. The instrument should never be introduced deeply, lest the lungs be injured. For this reason, few modern surgeons would choose to plunge a trocar into the pleura when the opening can be so much more safely made with a bistoury. The only reason assigned for the trocar is that the intercostal artery is less likely to be hurt by it than a cutting instrument, and that the canula is useful in maintaining the opening, and for the occasional use of injections. The size of the opening in the pleura should not be larger than necessary. The discharge of blood and matter will of course require a freer aperture than that of air or water. If requisite, a canula may be introduced into the wound, for the purpose of facilitating the evacuation of the fluid; and it may even in some cases be proper to let this instrument remain in the part, in order to let the water or pus escape, as often as accumulation takes place. It is obvious, however, that a canula for this object should only be just long enough to enter the cavity of the pleura, and should have a broad rim to keep it from slipping into the chest. A piece of sticking-plaster would easily fix the canula, which might be stopped up with a cork, or any other convenient thing, or left open, according as the circumstances of the case and the judgment of the surgeon should direct.

Laennec preferred the space between the fifth and sixth ribs. "Many reasons (he says) point out this spot as the best for the operation. We know that the upper lobe adheres to the ribs more frequently than any other part of the lungs, and the lower lobe is frequently attached to the diaphragm, while adhesions very seldom exist at the central part of the chest; and even should there chance to be any old adhesions in this point, they may be readily and certainly discovered by some remains of respiration over their site, and the place of the operation may then be varied accordingly. Besides, we know that the thickest false membranes exist at the junction of the diaphragm with the walls of the chest, and that on the right side an enlarged liver frequently reaches as high as the sixth, or even the fifth, rib; in which case,

when the operation is performed in the usual situation, the instrument, instead of entering the chest, would transfix the diaphragm and penetrate the abdomen." This accident, happened to Laennec himself in a case of pneumothorax; La Motte committed a similar blunder. (See *Traité Comp. de la Chir.* t. ii. obs. 77, p. 292.) The only reason for operating between the sixth and seventh ribs is to have a depending opening; but this object may be attained by operating between the fifth and sixth ribs, and directing the patient to lie on the diseased side. Some practitioners deem it prudent not to let out the whole of a large collection of fluid at once, but gradually, lest dangerous syncope should be induced. (See Townsend, in *Cyclop. of Pract. Med.* art. *Empyema*.)

[With regard to the place of election for the performance of the operation considerable difference of opinion exists, some surgeons preferring as high as the fifth intercostal space, some as low as the ninth, while the intermediate spaces are selected by others. The surgeon must to a certain extent be guided by the circumstances attending each case as to the level at which it will be most advisable to introduce the trocar. Whatever may be the level determined upon, it is obvious that the middle third of the chest between the latissimus dorsi and pectoralis major muscles offers the least obstacles to the operation. Two or three inches below the angle of the scapula, however, is a favourite position with some surgeons. After all, the seventh intercostal space mentioned by Mr. Cooper at the digitation of the serratus magnus muscle is as eligible a situation as any. In order to judge of the presence or absence of adhesions or of solid lung in selecting the place for the introduction of the trocar, every advantage should be taken that the aid of percussion, palpation, or the use of the stethoscope can afford. When the most eligible spot, after careful exploration, has been decided upon, the operative procedure may be conducted in the following way. The patient should be placed in the sitting position on a chair or sofa, so arranged that his body should not be impeded by the back of the chair or sofa from inclining laterally or directly backwards at the option of the surgeon as the operation proceeds. If the patient be too weak to leave the horizontal position, he may be brought to the edge of the bed, and the part of the chest to be operated on made to project beyond it, supported if necessary by an assistant; or the patient, if able to bear it, may be placed in the sitting posture across the bed, close to its edge, as recommended by Mr. Cook, so that the body may be directed from side to side or backwards beyond the bed as required, supported by assistants.

To make sure of the presence of fluid at the point selected, the trocar may be preceded by an exploring puncture made by means of a very fine trocar. Should the existence of fluid be indicated, the smaller instrument may be removed, and a larger one, about the  $\frac{1}{12}$ th of an inch in diameter, be at once plunged into the intercostal space close to the upper edge of the rib, or at any rate so far from the lower edge as to avoid all risk of wounding the intercostal vessels. As the skin is the most resisting structure the trocar has to perforate, many surgeons prefer making a puncture in it with a scalpel before introducing the trocar. As the fluid flows, the greatest care should be taken that the



atmospheric air be not drawn into the chest by any irregular or forced inspiration caused by the exertions of the patient, or by the necessary movements of his body directed by the surgeon in order to keep the orifice of the canula in the most depending position. At first the fluid will flow freely enough, especially during expiration. After a time, however, very little, if any, fluid will escape during inspiration by the canula. It should now be temporarily closed by the finger, and the position of the patient altered, so as to render the opening dependent, when more fluid will be obtained. Lastly, for this purpose pressure may be made on the chest by an assistant, which must be maintained. When the flow entirely ceases, and the surgeon is about to withdraw the canula, the greatest attention is required that the pressure of the assistant be not lessened, and suction power permitted, by which air would inevitably be made to enter the chest. Immediately the canula is removed a small pledget of lint should be placed on the wound and secured by adhesive plaster. The entrance of air into the cavity of the pleura would entail very serious consequences by favouring the decomposition of the pus or other fluid with which it came in contact; it is therefore of great importance that this should be prevented by every means in our power. Instruments have accordingly been contrived to prevent the possibility of this occurrence. The most simple of these consists of a separate tube with a stopcock, to which an empty bladder is affixed. This tube is made to fit the canula exactly, and thus the fluid as it flows is collected in the bladder without contact with the atmosphere, and the possibility of air entering the chest effectually prevented. A still more perfect instrument, by which at the same time that air is excluded from the chest a suction power is had recourse to, for the purpose of removing the fluid from the pleural cavity, is a glass syringe with double action, provided with a tube of entrance and of exit, each armed with a spherical valve. By means of this instrument, nicely adjusted to the canula, the fluid can be drawn out from the chest and evacuated into a receiving vessel without altering the position of the patient, inasmuch as the fluid will be made to rise into the syringe from the lowest part of the cavity by the suction power exerted on raising the piston of the instrument, while by its depression the fluid will be forced through the tube of exit into a receptacle, the air at the same time being effectually excluded from the chest.

M. Chassaignac's drainage tube has also been used to remove the fluid from the chest in cases of empyema. The mode of introducing it is as follows. A long curved metallic eye probe is introduced through an intercostal space, previously perforated for this purpose by a trocar; the probe is then directed downwards to the most depending part of the cavity containing the fluid. The point of the probe is now made to project near the upper margin of a rib and cut down upon. The drainage tube, perforated by several openings, is attached by a strong silk ligature to the eye of the probe, and is made to enter the cavity of the pleura and to follow the tract of the probe as it is withdrawn. The two ends of the perforated tube are tied together, which thus forms a hollow perforated seton, by which the fluid may be at once removed and as fast as it accumulates. Two cases thus treated will be found in vol. xlii. of the *Med. Chir. Trans.* p. 231.

They occurred in the practice of Dr. Goodfellow at the Middlesex Hospital, and are related by him. A description of the operation is appended by Mr. Campbell de Morgan. The operation has not been sufficiently repeated to enable us to say that it should be preferred to that ordinarily performed by the trocar. Both Dr. Goodfellow's cases were successful. The advantage of a double opening and continuous discharge of the fluid as it formed were well marked in these cases.]

Paracentesis of the abdomen, and that of the thorax, are described in all treatises on the operations of surgery. The works of Sharp, Le Dran, Bertrandi, Callisen, Richter, Sabatier, Larrey, and Boyer, are particularly deserving attention. A case in which eleven pints of a fluid resembling whey were discharged from the chest by paracentesis, and the patient recovered, is detailed by Dr. Archer in the *Trans. of the King's and Queen's Colleges of Physicians in Ireland*, vol. i. art. 1. Jackson, in *Philadelphia Journal of the Med. Sciences*, vol. i. new series, p. 149: Operation performed in a Case of Effusion. N. Freidreich, *Vorzüge des Bauchstiches in der Bauchwassersucht*, 12mo. Würzb. 1816, 1817. Laennec on *Diseases of the Chest*, ed. 2, by Forbes. *Good's Study of Medicine*, vol. iv. ed. 4.

For an account of paracentesis of the bladder, refer to **BLADDER, PUNCTURE OF**. Consult also **EMPHYSEMA, EMPYEMA, PERICARDIUM, PNEUMOTHORAX**, and **WOUNDS OF THE THORAX**.

**PARAPHIMOSIS**, or **PARAPHYMOSIS**. (From *παρά*, back, and *φίμω*, to bridle.) This signifies the case in which the prepuce is drawn quite behind the glans penis, and cannot be drawn forward again. (See **PHIMOSIS**, with which it will be considered.)

**PARONY'CHIA**. (From *παρά*, near, and *ὄνυξ*, the nail.) An abscess at the end of the finger, near the nail. (See **WHITLOW**.)

**PAROTID DUCT**. Every one acquainted with anatomy is aware that, behind the jaw, on each side, a large conglomerate gland is situated, the principal of such as are destined to secrete the saliva, with which the cavity of the mouth and the food which we swallow are continually moistened. The parotid duct crosses the cheek, being situated about one-third from the zygoma, and two-thirds from the basis of the jaw. After passing over the masseter muscle, it pierces the buccinator, and terminates in the mouth by a considerable orifice, opposite the space, between the second and third bicuspid grinders of the upper jaw. As soon as it has passed the masseter, it dives deeply into the fat of the cheek, and, as M. Louis observes, makes an angle before it opens into the mouth. (*Mém. de l'Acad. de Chir.* t. iii. p. 457.)

On account of its situation, the parotid duct is liable to be wounded, and this has even been done with the surgeon's lancet through ignorance. (See *Monro's Works*, p. 520.) In cases of this kind, the continual escape of saliva may prevent the wound from healing, and what is called a *salivary fistula* would be the perpetual consequence, if no steps were taken to afford relief. The parotid duct has sometimes been ruptured by blows. (*Œuvres Chir. de Desault*, t. ii. p. 221.) Cases also occur in which the face becomes considerably swollen, in consequence of the saliva insinuating itself into the areolar tissue, just as air does in emphysema. Respecting the last circumstance I shall only just mention, that mischief of this kind may always be prevented from becoming very extensive, by making a depending opening for the ready escape of the fluid.

With regard to the treatment of salivary fistulæ,

if the division of the parotid duct is recent, the sides of the wound should be brought into contact, and a steady pressure maintained on that part of the cheek by means of suitable compresses, and a roller. In this manner a salivary fistula may often be prevented altogether; either the divided ends of the duct reunite, and the spittle resumes its original course into the mouth; or, what is more probable, the wound in the face heals at every part, with the exception of a small fistulous track, which serves as a continuation of the duct into the cavity of the mouth. The latter kind of cure, however, can only take place when the wound extends quite through the cheek; but the chance of the two portions of the duct uniting, and becoming continuous again, should always be taken in recent cases.

When a salivary fistula is actually formed, a seton, introduced from the external fistulous orifice into the mouth, is a method which has justly received considerable approbation. *Monro* adopted it with success: he kept in the seton till the channel which it had formed had become fistulous, after which it was withdrawn; the external orifice, being touched with the *argentum nitratum*, healed up, and the saliva in future flowed through the artificial fistulous channel into the mouth.

*Desault* used to practise the seton as follows. He introduced two fingers of his left hand into the patient's mouth, and placing them between the teeth and the cheek, opposite the fistula, thus kept the integuments tense and the gums from being injured. He then introduced a small hydrocele trocar, with its canula, just before the opening of the posterior part of the duct, and pushed it through the cheek in a direction a little inclined forward. An assistant now took hold of the canula, while *Desault* withdrew the perforator, and passed through the tube a bit of thread into the cavity of the mouth. The canula was then taken out, and a seton, which was then fastened to the end of the thread in the mouth, was drawn from within outward, but not so far as to come between the edges of the external opening, where the thread alone lodged, and this was fastened with sticking-plaster to the outside of the cheek. The outer wound was dressed with lint and compresses. *Desault* used to change the seton daily, introducing regularly rather a larger one, and taking especial care not to bring it between the edges of the wound, which was afterwards covered with sticking-plaster. He enjoined the patient not to move the jaw much, and only allowed him, for some time, liquid food. In about six weeks he used to omit the seton, leaving in the thread, however, for a little while longer. This being taken away, he used to finish the cure, by touching the little aperture remaining with caustic.

For keeping the opening distended, canulæ were employed by *Duphenix*, who used to make a suture over them; a plan objectionable, inasmuch as it was attended with the inconvenience of a solid body left in the parts, and also that of the instrument being apt to slip into the mouth. *M. Beclard* cured a salivary fistula by the formation of a new passage at the inside of the cheek, by means of a leaden style, which was made to reach the excretory duct, at the point where its continuation was interrupted. The outer opening was then made a fresh bleeding wound, and united with the twisted suture. When the case will admit of the employment of the twisted suture, *Beclard's* plan

is a good one, because the cure will be more speedily effected by it than the seton. (See *Monro's Works. Œuvres Chir. de Desault, par Bichat, t. ii. p. 221. Also Mém. de l'Acad. de Chir. t. iii. J. B. Siebold, Diss. sistens Historiam Systematis Salivalis Physiologicæ et Pathologicæ considerati, fol. Jenæ, 1797. Beclard, in Archives Gén. de Méd. Juin, 1823.*)

#### PAROTID GLAND, EXTIRPATION OF. (See TUMORS.)

**PARULIS.** (From *παρά*, near, and *ὄλον*, the gum.) An inflammation, boil, or abscess in the gums.

**PENIS, AMPUTATION OF.** No part of the penis should ever be amputated on account of mortification, because the dead portion will be naturally thrown off, and the ulcer heal, without any occasion for the employment of the knife. It is for cancerous disease that it is most frequently necessary to amputate more or less of this organ. However, before a surgeon ventures to do this, he ought to be certain that it is the substance of the penis which is incurably diseased; for tumors, excrescences, ulcers, and gangrenous mischief of the prepuce, sometimes present appearances which may lead an inexperienced practitioner to fancy the whole thickness of the part affected with irremediable disorder, while the glans is actually in a sound state. Hence, when doubt exists, it is better to remove first the prepuce and skin, in order that the true condition of the glans may be detected.

When cancer attacks the prepuce, the swelling produced in its loose and extensible texture may be such as to push the glans far backwards, and occasion an appearance as if the body of the penis were implicated, while the disease is entirely restricted to its investments. *M. Lisfranc* ascertained that even when cancer is situated on the dorsum of the penis, or at its root, or even on the scrotum, it first commences in the skin, and that the subjacent fibrous textures constitute for a long while an impediment to its deeper extension. The important practical inference deducible from this fact is that, in many instances, it is only necessary to remove the integuments, and the organ itself may be preserved. After dissecting away the disease seated in the integuments, *M. Lisfranc* carefully removes any portion of the fibrous covering of the corpora cavernosa at all changed in structure, and even cleans and scrapes the surface of the corpora cavernosa themselves. If the disease is found to reach too deeply, he resorts to amputation.

Amputation may be performed in the following manner. With a long narrow bistoury a circular incision is to be made through the skin, about a finger-breadth from the cancerous part. As *Callisen* observes, it is hardly ever requisite to draw the skin back, before it is cut; because after the corpora cavernosa are divided they retract so considerably that there is always a sufficiency of the integuments. As soon, therefore, as the circular incision through the skin has been made, the corpora cavernosa and urethra are to be cut through by one stroke of the knife, on a level with the cut edges of the integuments. The generality of surgeons advise us to draw the skin towards the glans penis before we employ the knife. *Sabatier* was convinced of the inutility of saving any of it, and of the inconveniences which might result from its lying over and obstructing the orifice of the urethra. His mode of operating is also particu-



larly simple, as he cuts through the integuments and penis together by one stroke of the knife, without making any preliminary circular division of the skin. (*Méd. Opératoire*, t. iii. p. 305, ed. 2.) According to Boyer amputation of the penis differs from all others; for, instead of endeavouring to save more of the skin than of other soft parts, one object is to remove more of it than of the corpora cavernosa. [He directs that the surgeon should take in his left hand the portion of the organ he is about to remove, drawing the skin forwards towards the glans, while an assistant at the same time holds the penis at its root near the pubes, and stretches the skin in that direction. Without this precaution, as he judiciously observes, there is a risk, if the amputation is at all low down, of removing some of the skin of the scrotum, and producing a wound of much greater extent than necessary. The compression of the root of the penis by an assistant is also of great advantage in restraining the hæmorrhage until ligatures have been placed on the bleeding vessels.]

M. Malgaigne does not believe in the alleged retractility of the corpora cavernosa, but remarks very justly that the organ being pendulous, and only attached by one extremity, there is no reason why either the skin or corpora cavernosa should retract after division. He advises that the skin should not be drawn either forwards or backwards, but should be cut at the same level with the corpora cavernosa. This we believe to be the proper mode of procedure, the object being to preserve a sufficient quantity, but not a redundancy, of skin to cover the stump.

The ordinary practice now is to remove the organ by a single stroke of the knife, any preliminary incision of the skin being deemed quite unnecessary.]

The bleeding arteries are to be immediately tied; the chief are the dorsal, and one or two in each corpus cavernosum, near the septum pecteniforme. Should a general oozing from the wound still continue, it may usually be arrested by the application of ice to the part, or of lint dipped in ice-cold water; but should this be ineffectual, a styptic, such as the solution of the perchloride of iron, may be applied to the bleeding surface. Applications of this latter kind should, however, be avoided, if possible, because stimulating and productive of pain and inflammation. After the first dressings have been removed, the part may be dressed with any simple ointment, or with water dressing.

[If any difficulty is met with in passing the urine after the operation, it should be drawn off with the catheter. Some surgeons prefer to retain a gum elastic catheter in the bladder for a day or two after the operation; but this does not appear to be necessary.]

It is, however, very desirable to pass a full-sized instrument occasionally into the urethra while the healing is going on, to prevent the contraction of the orifice, which not unfrequently occurs, and which may cause considerable subsequent annoyance to the patient. Perhaps the best way of obviating this tendency to contract is to make an incision about  $\frac{1}{3}$  of an inch in length in the mucous membrane of the under surface of the urethra, to evert the angles of this incision, and to fix them on each side by a fine suture to the integument.]

When the penis is amputated near the pubes, the remainder shrinks under that bone and within the integuments so far that it is difficult to tie the arteries. In order to obviate this inconvenience, Schreger recommends the skin to be drawn forwards, and fixed with a band; then an incision to be made just deep enough to divide the dorsal arteries, which are to be tied before the knife is used again. The incision is then to be continued perpendicularly till the two arteries of the corpora cavernosa are cut. These are now to be tied. Then the corpus spongiosum and its two arteries are to be cut through, which last are to be secured. Lastly, the rest of the skin of the penis is to be divided. In this way Schreger amputated a diseased penis, of which only a part, about an inch in length, was sound.

When the stump retains a certain length, the patients afterwards make water without difficulty; but when amputation has been performed towards the pubes, the urine dribbles over the scrotum; and, in order to avoid this, the patients are obliged to squat down whenever they empty the bladder. This inconvenience may be remedied by the use of a conical ivory tube, the base of which is applied to the pubes. (See *Malgaigne*, *Op. cit.* p. 627.)

*Sharp, Le Dran, Bertrandi, Sabatier, C. Bell and Liston's* books on the operations may be consulted. *Hey's Practical Obs. in Surgery*, p. 445. *Pearson, On Cancerous Complaints*, p. 103, &c. *Warner's Cases in Surgery*, p. 278, ed. 4. *E. C. Biener, De Extirpatione Penis per Ligaturam*, 4to. Lips. 1816. *P. Roux, Voyage à Londres, &c., fait en 1814. Wadd Cases of Dis. of the Prepuce and Scrotum. J. H. Thaut, Diss. de Virgæ Virilis Statu Sano et Morb. ejusdem imprimis Amputatione. B. G. Schreger, Chir. Versuche; Neue Methode den Penis zu Amputiren*, b. 1. p. 242, 8vo. Nurnberg, 1801. *Velpeau, Nouv. Elém. de Méd. Opér.* t. iii. p. 567, 8vo. Paris, 1832.

**PENIS, CANCER OF.** A wart, or a tubercle, on the prepuce, the frænum, the glans penis, or corpora cavernosa is generally the first symptom; and it often remains in a quiet state for many years. When irritated, however, it becomes painful, and enlarges, sometimes enormously, in a very short time. At a later date, as in cancer elsewhere, ulceration and a discharge of watery sanious fetid matter, rather than of well-formed pus, take place. The disease sometimes also occasions in the urethra fistulous openings, out of which the urine escapes, and as the disease advances, the lymphatic glands in the groin become affected. Mr. Pearson says that "cancerous excrescences have a broad base, often more extensive than their superficies; they seem to germinate deeply from within, or rather to be a continuation of the substance of the part; and, in their progressive state, the contiguous surface has a morbid appearance." What he considers as a venereal wart, has a basis smaller than its surface: its roots have rather a superficial attachment, they are softer, and the contiguous parts have a natural appearance (p. 97). Such are this gentleman's remarks as regards diagnosis.

Mr. Travers observes: "Wherever the disease begins in an irritable pimple, whether of the glans or prepuce, and this breaks into a hard-based and spreading ulcer, with a disposition to fungate, the case must be viewed with great suspicion, whether the glands in the groin be affected or not; especially if the patient be turned of fifty years." Foul, spreading, sloughy ulcers of the penis should be discriminated from cancer; and likewise diseases produced, and kept up, by local irri-

tation of the prepuce. (See *Earle's Obs. in Med. Chir. Trans.* vol. xii. p. 287, &c.) Almost all the cases of cancer of the penis recorded by Mr. Hey were attended with a congenital phimosis. The same complication also existed in another example, in which Boyer performed amputation of the penis, in La Charité, on account of a cancerous affection of the part. The examples under M. Roux were likewise accompanied with a natural phimosis. Hence this author considers such a state of the prepuce particularly conducive to cancer of the penis, and earnestly enjoins surgeons to recommend their patients to have the first inconvenience rectified, so that no risk of the other more serious affection may be encountered. (See *Parallèle de la Chirurgie Angloise*, &c. pp. 306, 307.) In two out of three cases, which were considered to be cancerous, and for which amputation was done under my notice, phimosis did not exist; yet I believe that the statements of Hey and Roux are correct.

[Before ulceration has taken place the stony hardness of the cancerous tubercle, or infiltration, forms the most reliable diagnostic sign of cancer of the penis. Circumscribed syphilitic indurations, however, occasionally so much resemble cancerous tubercles, that I have seen the prepuce removed under the supposition that the affection was cancerous. A subsequent secondary eruption soon proved the true nature of the malady. In the substance of the corpora cavernosa, also, I have several times met with circumscribed deposits of lymph, so hard and persistent that the progress of the case alone could be relied upon to determine the non-malignant nature of their character.]

The disease usually manifests itself in the fore part of the organ, and consequently admits of removal by amputation; yet I have met with a marked case in which the cancer commenced as far back as the bulb of the urethra, the penis anterior to the pubes being entirely free from disease. The case occurred in the practice of Mr. Langmore, of Sussex Gardens. It appeared to be an obstinate and anomalous case of stricture of the urethra in the usual situation, close to the bulb. The peculiarity of the case consisted chiefly in the rapidity with which the stricture narrowed, in spite of the passage of instruments, and in the difficulty of introducing them with any certainty. In the course of a few months the urethra became so constricted that no instrument could be made to enter the bladder, and complete retention of urine supervened. Under these circumstances Mr. Cutler and myself were consulted, and gave our joint opinion that perineal section should be performed without delay. An incision was accordingly at once made in the median line, through the structures of the perineum, which were found irregularly thickened and indurated, and after some difficulty the urethra was opened behind the obstruction. During the operation the nature of the affection was not detected, and a favourable termination of the case was hoped for. The distressing symptoms depending upon the obstruction to the escape of the urine soon disappeared after the operation, and the patient began to improve somewhat in health and spirits. The wound, however, did not heal, but assumed a very unhealthy aspect, and ultimately presented all the worst characters of cancerous ulceration, of which the patient died in a few months, the rectum having ultimately become implicated in

the disease. Mr. South also alludes to a case of cancer of the penis affecting the posterior portion of the organ. "I remember," he says, "one very remarkable case, in which, under favourable circumstances, the younger Cline removed the whole penis as low down as the membranous part, by detaching it as far as possible from the pubic bones in front of the scrotum; and then making a cut into the perineum, he turned the penis down through it, and completely scraped off the crura to their very origins from the bones, and removed them and the bulb, leaving only the membranous part of the penis; but the wound in a few weeks took on a cancerous disposition, spread rapidly, and destroyed the patient probably quicker than if he had been left alone." (*Translation of Chelius by South*, vol. ii. p. 801.)

Some surgeons classify cases of cancer of the penis into scirrhus and epithelial. Without venturing to assert that ordinary scirrhus cancer never invades the penis, my experience would lead me to say that epithelioma was almost constantly the form in which it appears in this organ.]

Mr. Travers has given an excellent description of what he terms the warty cauliflower fungus of the prepuce, arising from epithelioma, within which the glans is found at first shrunk and entire, but afterwards diseased and incorporated with the fungus. He has seen in other instances the ulceration confined to the glans, and the inflamed prepuce thrown back, and discoloured from excessive distension; and although he never met with a Jew who was the subject of cancer of the penis, he operated on a man who had been cut for phimosis ten years previously, in whom a pimple on the frænum ulcerated, and assumed the form of cauliflower fungus, completely environing the glans, while the latter remained sound. The pain of this disease is very acute at intervals. There is much tumefaction of the organ, and a great hardness extending along the corpora cavernosa and septum penis. The glands in the groin are as often unaffected as not. (See *Med. Chir. Trans.* vol. xvii. p. 337.) In University College is a penis taken from an old man, a patient of mine. The preparation exemplifies many of the circumstances described by Mr. Travers, especially the great induration of the corpora cavernosa, and the enlargement of the organ.

[As in other cases of cancer, the only reliable treatment is complete ablation by the knife, by the écraseur, or by escharotics.]

If the penis be amputated at some distance beyond the disordered part, and before the disease has long existed, the patient may escape a return of it; but, according to Mr. Travers, this is a rare instance of good fortune. Slight symptomatic enlargement of the glands should not be accounted a bar to the operation. On the other hand, the absence of all glandular affection is no security against its return and fatal termination in a few months.

This disease, after amputation of the penis, may reappear on the stump, or in the inguinal glands. (See *Travers*, in *Med. Chir. Trans.* vol. xvii. p. 340.) (See CANCER.)

PERINÆUM, FISTULA OF. (See FISTULA IN PERINÆO.)

PERIOSTITIS. Inflammation of the periosteum. Is sometimes an idiopathic affection, excited by cold or mechanical injuries; sometimes



a secondary complaint, produced by various deranged states of the general health, as by rheumatism, syphilis, and the abuse of mercury.

[This term was first used by Sir Philip Crampton to express an inflammation of the periosteum (*Dublin Hospital Reports*, vol. i. 1817); but as the symptoms occasioned by inflammation in any other part of a bone are almost precisely the same as when its investing membrane is inflamed, this word has often been employed to denote an inflammation of the osseous tissue generally. Of late years, however, as the pathology of the disease has become better understood, a different nomenclature has been introduced, with a view to define the various seats of this morbid process, and the term *periostitis* is now intended to imply an inflammation which is chiefly confined to the periosteum. When the fibrous matrix of the bone-tissue itself is inflamed, it is termed an *ostitis*; and if the endosteum or medullary structure be the principal situation of the disease, it is called an *osteomyelitis*, or *endostitis*. Although inflammation may commence in any one of the fibrous constituents of bone, it is seldom limited to that in which it originated, but it spreads by continuity, and implicates the other portions of these structures; so that destruction of the bone-tissue to a greater or less extent commonly ensues, and it is often most difficult to define accurately which particular part is affected.]

*Periostitis* may be acute or chronic. The acute form commonly occurs in persons who are in good health, as the result of cold, or of some mechanical injury. It frequently involves a considerable surface of the membrane, and runs somewhat rapidly through its stages, giving rise to severe febrile disturbance, and generally terminates in the death of a large piece of bone. This variety of the disease was called by Sir Philip Crampton the *idiopathic*, whilst the chronic affection, which is usually found in persons who are much debilitated, or are the subjects of a constitutional taint, he named the *symptomatic*. This latter may commence without any palpable cause, but is generally excited by some external agency, and is limited to the part thus affected; it is generally slow in its progress, and by its long continuance may give rise to hectic. Dr. Graves (in his *Clinical Lectures*) prefers to call the former of these affections the *diffused*, and the latter the *circumscribed* form. (Graves's *Clinical Lectures*.) The same causes may produce inflammation in any portion of the organic constituents of bone; but, as before stated, *periostitis* is commonly the result of external influences—as cold, damp, a blow, a burn—or it may be caused by those diseases which more especially attack the fibrous tissues of the body, as rheumatism or syphilis.

*Ostitis* is not unfrequently the consequence of an injury, but this form of the disease is mostly dependent on constitutional causes—as scrofula, syphilis, the effects of mercury, fevers, &c.—or the inflammatory action may spread from the periosteum to the bone-tissue. When the medullary structure becomes primarily inflamed (*osteomyelitis* or *endostitis*), it is usually caused by a direct injury to the medulla or its membrane, such as is occasioned by fractures, gunshot wounds, severe concussions, amputations, or other operations on bone; or it may be secondarily involved by extension of inflammation from the periosteum or bone itself.

When the periosteum is inflamed, the local changes consist in a thickening and increased vascularity of the membrane, followed by an exudation of lymph beneath it—between it and the surface of the bone; effusion also takes place into the neighbouring tissues. If the inflammation be severe, pus will be formed beneath the periosteum, separating it from the bone, and suppuration may also occur in the surrounding parts. The pent-up matter will gradually find its way through the periosteum to the surface, and through the opening thus formed exposed bone can be felt. The superficial layers of the bone, having been deprived of their vascular supply, in consequence of this subperiosteal effusion, usually exfoliate, and a shell of bone, often of considerable thickness and extent, may thus be removed. (Vide NECROSIS.) Sometimes, when the exudation has taken place slowly, is limited in amount, and the inflammation not severe, it may become organised, and finally ossified, thus forming irregular projections upon the surface of a bone. This condition is, however, principally met with in those bones which are superficial and exposed to atmospheric influences, and it is generally combined with a syphilitic taint. These bony excrescences are called *nodes*. (See EXOSTOSIS.)

The symptoms of inflammation of the periosteum are pain along the course of a bone, of an aching throbbing character, which is often very severe, and especially so at night; it is much increased by pressure, and the slightest touch is sometimes intolerable. Swelling soon sets in, with a tense glistening condition of the skin, followed by œdema; in the acute variety, the swelling becomes diffused, and the integuments discoloured; fluctuation can be detected, and rigors often indicate the formation of pus, which, unless early evacuated, will strip up the periosteum from the bone to a considerable extent, and burrow amongst the adjacent tissues; there is at the same time much general inflammatory fever. In the chronic form the pain is much less severe, and may even be intermittent; the œdema is less, the swelling more circumscribed, and the integuments over it become congested. The effusion is either gradually converted into fibrinous material, causing a brawny indurated condition of the parts, or else suppuration slowly takes place. There is a form of acute periostitis which attacks the ungual phalanges of the fingers termed *paronychia*; it generally occurs in persons who are in a cachectic condition, is accompanied by intense pain, and gives rise to very severe local and constitutional disturbance, often terminating in rapid necrosis of the whole phalanx. (See WHITLOW.)

In *ostitis*, or inflammation of the bone-tissue itself, it is the fibrous or organic element which is inflamed. The blood-vessels which enter the substance of the bone become enlarged, and exudation takes place from them into the Haversian canals and into the cancellous texture. If the inflammation continue, and be of the acute form, the increasing effusion by its pressure causes dilatation of the Haversian canals, and ultimately absorption of their walls, so that several of them may be blended together: the bone thus acquires a spongy porous appearance, and its texture is softened from loss of the inorganic constituent, which is set free by the destruction of its fibrous framework. The exudation may degenerate, and a large portion

of the bone thus become infiltrated with pus, constituting what has been called *diffuse suppuration of bone*; or, if it be limited in extent, an abscess will be formed in the substance of the osseous tissue. In this manner the interior of a bone may be destroyed to a considerable extent, leaving large wide cavities or spaces, whilst the cortex, or shell, is expanded and thinned. After the inflammatory action has ceased, this rarefied condition of the bone may remain, when it is of course very fragile. Rokitsansky alludes to this form of the disease under the name of *osteoporosis*, and Gerdy describes it as an *ostéite raréfiante*. A gradual dissolution of the bone may take place in consequence of the continuance of a morbid inflammatory process, constituting the disease known as *caries* (see *CARIES*), and this is more particularly met with when the patient is of a strumous habit. Gerdy prefers the term *ostéite ulcérente* to that of *caries*.

This process may continue for a length of time in a healthy person, with very slow molecular destruction of the osseous tissue: it is then known as *ulceration of bone*, and is commonly seen on the surface, as the result of periostitis. Gerdy alludes to it as the *ostéite érodante*.

Ostitis may also lead to the death of the whole or a portion of the bone, and is therefore one of the causes of necrosis. (See *NECROSIS*.)

If the inflammation involve the articular extremity of a bone, it expands the cancelli, destroys their septa, and enlarges the ends of the bone; in extreme cases converting them into large, irregular, cellular masses. (See *SPINA VENTOSA*.) The adjoining articulation will probably be opened into and destroyed. It is generally in a scrofulous person that the articular extremities of a bone are thus affected.

In the more chronic form of ostitis, the exudation into the substance of a bone does not undergo a degenerative change, but, on the contrary, becomes organized, and ultimately converted into osseous tissue. The Haversian canals are considerably encroached upon by thickening of their walls, the cancellated structure is filled up by bony deposit, and the medullary canal is also much diminished in size, so that the bone throughout becomes more dense and solid, whilst its weight is at the same time greatly increased. This condition is termed by Rokitsansky a *sclerosis*, and by Gerdy an *ostéite condensante*. Generally, whilst this induration is going on in the interior of the bone, there will be an exudation upon its surface beneath the periosteum, which, also becoming transformed into osseous material, further increases the size of the bone. If the flat bones be involved, the diploe entirely disappears, and a section through them may be as hard and dense as a piece of ivory. This condition is also seen in the shaft of a long bone, where the medullary canal may be completely closed, and the bone converted into a solid cylinder.

But *osteomyelitis* or *endostitis*, in which the medullary structure of a bone becomes the seat of inflammation, is by far the most grave of those under consideration. This, as before stated, is commonly from some direct injury, whether by accident or operation, or it may occur secondarily by extension of the inflammation from the periosteum or bone-tissue. In the majority of cases, when *osteomyelitis* arises from an injury, the inflammation assumes the suppurative form; and the medullary canal, the cancelli, and the Haver-

sian canals become filled with pus: the periosteum is soon separated from the bone by the presence of purulent fluid between them, and the entire shaft rapidly perishes. The exudation may, however, become ossified, and the bone then undergoes the same changes, and becomes solidified in the manner described above.

This form of inflammation is well seen after amputations through the shaft of a bone: when the whole thickness of the end of the stump will die, and the walls of the medullary canal also to a varying extent, leaving the interior of the shaft blocked up by a fibrinous material which ultimately becomes ossified, and forms a bony plug, which completely occludes the medullary cavity. Not unfrequently, however, the whole stump of bone perishes, and then the patient commonly dies.

The symptoms of ostitis and osteomyelitis are very similar to each other, and differ from those of periostitis in a few points only. The early symptom is usually pain of a rheumatismal character, which becomes most intense, with a throbbing bursting sensation: there is inability to move the affected limb: the outline of the bone is less masked by effusion than in periostitis, nor does pressure along it increase the pain, until the surrounding tissues are also inflamed: oedema, alteration in the colour of the skin, and the formation of pus, are generally more tardy than in periostitis. The constitutional disturbance is, however, much more severe from the commencement.

The chief distinctive mark between ostitis and osteomyelitis is that there is much more irritative fever in the latter; symptoms of a typhoid character are often present, and pyæmia as a sequel is not rare. This is not, however, a very unfrequent termination in severe and rapid cases of ostitis and periostitis. (*Path. Soc. Trans.* vol. xiii. p. 188.)

The proper treatment in these affections is rest, local and general: poultices and soothing applications to the affected part: leeches are sometimes of use in the early stages, especially in periostitis. Incisions down to the bone should be practised as soon as the presence of pus is detected, and if the pain be very severe, it will be much relieved by this operation. In those cases where pus is suspected to be pent up within the bone, the use of a trephine may be required. Opium in full doses, with salines, or (where there is much depression and debility) with tonics and stimulants, should be given. In chronic cases the diathesis of the patient must be considered, and the appropriate treatment for it adopted. In syphilitic affections the iodide of potassium is by far the most useful remedy: the bichloride of mercury, in small doses, is also in some cases of great service. Where there is localized periostitis, with thickening of the neighbouring parts, the tincture of iodine, blisters, mercurial ointments, and plasters are often valuable adjuvants, as are also other discutient applications. In all cases, whether acute or chronic, the principles of treatment throughout should be to allay the pain, to aid the efforts of nature, whether to disperse or to favour the inflammatory process, and to anticipate her by incision as soon as pus is formed: to support the strength of the patient, and to treat the several taints of constitution which may reveal themselves.]

G. G. Gascoyen.

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**PERNIO.** (From *πέρνα* or *πτέρνα*, the heel.) A chilblain, especially one on the heel. (See **CHILBLAIN**.)

**PESSARY.** (From *πέσσω*, to soften.) The intension of pessaries, among the old practitioners, was to keep medicinal substances applied within the pudenda. They are now never made use of except for preventing a prolapsus of the uterus or vagina, or for keeping up a vaginal hernia. (See **HERNIA**.)

M. Jules Cloquet gives the particulars of a case, in which a pessary was met with in the body of an old woman, the broad lower end of which had perforated the rectum, while the upper narrower one had produced ulceration of the vesico-vaginal septum, and entered the bladder. Three-fourths of the interior of its wider part were filled with a white crystallised concretion, strongly adherent to it, with brownish stercoraceous matter between the large crystallisations. The upper narrower end was incrustated with a concretion, of irregular shape but smooth surface and yellowish colour, composed of uric acid. (See *Jules Cloquet*, in *Pathol. Chir.* p. 100, 4to. Paris, 1831.)

[The employment of pessaries with the original design has lately been revived. Substances, chiefly sedative or astringent—such as morphia, atropia, sulphate of copper, and tannin—are mixed with some fatty material, and formed into ovoid or conical pessaries. These, when introduced into the vagina or cervix uteri, melt slowly, and the sedative or astringent ingredient, coming into contact with the mucous membrane, exerts its proper action. Professor Simpson at first used yellow wax and lard as the medium. (See *Edinburgh Medical Journal*, 1848.) But these did not answer well. More recently the preference has been given to coconut-oil or butter.

According to Dr. Tanner, Mr. White Cooper introduced this substance as a basis for ophthalmic ointments. Dr. Tanner adapted it to uterine medicated pessaries. (See *Obstetrical Transactions*, vol. iv. 1863.) It is free from offensive smell, and if too hard may be softened by adding olive-oil or glycerine.

The use of the word "pessary" ought, perhaps, to be restricted to applications of the kind just described. By far the most prevalent use, however, is to designate a class of instruments intended to give mechanical support to the uterus and vagina when these organs are suffering from prolapsus. For this use the word *hysterophore* (from *ὕστερα*, womb, and *φορέω*, I bear) has been proposed by Schneemann and Roser.

But pessaries may be usefully employed for yet other purposes.

Pessaries, modified in form according to the particular application, may be classed as follows: 1. Medicated, already described.—2. Hystero-

phores, to support the prolapsed uterus and vagina.—3. Intra-uterine pessaries, used to correct flexions of the uterus, and to stimulate the uterus and ovaries to exercise their functions.—4. Various pessaries acting as levers, designed to correct anteversion or retroversion of the uterus.—5. Vaginal pessaries or "rests," designed to prevent contact of inflamed walls of the vagina, or to give support and rest to the inflamed and enlarged uterus.

The second order of pessaries, or hysterophores proper, present an infinite variety in material, form, and construction. The most simple form, and one long used, was a piece of sponge, not often effective, and always objectionable from its becoming foul. Boxwood, ivory, cork, and metals have been worked into every imaginable shape. Hair or cloth have been moulded into the desired shape, and covered with varnishes more or less impermeable. These were apt to lose shape and to become foul. Solutions of caoutchouc answer best. As to the form to be selected, although this must depend upon the peculiarities of the case, yet it may be affirmed, generally, that solid balls or spheres, and most circular or elliptic or figure of 8 rings ought to be discarded.

To guide us in the appreciation of the use of pessaries, it is necessary to have a clear idea of the mechanical fault that has to be corrected, and of the mode in which pessaries act. The causes and nature of prolapsus will be particularly described under the article "**UTERUS**." It is only necessary here to point out that the uterus is attached by the anterior surface of its cervix to the base of the bladder, whilst about the same level it receives on either side the utero-sacral ligaments covered by folds of peritoneum from behind. This point forms the centre of movement of the organ. The fundus is free, and it can incline backwards or forwards; and the whole organ moves downwards under the pressure of the superincumbent viscera during inspiration, and rises on expiration under the influence of atmospheric pressure. Whatever forces the base of the bladder downwards must cause the uterus to descend with it. One of the most efficient supports of the bladder and uterus is the tonic contractility of the vagina; and without this, the adjuvant action of atmospheric pressure is lost. Almost invariably, an antecedent condition of prolapsus uteri is relaxation of the anterior wall of the vagina. On straining, as in defecation, the anterior wall of the vagina first comes down; the base of the bladder, and with it the os uteri, next appear. The os uteri, in its descent, revolves round the symphysis as a centre; the cervix, being fixed to the bladder, comes down, maintaining its relative position to the bladder; the fundus, being free, rolls back, so that, in proportion to the extent of the prolapsus, there is retroversion of the uterus; and this position is then maintained and aggravated by the weight of the intestines pressing directly upon the anterior or (as it has now become) the upper surface of the uterus. If the prolapsus be complete, then the mass, having cleared the floor of the pelvis, which curves forwards and upwards, may alter its direction, and the os will turn more downwards. Now, a properly constructed pessary must be adapted to preserve or restore the natural form and conditions of the organs.

This was well seen by Jules Cloquet (see art. "*Pessaire*," *Dict. de Méd.* 1841), who had casts made of the vagina in normal conditions. Upon

the models so obtained he constructed pessaries, to which he gives the name "*elythroïd*." They were made of indiarubber, were flattened in front and behind, curved in their long axis to fit the curvature of the pelvis; the upper end formed an oval cup; the lower end was terminated right and left by a rounded angle. These instruments caused no inconvenience to the bladder or rectum, and, taking their support upon the sides of the vagina above the labia majora, they maintained the uterus at its proper elevation.

When prolapsus of the uterus is complicated with considerable descent of the anterior vaginal wall, an apparatus after the design of Roser's hysterophore is very useful. This consists of an intra-vaginal part,\* which is made to press upwards, and to keep in close apposition to the symphysis, the anterior wall of the vagina, and with it the cervix uteri. But it is of little service where there is great descent of the posterior vaginal wall. An instrument formed on a similar principle, but I think more simple and effectual, has recently been constructed by Mr. Roper, who took for his guide plaster-casts made by him of the vagina. (See *Catalogue of the Exhibition of Obstetrical Instruments held by the Obstetrical Society of London*, 1866.)

One principle that should govern the construction of pessaries is to preserve the muscular power and tonic contractility of the vagina. The balls, which simply act by distending the vagina, entirely contravene this principle, so that when removed things are worse than before; the vagina is more relaxed, and the tendency to prolapsus is increased. But a properly constructed pessary, which permits and promotes the healthy action of the muscular wall, exerts a truly curative action. One of the most useful forms is one in pretty extensive use in London, and which I have largely employed in hospital and private practice. It has a small cup, with well-rounded edges to receive the cervix uteri, and is prolonged into a curved stem about the thickness of the little finger, adapted to the curvature of the pelvis. It is often made of gutta-percha; but, owing probably to a common adulteration of this substance, these soften and lose their shape. The best material is ebonite; this remains perfectly unchanged and clean. Attached to the lower or vulvar end of the stem are four elastic bands, two of which are looped before and two behind to a hypogastric belt. When introduced, this pessary will push up and back the cervix uteri; the stem is grasped by the contracting vagina, which is thus aided in performing its natural function in supporting the uterus; it occasions no distress by its bulk, and does not restrain the natural rising and falling of the uterus, the external elastic bands acting with and aiding the muscular and elastic structures of the vagina and perinæum. So perfect is the action of this pessary in some cases, that the external bands may be dispensed with; the vagina is so restored to power, that it supports the pessary and uterus by itself; and, after a time, the vagina can support the uterus without the pessary: a cure is effected. This contractile action of the vagina is further aided by atmospheric pressure, which tends to carry the contents of the pelvis upwards on every expiration.

A Greek veterinary surgeon, Apsyrtus, at the end of the twelfth century, appears to have been the first to use the air or dilating-pessary. Having

reduced the prolapsed uterus of a mare, he inserted in the vagina a sheep's or pig's bladder, and then inflated it by means of a reed. Four hundred years later Albucasis applied the same apparatus to a woman. This is the account: "*Accipe vesicam ovīs et intromitte vesicam totam in vulvam ejus (mulieris), deinde suffla in canulam, donec infletur vesica intra vulvam.*" (Lib. iii. cap. 29.) The revival in modern times of the air-pessary dates from the publication of a memoir by Dr. Halpin of Cavan (see *Dublin Medical Journal*, 1840), who used a small bladder furnished with a stopcock and tube connected with a syringe in cases of retroversion.

M. Hervez de Chegoin having to treat a case of retroversion of the womb, where the concavity of the sacrum was very spacious, adapted an indiarubber bottle in such a manner as to fill the hollow of the sacrum, and to push up the body of the uterus. He thinks pessaries ought not to bear upon the os or cervix uteri, continual pressure and chafing upon this part being injurious. In ordinary cases of retroversion and anteversion he used a flat ring-pessary, having one border wider than the other. The wide border was applied posteriorly; it supported the body of the uterus, and the neck came through the opening. The principle of the lever came into operation here. The natural indiarubber bottle—that is, in the form in which caoutchouc is imported—has been long used in England as a pessary. But the thickness and hardness of these bottles must deprive them of all elastic property. Until the process called vulcanisation, by which a certain proportion of sulphur is incorporated with caoutchouc, was discovered in this country, it was impossible to impart to this material the thinness, lightness, strength, and elasticity requisite to make a good air-pessary. The vulcanised caoutchouc was soon adopted by M. Gariel, a French surgeon, who handled it in a most ingenious manner. His air-pessary has been much used on the Continent. It consists of a bag of the prepared caoutchouc, which, when undistended, is very small, and easily introduced into the vagina. It is furnished with a long flexible tube and stopcock, and is inflated after insertion by means of an elastic bladder. In many cases this pessary answers well. It has no perceptible weight; it causes no distress from chafing, and is very easily removed in the flaccid state by opening the stopcock. The shape of the pessary may be adapted to the indications of a given case.

In an excellent memoir, Gillebert d'Héricourt explains the action of the air-pessary. By experiments and measurements he showed that whilst solid ring and ball-pessaries actually shortened the vagina, the air-pessary elongated it. Thus the main object of carrying the prolapsed uterus upwards was effected. He further showed that the air-pessary might be so shaped and applied as to press in front of the cervix uteri, which will carry the os backwards and tilt the fundus forwards, restoring the natural inclination as well as position of the entire organ.

There is, however, often a difficulty in securing the retention of the simple air-bag in the vagina. To remedy this, and to fulfil other indications, I have had a solid curved stem enclosed in an elastic covering admitting of inflation. This instrument can be supported, if necessary, by elastic bands attached to a hypogastric belt.



A pessary very largely used on the Continent and in England is the hystero-phore of Zwanke. It consists of two wings, united by a joint, and connected each with a stem. To facilitate introduction and extraction, the wings can be brought together. When this is done the stems diverge; on bringing the stems together, the wings open, and stretch the fundus of the vagina. The instrument is light, does not interfere materially with the mobility of the uterus, and in many cases supports the uterus very effectually. Several modifications have been made, the principal being by Schilling and Breslau.

*The third order.* Velpeau, Amussat, and Kiwisch contrived intra-uterine stems or pessaries, for the purpose of supporting the retroflexed uterus. The practice has been taken up by Dr. Simpson. His instrument consists of a stem, long as the cervico-uterine canal, which occupies the cavity of the uterus, and is attached to a disk upon which the cervix rests, the whole being kept *in situ* by a wire-frame which rests upon the mons-veneris. (See *Dublin Quarterly Journal of Medical Science*, 1848). M. Valleix thought to make the instrument safer by shortening the stem. But it is obvious that if the stem is so short as not to pass beyond the os internum, it must fail in supporting the bent body of the uterus. And herein lies the practical difficulty. If the stem is so long as to reach the fundus of the uterus, and the instrument is fixed by being connected with a rigid framework outside the pelvis, the natural mobility of the organ is prevented, the uterus is actually impaled, and serious consequences have been reported. If the stem be reduced in length, the instrument becomes useless. The problem has been solved by Dr. H. G. Wright, who has contrived, and successfully used, an intra-uterine pessary which requires no external support—which, maintaining itself in the uterine cavity, becomes as it were part of the uterus, and in no way impedes the natural movements of the organ. It consists of a thin, curved, spring-shaped instrument, somewhat like the letter Y. The expanded branches can be brought together so as to lie within a canula, which can be introduced like a uterine sound; the canula being withdrawn, the branches open in the uterus, lying in the sides of the cavity. It can be easily withdrawn by slipping the canula up over the branches, which brings them together again. (See *Lancet*, February 1866.) Similar instruments, but not equal in point of lightness and safety, have been devised by Dr. Graham Weir in 1855, by Dr. Greenhalgh in 1864, and others. Dr. Simpson has also used galvanic intra-uterine pessaries. (See *Edinburgh Monthly Journal of Medical Science*, 1854). These have stems composed of zinc and copper. They are used to stimulate the growth of the organ when it is imperfectly developed, and to excite menstruation in amenorrhœa.

*The fourth order*, or the lever-pessaries, have been principally devised by Dr. Hodge (*On Diseases peculiar to Women*, Philadelphia, 1860). His instrument is varied in form and size to suit different cases. It consists of a bar bent in the form of a horseshoe. The arch is fitted into the cul-de-sac of the vagina behind the cervix uteri, whilst the horns find a *point d'appui* against the anterior wall of the vagina. The arch, rising, lifts up the retroverted body of the uterus. Another

common form is the *closed lever*; this is a ring compressed so as to form an ellipsis, and then curved like the letter S. The curvature is modified, according to the exigency of the case. Dr. Hodge applies the lever-pessary to relieve almost every kind of uterine disease. It does not impede sexual intercourse. It is now largely used in England as well as in America. Dr. Graily Hewitt has contrived a form of lever-pessary specially adapted to relieve anteversion. (See *Obstetrical Transactions*, 1867.)

Pessaries of the *fifth* order are adapted to relieve or cure various diseases of the uterus and certain conditions of the vagina. Vaginismus, with or without inflammation of the mucous membrane of the vagina, atresia, or unnatural coarctation, all rendering sexual intercourse painful or impossible, may in many cases be cured by wearing a cylindrical elastic pessary, which is introduced flaccid and then inflated. A very useful form has been made for the writer by Weiss. It acts by keeping the inflamed surfaces apart, giving the structures "rest," and gradually subduing spasmodic muscular irritability. It induces tolerance of function, and thus cures a large class of cases of sterility.

Before introducing pessaries it is generally desirable to subdue any existing acute inflammation of the cervix uteri or vagina, and it is especially important to ascertain the extent of mobility of the uterus upwards. For example, the uterus may be driven downwards by an abdominal tumor, by enlargement (as from fibroid growths) of its own body, or it may be bound down at the fundus or sides by peritoneal adhesions. In any one of such cases, injury might be done by the attempt to introduce a pessary. The prolapsed uterus should therefore first be carried up to its full normal site by the finger, and its relations well ascertained. Before introducing a pessary, it is well to empty the rectum and bladder. The mode of introduction must depend upon the form of the pessary. The rule, however, of observing the axes of the pelvis, and the curve of Carus, must always be borne in mind. The labia should be held apart by two fingers, and the instrument insinuated between them—at first backwards towards the hollow of the sacrum, and gaining room for the entrance through the vulva by pressing upon the distensible perinæum, avoiding the pubes. The patient may be either on the back or left side.

Occasional consequences of wearing pessaries deserve consideration. Almost all at first excite increased mucous discharges, a subacute catarrh, of the vagina. Those in the construction of which the natural mobility of the uterus is not regarded, may cause chafing, inflammation, erosion, and hæmorrhage of the cervix. Those which distend the vagina greatly, and press upon the bladder and rectum, occasion great distress by impeding the action of these organs.

When a pessary has been introduced, women are apt to think nothing more is required, and very serious consequences have resulted from neglect. Every person wearing a pessary should continue under medical observation. She should present herself for examination at least once a month. It may be useful to alter the form of the instrument, or necessary to remove it altogether. It is doubtful whether any pessary ought to be worn for any length of time without frequent removal, in order to wash out the vagina, and to observe the condition

of the instrument. But it is very difficult to persuade some women to take this trouble. Thus, large boxwood balls and rings have been worn for months and years; and sometimes inflammation, ulceration, hæmorrhage, and even perforation of the recto-vaginal or vesico-vaginal septum has ensued. A woman was admitted into the Hôtel-Dieu by Dupuytren. She had worn a stem-pessary; the stem had broken off. The ring of the instrument was felt by Dupuytren projecting into the rectum, and the sound detected the anterior border which had penetrated into the bladder. It was removed with some difficulty. Many similar cases are related. M. Lüders (see *Monatsschrift für Geburtskunde*, 1858) tells the following: A lady had a pessary applied by a midwife. It was of caoutchouc stuffed with hair,  $3\frac{1}{2}$  inches long,  $2\frac{1}{2}$  broad, and 1 inch thick. Peritonitis followed, then hectic fever. A swelling was felt between the vagina and rectum; the pessary was not found. Six months later another physician found the same swelling, and a transverse scar in the posterior vaginal wall. Two years later a fistulous opening appeared in the anterior wall of the rectum, through which the pessary was at last removed. The patient then rapidly recovered. The pessary had first passed into Douglas's space.

When pessaries have been worn for a long time, the ostium vaginae sometimes—and this is especially the case in elderly women—gradually contracts, and the opening becomes so small that the instrument cannot be taken out without the aid of the surgeon. The writer has experienced more difficulty in delivering women of an imprisoned pessary than of a foetal head. If the instrument is a wooden ball, forceps (curved so as to fit and grasp the sphere beyond its equator) must be used, and traction must be carefully made in the direction of the axis of the pelvis. It has been necessary to make small incisions in the labia to gain sufficient dilatation. Occasionally the small obstetric forceps has been used for the purpose, and here the obstetric lever, or one blade of the short forceps, may be very serviceable.

The ring-pessaries and Zwanke's hysterophore not seldom give rise to much distress, and even danger. The thin margins of the wings of Zwanke's instruments put the roof of the vagina on the stretch, and the continual pressure causes inflammation, and even ulceration. It has been known to cut through the urethra; more frequently the vaginal wall contracts below the wings, so as to shut them up in a groove-shaped cavity; in such a case the extraction is sometimes difficult and painful. It is necessary to open the branches of the stem, to approximate the wings, to hook a finger in the angle of the joint, and to extract gradually, so as to overcome the annular contraction of the vagina, carrying the instrument backwards along the hollow of the sacrum.

To extract an oval or circular ring-pessary, it is necessary first to seize and depress one edge, so as to bring the ring down with its diameter corresponding with the axis of the pelvis. A serious danger liable to arise from the ring form is that the cervix uteri passing through the opening may become fixed and strangulated. In such a case, liberation may be effected by seizing the border of the ring with the index-finger of one hand, whilst the index of the other pushes up the imprisoned cervix. It has been found necessary first to cut the pessary. Dr. Marion Sims says (*Clinical Notes on Uterine*

*Surgery*, London, 1866), he has seen Hodges's open lever-pessaries dig holes in the anterior wall of the vagina, almost through into the bladder; and that he has often seen Meig's ring-pessary cut a sulcus in the posterior cul-de-sac in the vagina, deep enough to bury the finger in. He relates a singular case, where the disk or cup of a stem-pessary was taken up into the cavity of the uterus, where it remained locked by the contraction of the lower part of the cervix. It was removed by an ingenious adaptation of elastic traction, sustained so long as to wear out the resistance of the cervix.

The intra-uterine pessaries of Simpson and Val-leix and others often cause so much irritation as to make it necessary to remove them; they have also caused serious and even fatal metritis, perimetritis, and peritonitis. The writer has himself been called upon to treat a very severe case of pelvic cellulitis and peritonitis due to the use of Simpson's instrument. Fatal cases have been recorded by Cruveilhier (see *L'Union médicale*, 1854); by Dr. Oldham (see *Guy's Hospital Reports*, 1849); by M. Depaul (see *L'Union médicale*, 1854); by M. Nélaton (see *op. cit.*)

**BIBLIOGRAPHY.**—The references given in the course of the article supply the chief bibliographical elements. Consult also P. N. Gerdy, *Traité des Pansements*, 1839; and the Catalogue of the Exhibition of Obstetric Instruments of the Obstetrical Society of London (1866).] Robert Barnes.

**PHAGEDÆNA** (from φάγω, to eat). An ulcer which spreads, and, as it were, eats away the flesh. Hence the epithet *phagedænic*, so common among surgeons. For an account of phagedæna gangræna, see **HOSPITAL GANGRENE**; see also **ULCERATION** and **MORTIFICATION**.

**PHARYNGOTOMUS** (from φάρυγξ, the throat, and τομή, an incision). An instrument for scarifying the tonsils, and for opening abscesses about the fauces. It was invented by Petit, and is nothing more than a sort of lancet enclosed in a sheath. By means of a spring the point is capable of darting out to a determinate extent, so as to make the necessary wound, without risk of injuring other parts.

**[PHARYNX, SURGICAL AFFECTIONS OF. Φάρυγξ. Fauces. Glosier and Arrière-bouche. Schlund. Gullet.** Communicating with the surface by the mouth and nostrils, the pharynx forms the portal to both the windpipe and œsophagus, and has a passage leading into the inner ear. It is in close connection with many important parts,—arteries, veins, nerves, and lymphatics, and lies in near contact with the base of the skull and the spinal column. It is chiefly for these reasons that its lesions and diseases are of so much interest to the surgeon. Its lining membrane is continuous with that of the mouth, nostrils, œsophagus, and larynx, and it is separated from the cervical vertebrae by a somewhat loose layer of cellular tissue. It is, moreover, surrounded and compressed by muscles, and does not form a complete canal in front till it attains the level of the cricoid cartilage. The root of the tongue and the pillars of the fauces lie at its upper aperture, and below it becomes somewhat narrowed as it emerges into the œsophagus, about the level of the fifth cervical vertebra.

*Pharyngitis.*—The pharynx is liable to inflammation, sometimes of a very violent description, which, however, falls more frequently within



the domain of the physician than the surgeon, from its common association with various internal diseases.

It is chiefly as a result of the application of irritants that pharyngitis is seen by the surgeon, but it may arise from very many causes, such as cold and damp, erysipelas, smallpox, measles, scarlet fever, dyspepsia, the extension of inflammation from the mouth or tonsils, syphilis, scrofula, &c. The irritation caused by the impaction of a foreign body, or by the contact of acids, alkalies, boiling fluids or flame, constitutes not unusually the cause of pharyngeal inflammation as it is presented to the surgeon.

The symptoms of pharyngitis will vary with its intensity and cause. When severe, the constitution sympathises very markedly, and we observe the usual signs of general fever. In the sub-acute and chronic forms of the complaint, the tendency to constitutional depression is often very great, especially in that form of pharyngitis which sometimes attends erysipelas and the exanthemata. Locally we notice a greater or less degree of dysphagia, with pain accompanying the attempt to swallow,—spasm,—frequent endeavours to hawk up or swallow down the superabundant and adhesive mucus which is soon secreted after the establishment of the inflammation. There is frequently regurgitation of the liquid portions of the food by the nostrils,—there is pain on pressing the throat, and some swelling or fulness. Internally, the changes produced by the inflammatory action will vary greatly according to the exciting cause, the duration of its action, and the intensity of the resulting effect. The mucous membrane may be only slightly reddened, or it may be greatly injected, softened, or completely destroyed. It is commonly, even in the slighter forms, tumefied, rendered more vascular than usual, and its follicles enlarged, but in such severe and fatal accidents as occasionally arise from the application of strong caustic liquids, the lining membrane of the mouth and pharynx may be quite charred and destroyed.

If the inflammation extend to the nostrils and downwards into the œsophagus and larynx, we shall have a change in the tones of the voice and, it may be, dangerous embarrassment of the respiration.

Reference has already been made to the destructive effects occasionally seen in the gullet from an attempt to swallow caustic solutions, boiling liquid of any kind, or the respiration of flame, as that of gas or fire, or of hot steam. Such injury as is sometimes caused in this manner may produce very rapid death from collapse. In such cases, the spasmodic action of the constrictor muscles of the fauces in general causes the fluid to be expelled before it penetrates beyond the pharynx, but such injury to the interior of the gullet is nevertheless occasioned as may quickly prove fatal. The lining membrane reduced to a pulp, or charred throughout or in patches,—perforation of the walls,—violent inflammation, followed by effusion at the glottis,—these are the most common effects. If the patient recovers from the immediate shock produced by the accident, he has a long and trying ordeal to pass through before recovery can become established. Ulceration and sloughing of the mucous membrane, followed by cicatrisation (in favourable cases) and almost inevitable contraction of the canal, produce a succession of most formi-

dable dangers. Even in the less severe cases, plastic exudation on the surface and beneath the mucous membrane is often the source of much embarrassment. A patient who has drunk a strong caustic solution frequently suffers from violent retching, which can seldom be allayed, and which is easily reproduced if it for a moment cease,—great prostration,—difficulty of breathing and swallowing, and often the evacuation of changed blood by emesis and stool.

When slight, then pharyngitis may speedily end in recovery, or pass into a chronic state, but in more severe cases sub-mucous deposition of plastic matter takes place, or abscesses may form in the cellular tissue around, or ulceration, sloughing, or even gangrene and perforation may follow. Rarely, but in a few cases, extensive adhesions between surfaces are met with, as when the soft palate becomes connected to the back of the fauces. Adhesions of a very complete kind have in this way sometimes been formed. Stricture of the passage is by no means an unfrequent result of severe and protracted inflammation, followed by loss of substance. A false membrane—grey, tough, and adherent—is produced with great rapidity, and over-spreads the surface of the pharynx in some affections of the throat, which are occasionally epidemic, and to which the name diphtheria has been applied.

The treatment which we must employ in any case of inflammation of the pharynx will depend very much on the cause giving rise to it and the form it assumes. It is no part of my duty to detail the means employed to combat such inflammation as it occurs in connection with the exanthemata, in diphtheria, &c., but it may be remarked that while in most of the forms in which it is presented to the surgeon it demands a decided antiphlogistic treatment, yet as seen in connection with the low forms of erysipelas and other asthenic complaints, not only should no measures be used which may possibly depress the vital powers, but every exertion should be made to retain them in vigour.

In strong and plethoric persons, where the inflammation is severe, general blood-letting may be called for,—in most cases leeches, fomentations, poultices, and ice allowed to melt in the mouth will be of benefit. Low diet should be ordered, and emollient gargles used. Emetics are occasionally serviceable in the outset of idiopathic pharyngitis, and the administration internally of calomel and opium, or antimony and purgatives, may in certain cases be thought advantageous. If there be danger of suffocation, tracheotomy may be demanded,—the opening in the windpipe being retained till all danger is past. If the food and medicine cannot be swallowed, they must be given by enema. After the acute stage has passed, detergent and disinfecting gargles, as those containing chlorine, and the local application of solid or fluid caustic, will in many cases be attended with good. In the low asthenic form of inflammation, the application of a strong solution of nitrate of silver is most valuable, and then too tonics and good food, with, it may be, wine, will require to be added. The remedies, however, it is again repeated, must be in all cases varied according to the exciting cause and the severity of the affection. When a caustic fluid has been the occasion of violent and destructive inflammation, we may

(especially if any part of the liquid has penetrated to the stomach) employ such a chemical preparation as may tend to neutralise its effects, or employ some bland mucilaginous liquid for the same purpose. If the destruction of the mucous membrane be great, it will be dangerous to attempt to pass a stomach pump tube. Means such as are above described are energetically employed to allay the inflammatory action, and the strength is upheld by the use of milk and unirritating food by the mouth, and (if necessary) strong beef tea and brandy injections into the bowel. After the acute stage has passed, counter-irritation to the throat and nape of the neck, and the use of bougies, in order to retain the integrity of the passage till all fear of contraction is passed, will be required. If an impassable stricture becomes established, we have the most hopeful case for making an artificial opening into the stomach, as no disease is present which of its own nature tends to kill.

In the chronic form of pharyngitis, which appears to be due to scrofula alone, remedies which will correct the cause must be employed, and the guarded use locally of caustic solutions. The inflammation and ulceration which attend syphilis will demand treatment appropriate to that malady. In those forms of disease which are accompanied by great effusion of plastic matter, the mechanical removal by forceps of the false membrane when loose,—the application of strong acid to the part, chlorate of potash internally and as a gargle,—nourishment and stimulants, and perhaps tracheotomy, form the outline of treatment demanded.

*Pharyngeal Abscess* may result from inflammation in the soft tissues, or be caused by the presence of disease in the base of the skull, or the upper cervical vertebrae. It occasionally occurs in the progress of low fevers, and is often connected with the scrofulous diathesis. It is most frequently situated behind the pharynx, and is thus termed "post-pharyngeal" or "retro-pharyngeal abscess." This affection is often a serious one, both from the danger it directly causes, and more especially from the more serious bone disease, of which it may be a mere consequent. It sometimes becomes established in the most insidious manner, and is often difficult to recognise in its early stage. It occasionally forms with great rapidity, and from the pressure it exercises on the larynx, threatens suffocation, especially when the patient is in the recumbent position. The peculiar nasal tone which abscesses in this situation sometimes cause may lead to a suspicion of their presence. When large, the voice may be suppressed and deglutition impossible. These abscesses are in general small, but occasionally attain a great size.

To recognise the presence of a pharyngeal abscess is not by any means always easy, although in general the finger will be able to distinguish the fluctuation. They ought to be freely opened, at as early a period as the fluctuation becomes evident, by means of a bistoury covered up to near its point with adhesive plaster,—a precaution it is as well to take in order to avoid injury to the tongue. The pus that escapes is usually foetid, especially if the accumulation depends on affection of any of the bones. It has been proposed to open pharyngeal abscesses if possible from the side of the neck, from the fear (generally imaginary) that the food would gain admittance

into the wound and set up further irritation. Such a practice is certainly bad, unless the pus point in the neck. If any fear really exists as to the entrance of the ingesta into the wound made within the canal, a tube may for a short time be passed beyond it, when food is to be introduced.

Pharyngeal abscesses should always be opened early, as if abandoned (although they may burst spontaneously into the pharynx yet) there is great risk of their burrowing far and wide among the tissues and, it may be, opening ultimately in the neck, into the anterior mediastinum and pericardium (as in one case which fell under the notice of the writer), or into the cavity of the chest. After evacuation, disinfecting gargles will be of use, and means should be employed to remove the cause of the accumulation, whatever that may be.

*Ulceration* may follow inflammation in the pharynx, and is not uncommon in scrofulous children whose health has been much depressed. It is occasionally in such cases very extensive and destructive, and very difficult to manage. It may spread far and wide, penetrating into the nostrils, and eventuating in destruction of the bones. It more commonly, however, remains superficial, and causes much foetor in the breath and expectoration, an annoying cough, and depression. It is to be treated as other strumous affections, with the addition of chlorate of potash or chlorinated gargles, and the use of the former internally with tonics, cod liver oil, &c. Caustic should be avoided if possible, in these cases, or at least very sparingly used. *Syphilis*, either in its secondary or tertiary stage, is in adults not an unfrequent cause of pharyngeal ulceration. The ulcer is then often deep and foul, and may be attended with extensive sloughing. It may cause much difficulty in swallowing. Its character would be rendered apparent by its association with other evidences of the constitutional cause, and its treatment would depend on that connection, and on the stage of the affection with which it is associated. The local application of nitric acid and the use of chlorinated gargles will be beneficial. During cicatrisation, if the ulceration has been extensive, annoying adhesions may occur, causing displacement of the canal and partial closure.

*Tumors* of various kinds are met with in the pharynx. These are frequently malignant. They may be of the character of fatty growths, or of fibrous or malignant polypi, and originate in the pharynx, or be connected with the posterior nares or the oesophagus. Tumors in this region may spring from the base of the skull, or the vertebrae, or have their seat in the loose sub-mucous cellular tissue, and they cause a greater or less impediment to the functions of deglutition and respiration, according to their size and position. They may also affect the voice, cause regurgitation, or vomiting of the food, irritating cough, and even push the tongue forward, so as to cause it to project from the mouth. These growths, which are commonly pedunculated and narrow-stemmed, may be in general detected by drawing the tongue well forward, or by introducing the finger into the throat. They demand removal by twisting, division with scissors, strangulation with the simple ligature or the "tumor tourniquet," or it may be by incising the soft palate, or even by excising a portion of the upper jaw. It is fortunately seldom necessary to have recourse to such violent measures as



the two last mentioned! Excision is not always safe, nor is torsion easy, while ligaturing, and leaving the putrid mass in the throat, is very objectionable. Yet we must frequently, to save life, have recourse to one or other of these methods, according as they seem best adapted to the case in hand.

If the stem appears to contain large vessels, and excision is to be attempted, a double ligature should be passed through the pedicle, and it should be strangulated in two portions before being excised. (See POLYPUS.) If there is fear of suffocation during operation on these growths from drawing them forward, or from their effect in closing the glottis, laryngotomy should be first practised, so as to obviate that source of danger.

*Foreign bodies in the Pharynx.*—Small and sharp bodies, such as needles, pins, bristles, fish bones, &c., are apt to become entangled in the folds of mucous membrane which lie at the sides of the pharynx, and pass from the root of the tongue to the epiglottis. Such bodies cause great irritation, and it may be violent inflammatory action, ulceration, and abscess, and may even cause fatal results by piercing the great vessels, the heart or lungs. Pain, difficulty of swallowing, spasm, cough, and, if situated near the glottis, dyspnoea also, may be thus occasioned. Such bodies can be frequently detected by placing the patient in a good light, and inspecting the throat both before and during a full inspiration, the tongue being at the same time well depressed. If this fail to discover the intruder, let the finger be carried, regardless of the retching, all over the surfaces at the back of the throat and into all the sinuosities at the root of the tongue, and when the foreign body is found let it be hooked out, if possible, with the nail. If its removal cannot be accomplished with the nail, a pair of fine curved forceps should be passed over the finger, and guided by it so as to fulfil the object sought. If we cannot discover what we are in search of, or if it has become deeply entangled so as to be too difficult to withdraw with safety, then it is on the whole best to leave it alone till it becomes loosened by ulcerative action.

Large bodies, such as masses of meat, not unfrequently become impacted in the lower part of the gullet, and if not removed may quickly prove fatal by the pressure exercised on the windpipe, or by the spasm their presence occasions. The writer has during last year made two post-mortem examinations which well illustrate the fatal effects which may follow the impaction of such foreign bodies in the pharynx, and their being overlooked by the surgeons who were called to the case. In the first instance the patient was found by the police lying, at night, insensible in a public passage. He was conveyed to the police-office, and, as he smelt strongly of alcohol, he was supposed to be very drunk. He was breathing laboriously, his eyes were much injected, his face purple, and his pulse almost gone. A surgeon who saw him introduced the tube of a pump, emptied the stomach, and had him put to bed. He thought, with the others, that it was a bad case of intoxication, or a fit of apoplexy. The man lived eight hours. On inspecting the body, three-quarters of a pound of beef-ham was found firmly lodged in the pharynx, but not wholly closing the larynx. It was mysterious how the tube could be introduced and not lead to the detection of the foreign body or the

immediate death of the patient. Information afterwards received renders it probable that this man, who had been drinking freely during the evening, but who when last spoken to (shortly before being found) was far from drunk, had tried to bolt the ham, under the popular impression, prevalent in Scotland, that it would have the effect of mitigating the effects of the liquor he had taken. In the second case, referred to above, a middle-aged Irish workman went into an eating-house, and was hastily partaking of a plateful of soup in a room where there were several other persons similarly occupied. He suddenly fell down, and was said by the bystanders to have expired after a few convulsive movements. It was immediately concluded by the ignorant people present that the man had been poisoned by the soup, and the authorities were called upon to investigate the case, and at their instance the writer made a post-mortem examination of the body. A mass of gristle which had been in the soup was found entirely closing the orifice of the larynx, and firmly fixed in the gullet. A surgeon who was called immediately on the man falling down declared death to have arisen from heart disease, being misled by the account given by the bystanders as to the suddenness of the death.

The subject of foreign bodies impacted in the throat is, however, fully considered under the head *ŒSOPHAGUS*, to which the reader is referred.

The pharynx is occasionally *paralysed* in cases of general palsy, and in some affections and injuries of the brain and upper portion of the spinal cord. Convulsive constriction, too, is met with in tetanus, hydrophobia, hysteria, &c., and violent local inflammation, or irritation, is caused by some poisons, as arsenic, and by some affections and injuries of the nervous centres. The treatment of these various affections will include that necessary for the pharyngeal complication.

*Wounds of the Pharynx* demand the same treatment as is detailed in the section on wounds of the *œsophagus*. They are occasionally seen in attempts at self-destruction, murder, and in war. Wounds from within are more apt to occur in the pharynx than in the *œsophagus*, for obvious reasons. Pipe-stems, pencils, pens, canes, spoons, &c., have been by accident forced into the posterior or lateral wall of the pharynx, and have sometimes caused fatal injury by wounding some of the great arteries. Violent inflammation, ulceration, and abscess follow, if any part of the foreign body remains unextracted, and it is of primary importance that the surgeon should satisfy himself that no portion remains so inserted. If severe hæmorrhage follow the extraction of such a body, and cannot be otherwise suppressed, the common carotid of the side wounded must be secured. In gunshot wounds received in battle, or in attempts to commit suicide, the brain, spinal column, or great vessels of the neck are very apt to receive fatal injury.]

Geo. H. B. Macleod.

**PHIMOSIS**, and **PARAPHIMOSIS** (from *φίμω*, to constrict). Often written "phymosis," but the derivation will show that the former spelling is correct. A phimosiis is when the prepuce cannot be drawn back, so as to uncover the glans penis. A paraphimosis is when a contracted prepuce has been drawn back behind the glans penis, and cannot be brought forward again.

Phimosis may be of two kinds, *accidental* or *congenital*. Both the accidental phimosis and paraphimosis may arise from a thickening of the cellular tissue of the prepuce, from any irritating cause capable of producing inflammation. A chancre is a frequent cause; but a mere inflammation and discharge from the glans and prepuce, and also a gonorrhœa, may bring on these affections. The inflammation often runs high, and is frequently of the erysipelatous kind. The cellular tissue being loose, the tumefaction is considerable; and the end of the prepuce being a depending part, the serum often lodges in it. A congenital narrowness of the aperture of the prepuce is very common, and persons so affected have a natural and constant phimosis. Such a state of parts (says Mr. Hunter) is often attended with chancres, and it produces great inconvenience during the treatment. When there is considerable diffused inflammation, a diseased phimosis, similar to the natural one, unavoidably follows; and whether diseased or natural, it may produce a paraphimosis, simply by the prepuce being brought back upon the penis. This tight part, then acting as a ligature round the body of the penis, behind the glans, retards the circulation beyond the constriction, so as to produce an œdematous inflammation of the everted part of the prepuce.

When the prepuce is long, phimosis may also arise from the swelling of the glans penis, produced by sores on the latter part, or the irritation of a severe gonorrhœa. (*Travers, in Surgical Essays, part i. p. 132.*)

In some children, the *natural* or *congenital* phimosis is so considerable, that the urine cannot pass with ease; but the aperture of the prepuce generally becomes larger as they grow older, and the bad consequences which the phimosis might have occasioned in disease are thus avoided.

In certain individuals the prepuce sometimes contracts without any visible cause, and becomes so narrow as to hinder the water from escaping, even after it has passed out of the urethra; consequently the whole cavity of the prepuce becomes filled with urine, and great irritation and pain may be thus occasioned.

In phimosis, when the prepuce swells and becomes thickened, more and more of the skin of the penis is drawn forwards over the glans, and the latter part is at the same time pushed backwards. From such a cause, Mr. Hunter has seen the prepuce projecting more than three inches beyond the glans, with its aperture much diminished.

As Mr. Hunter notices, the prepuce often becomes in some degree everted, by the inner skin yielding more than the outer, and the part seems to have a kind of neck, where the outer skin naturally terminates. From the tightness and distension of the parts, the prepuce now cannot be drawn back, so as to expose any sores which may be situated under it. This state is frequently productive of bad consequences, especially when chancres are situated behind the glans; for the glans being between the orifice of the prepuce and the sores, the matter sometimes cannot get a passage forward, between the glans and prepuce, and, consequently, it accumulates behind the corona glandis, so as to form a kind of abscess, which produces ulceration on the inside of the prepuce. The ulceration thus caused may perforate the prepuce, and the glans, protruding through the opening,

the whole prepuce is thrown towards the opposite side, and the penis seems to have two terminations. On the other hand, if the prepuce is loose and wide, and is either accustomed to be kept back in its sound state, or is pulled back to admit of the chancres being dressed, and is allowed to remain in this situation till tumefaction takes place, the phimosis may be converted into a *paraphimosis*. Also, when the prepuce is pulled forcibly back, after it is swelled, it is then brought from the state of a phimosis to that of a paraphimosis. The latter is often attended with worse symptoms than the former, especially when there has originally been a phimosis. The aperture of the prepuce is naturally less elastic than any other part of it; therefore, when it is pulled back upon the body of the penis, that part is grasped tightly by the contracted portion of the prepuce. Hence there will be, in a short time, two swellings of the prepuce, one close behind the glans, and *in front* of the constriction, consisting of the everted portion of the prepuce; the other *behind* the constriction. The constriction is often so great as to interrupt the circulation beyond it. This increases the swelling, adds to the stricture, and ulceration rapidly sets in at the constricted part, which may extend to a considerable depth into the substance of the penis. In severe cases, mortification of the prepuce may take place, by which means the whole diseased part, together with the stricture, is sometimes removed, forming a natural cure. In many cases the skin and prepuce are not the only parts affected; adhesions, and even mortification, may also take place in the glans, corpora cavernosa, &c. (*See Hunter on the Venereal Disease, p. 221, &c.*)

An accidental phimosis should always be prevented, if possible; and therefore, says Mr. Hunter, upon the least sign of a thickening of the prepuce, which is known by its being retracted with difficulty and pain, the patient should be kept quiet; if in bed, so much the better, as, in a horizontal position, the end of the penis will not be so depending. If confinement in bed cannot be complied with, the end of the penis should be kept up, though this can hardly be done when the patient is walking about. The object of this plan is to keep the extravasated fluids from gravitating to the prepuce.

When phimosis is recent, and attended with swelling of the glans or prepuce from inflammation, tepid water or milk and water may be injected beneath the foreskin, and the penis may be immersed, three or four times a day, in a tepid bath; and the use of leeches, which I think, with him and other writers (see *Dict. des Sciences Méd. t. xli. p. 334*), should never be put exactly on the swollen prepuce itself. As the inflammation subsides, injections of weak goulard, or the solution of alum, or liquor calcis and calomel, may be substituted. (*Travers's Surgical Essays, part i. p. 138.*) Instead of warm applications, some practitioners prefer cold; and it is yet an unsettled question which remedies answer best.

When there are sores, as they cannot be dressed in the common way, injections must frequently be thrown under the prepuce, or the operation for phimosis performed.

When matter is confined under the prepuce, Mr. Hunter recommends laying the prepuce open, from the external orifice to the bottom, where the matter lies; as in a sinus, or fistula. However, he



thinks the performance of this operation for the mere purpose of applying dressings unnecessary, as the sores may be washed with injections, by means of a syringe.

[In all ordinary cases of phimosis with concealed chancres any operation for the phimosis is not only unnecessary but in the highest degree injurious. The cut surface is immediately inoculated from the sores, and the mischief thereby greatly increased. By attention to cleanliness, washing away the discharge with injections of cold or warm water, and by the frequent injection also of slightly astringent or stimulating lotions, such as the *Lotio Plumbi Diacet.*, or the *Lotio Nigra*, the inflammation will subside, and the sores will heal in due course. When the sores are soundly healed, the phimosis often disappears spontaneously, and no operation is required. It is only in those cases where there is persistent contraction of the preputial orifice after the healing of the sores that surgical interference should be thought of.]

— On the other hand, there are cases in which the division of the prepuce for the purpose of exposing concealed sores should be resorted to without delay. These are cases in which there is much swelling and redness, with acute pain in the part, and a dirty sanious discharge from under the prepuce. When these symptoms are present, there is usually sloughing either of the glans or of the interior of the prepuce, to prevent the spreading of which it is very important that the diseased parts should be exposed, and proper dressings applied to them. Hæmorrhage from sores beneath the prepuce is another good reason for dividing the latter; it rarely occurs, perhaps never to any serious amount, except when sloughing is present, and it is a tolerably sure indication that the glans penis is affected. By exposure of the bleeding surface to the air, the hæmorrhage will often cease; should it not do so, it can without difficulty be arrested by the application of ice, or of styptics such as turpentine, or the perchloride of iron solution.]

The common operation for the cure of phimosis consists in slitting open the prepuce, nearly its whole length, in the direction of the penis. For this purpose a director is first to be introduced under it, and the division is then to be made with a curved pointed bistoury, from within outward. This, after having been introduced along the groove, as far back as the corona glandis, with its edge turned upwards, is then pushed through the prepuce over the corona, and the division is completed by the surgeon cutting forwards. After this, some surgeons apply a suture on each side for the purpose of preventing the skin and lining of the prepuce from becoming separated; while others dispense with sutures altogether. As the skin is usually divided further than the mucous membrane, which is apt to form a small cul-de-sac beyond the incision, it should be divided with scissors. If the frænum reach over the orifice of the urethra, it also should be divided.

[When the part is in a healthy condition, three or four sutures may be used with advantage. Immediate union is best promoted by an accurate adaptation of the cut edges. But when there are chancres, sutures had better be dispensed with, as the punctures will only serve as additional points for inoculation. Also, when there is much inflam-

mation or sloughing, sutures are useless; immediate union is not to be expected, and they will only increase the irritation.]

Many surgeons object to this operation, because the prepuce continues afterwards in a very deformed state; and they perform circumcision, or amputation of the prepuce in the following manner:—The prepuce is first taken hold of with a pair of forceps, as much of the part being left out as is judged necessary to be removed. The removal is then accomplished by one sweep of the knife, which, directed by the blades of the forceps, is sure of making the incision in a straight and regular manner. A fine suture is next passed through the edges of the inner and outer portions of the skin of the prepuce, so as to keep them together.

[When circumcision is performed in the manner above suggested, it will be found that the circumference of the incisions in the outer and inner skin do not correspond in extent, that of the outer skin being very much larger than that of the inner. The outer skin will readily retract, but the inner will be still to a considerable extent phimosed. To remedy this the inner skin should be slit up in a longitudinal direction as far as the corona glandis; this will enable it to be everted, and stitched to the outer skin, which should be done by five or six fine sutures of silk or silver wire. The appearance of the part will be improved if the angles caused by the longitudinal incision in the mucous membrane are rounded off before the sutures are inserted.]

Another convenient mode of performing circumcision, is to commence by slitting up the prepuce longitudinally as far as the corona, and then to remove the lateral portions in a circular direction with the knife or scissors. The edges are then brought together by sutures as in the former method. In this operation more of the inner and less of the outer skin is removed than when the prepuce is drawn forwards previous to its removal; the incisions in the two layers correspond in extent, and there is no necessity for a longitudinal division of the mucous membrane before inserting the sutures.

In cases of congenital phimosis, adhesions are not unfrequently met with between the prepuce and the glans. In most cases these will give way, and by the employment of a little force the prepuce can be peeled off the glans, but where this is impracticable, the adhesions must be separated by the knife.

After the operation, lint dipped in cold water should be applied to the penis, the patient should be kept in bed, and the part supported against the abdomen.

By careful management for the first forty-eight hours inflammation and swelling may in most cases be prevented and immediate union secured. A pill containing three grains of camphor and one grain of opium is very useful at night to prevent erections. The sutures should be removed on the second or third day.]

Dr. Ryan recommended a plan of operating for phimosis, which is less severe than the common ones, and attended with no mutilation. It consists in drawing back, as far as practicable, the external skin of the prepuce, and then insinuating a director, with an open termination, under its internal duplicature, and dividing it with a

curved bistoury. In some cases I have no doubt that this method would completely answer, and enable the surgeon to throw a lotion under the prepuce, and even to uncover the glans sufficiently to bring it fairly into view. The method of M. J. Cloquet also merits notice: it consists in slitting the lower portion of the prepuce upon a director, in a line parallel with the frænum. When this latter part is very short it is to be divided with the scissors. The longitudinal wound thus made becomes transverse when the prepuce is drawn back; and scarcely any deformity is the consequence. This method, which is advocated by Mr. Wallace, of Dublin, is sometimes practised in University College Hospital. In performing this operation, great care is to be taken not to let the director enter the urethra, instead of passing by the side of the frænum; a serious mistake, which is alleged to have really happened. (See *Liston on Pract. Surgery*, p. 479.)

With the view of preventing the deformity resulting from the angles of the wound occasioned by slitting up the superior portion of the prepuce longitudinally, M. Lisfranc has recommended the mere excision of a semicircular slice from the anterior and dorsal part of it, by means of a pair of laterally curved scissors; and of repeating this proceeding if the first excision should prove insufficient. M. Velpeau approves of this plan when the prepuce is long, and the phimosis is slight; but, under other circumstances, when a loss of substance is desirable, he prefers the removal of a triangular piece of the prepuce. This practice he deems, indeed, positively necessary in operating upon a phimosis attended with chronic induration, as he once did at the hospital St. Antoine, in which example the whole of the lining of the prepuce was transformed into a fibro-cartilaginous sac. (See *Nouv. Elém. de Méd. Op.* t. iii. p. 557.)

In nine cases out of twelve in which the experienced Mr. Hey had occasion to amputate the penis for cancerous disease, the patients were also affected with a natural phimosis. (*Pract. Obs. in Surgery*.) M. Roux has noticed the same thing in three similar examples; and, as he conceives that phimosis may be conducive to carcinoma of the penis, he thinks that it should always be remedied in time. (*Parallèle de la Chir. Angloise*, p. 306. Also *Travers, in Med. Chir. Trans.* vol. xvii.) See PENIS, CANCER OF.

#### TREATMENT OF PARAPHIMOSIS.

The removal of the stricture in this case should always be effected whenever its continuation threatens to produce a mortification in the parts, between the stricture and the glans. The reduction of a paraphimosis may be effected in most cases, and especially when recent, by compressing with the fingers all the blood out of the swelled glans, so as to render this part sufficiently small to allow the constricting prepuce to be brought forward over it.

[The best way to do this is to draw the prepuce forwards with the fingers, and at the same time to use the thumbs to compress the glans and press it backwards.] In a former edition of this work, as Mr. Dunn of Scarborough has reminded me, the power of cold applications, in promoting the reduction of the glans, should have been mentioned. This method should always be put in practice before the reduction by compression is attempted,

as a preliminary measure, which sometimes succeeds of itself, and renders unnecessary any painful handling of the parts. When the reduction cannot be accomplished by these means it becomes necessary to divide the stricture; but from the great success which I have seen attend the first mode, I should not conceive the second one to be so frequently necessary as Mr. Hunter seems to lay down. This operation is always troublesome to accomplish, because the swelling on each side of the stricture covers or closes the tight part, which cannot be got at without difficulty. The directions given by Mr. Hunter for its performance are the best: he advises the surgeon to separate the two swellings as much as possible, where he means to cut, so as to expose the constricted part; then to take a curved and sharp-pointed bistoury, and to pass it under the constriction and divide it.

[Instead of passing a curved knife under the constricted skin, it will, we think, be found more convenient to use a straight sharp-pointed knife and to cut from without inwards. Having separated the two swellings as far as possible, the skin at the bottom of the groove between them should be divided in a forward and backward direction to a sufficient extent to relieve the stricture. The tension being relieved, the edges of the incision gape widely apart, making it appear transverse instead of longitudinal in its direction. When the stricture is very tight it is sometimes advisable to divide it at more than one point. One incision may then be made in the centre and one on each side of the penis.]

The prepuce may now be brought forward, unless it be thought more convenient, for the purpose of dressing the chancres, to let it remain in its present situation. (See *Hunter on the Venereal Disease*, pp. 238, 239.) In recent cases, the reduction is then easily accomplished; in others, it will follow gradually under the use of cold or warm applications and antiphlogistic treatment; but, as the stricture has ceased, the dangers from that cause are obviated.

[After the stricture has been divided, it is never advisable to use any force to reduce the paraphimosis. The inflammatory effusion renders the prepuce very rigid and resisting, whereas the cause of mischief having been removed, the inflammation speedily subsides, and the prepuce will return spontaneously to its natural position.]

The original disease producing phimosis and paraphimosis must always be attended to, according to the nature of the affection of which these are only effects.

One of the most interesting of the old writers on Phimosis and Paraphimosis, is *J. L. Petit*, *Traité des Mal. Chir.* t. ii. Consult also *J. Hunter*, *On the Venereal Disease*. *Sabatier*, *Médecine Opératoire*, t. iii. 8vo. Paris, 1810. *Travers*, in *Surgical Essays*, part 1. 8vo. Lond. 1818. There is a valuable chapter on this subject in *Richter's Anfangsgr. der Wundarzn.* b. vi. Also, *R. Liston*, *On Practical Surgery*, p. 477. 8vo. Lond. 1837.

**PHLEBITIS** (from φλέψ, a vein). Inflammation of a vein. (See VEINS.)

**PHLEBOTOMY** (from φλέψ, a vein; and τέμνω, to cut). The operation of opening a vein for the purpose of taking away blood. (See VENESECTION.)

**PHLEGMASIA DOLENS**. A swelling of the lower extremities, the consequence of crural



phlebitis. It is mostly seen in puerperal women, but sometimes in other women who have not been pregnant; and now and then in the male sex. I have had two male patients of this kind: one of them was a soldier, in a military hospital at Cambray, during the war; the other was a man who died in the Queen's Bench Infirmary. In the *post-mortem* examination, the external iliac and other veins were found completely obstructed. Dr. Davis, of University College, was the first who proved, by dissection, that phlegmasia dolens depended on inflammation of the iliac and femoral veins. (See *Med. Chir. Trans.* vol. xii. 1823.) One of his cases occurred in 1817, considerably prior to the examples recorded by M. Bouillaud in 1823. The latter states, however, that Chaussier and Meckel had related still earlier instances of phlegmasia dolens in puerperal women, where the crural veins had been found inflamed and obstructed. (See *Archiv. de Med.* t. ii. Jany. 1823.)

[*Sparganosis*, Dioscorides; *Dépôt lacteux*, *Œdema lacteum*, Puzos; *Infiltrations lacteuses des extrémités inférieures*, *Phlegmasia lactea*, Levret; *White leg*; *Weisse Schenkelgeschwulst der Wöchnerinnen*; *Phlegmasia alba dolens puerperarum*, Charles White, 1784.

The disease was recognised clinically by Sydenham, Mauriceau, Puzos, Levret, Deleurye, and Morgagni. The clinical description of Puzos leaves little to be desired. He it was, indeed, who most strenuously supported the theory of lacteal metastasis, regarding the disease as depending upon deposits of milk in the vessels or pelvic cellular tissue. Nor is this theory to be altogether condemned. Certainly it is not true that milk, as milk, is carried to the crural veins, and coagulates there. But clinical observation shows that if the lacteal secretion be disturbed in the early stage (as by cold, emotion, or other causes), the blood receives or retains matters that ought to be eliminated; and these matters being of an irritating kind, cause the blood to coagulate in those vessels where there is a predisposition to this process from the circulation being obstructed.

Puzos, again, has the merit of having signalised the close relation between cases of ordinary phlegmasia dolens and cases of puerperal pelvic cellulitis. This relation appears to have been latterly lost sight of. The milk-deposit theory was contested by White, who proposed the designation now in vogue. He ascribed the disease to engorgement of the lymphatics, the result of injury during labour. Trye adopted this view, with some modifications. Hull attributed the disease to an inflammatory affection in the muscles, cellular tissue, and inferior surface of the skin, communicated in some cases to the large bloodvessels, nerves, and lymphatics. No considerable step was taken until D. Davis brought forward cases and dissections to show that the essential cause consisted in inflammation of the pelvic and crural veins. He was followed by Robert Lee, who cited numerous cases and dissections in support of the theory of phlebitis. He contended that the disease begins in the pelvic veins in the uterine branches, and thence extends to the iliacs and femoral. When the doctrine of primary phlebitis was shaken, when numerous experiments had shown that the phenomena considered to be due to inflammation of the veins, were in reality the results of changes in the blood and not of the vessels, the doctrine of thrombosis,

or clotting, came into prominence. F. W. Mackenzie endeavoured to show, by the concurrent evidence of clinical observations and experiments, that obstruction of the veins might arise from the clotting of the blood, which was caused by the entry into the circulation of irritating matter. Experiments by Henry Lee and others had proved the same thing. But Tilbury Fox, admitting this fact, pointed out that venous thrombosis was insufficient to account for the phenomena of phlegmasia dolens. To this modern theory he linked the antecedent theory of lymphatic obstruction, contending that both were necessary to bring out the characteristic symptoms of the disease. Venous thrombosis will cause oedema. But oedema is not phlegmasia dolens. In oedema there is effusion of serosity, possessed of little coagulable power, in the cellular tissue. In phlegmasia dolens, the lymphatics being also obstructed, the serosity cannot be absorbed; the swelling begins above, extending downwards in the limb; if punctured, very little oozes out, the serosity has gelatinised; the limb does not pit on pressure.

T. Fox insisted also that obstruction might be due simply to extrinsic pressure, as by a tumor; this would produce a mild form of the disease. But obstruction may be due to the entry of virus-matter into the vessels—veins and lymphatics—causing thrombosis, and a severer form of disease. It is difficult to illustrate by dissection all the anatomical conditions associated with the different varieties of the disease. It is not often fatal; and it is *à priori* probable that in the fatal cases, changes not essential to the production of the simple disease are superadded.

R. Lee found the branches and trunk of the left iliac vein filled with purulent fluid; the coats of the common, external, and femoral veins thickened, and filled with soft coagula of lymph and pus; the vena cava, to about two inches below the hepatic veins, blocked with lymph; and several glands in the vicinity of the vena cava and iliac veins in a state of suppuration. Wm. Lawrence (D. Davis) found the inguinal glands a little enlarged, not inflamed; the femoral vein from the ham upwards, the common and external iliac veins, filled with clot like that of an aneurismal sac; the uterus contracted, and its appendages and bloodvessels normal.

Cruveilhier and Ramsbotham noticed the implications of the glands. Similar observations are now numerous. During life also there is abundant evidence that the veins are obstructed by clot. The femoral veins can be felt like knotted cords; and the accompanying lymphatics are felt hard, enlarged, tender; and these conditions gradually disappear as the swelling of the legs subsides. When the swelling begins to subside, an attempt at the establishment of a collateral circulation is made. The superficial veins of the leg, thigh, and abdomen enlarge. The skin itself is thickened; the underlying tissue is hardened, dense. In some cases diffuse cellulitis and even suppuration takes place. But this appears to be an epiphenomenon, or due to some associated complication. Hull, Trye, Davis, Mackenzie, all call attention to the antecedence of fever. And, certainly, there must be something entering the blood- and lymph-vessels capable of causing blood and lymph to coagulate. Pressure clearly acts only in exceptional cases. The exciting causes are well stated by Hull:—contusions or violent

exertions of the lower abdominal and other muscles, inserted in the pelvis or thighs and cellular tissue; cold and moisture; suppression of lochia and milk; errors of diet; standing or walking too much before the vessels and other structures have recovered. To these might be added emotion, the influence of which in causing thrombosis the writer has frequently observed. It has been further advanced, that a predisposing cause must exist in a greater coagulability of the blood, the result of pregnancy and labour. Humphrey regarded this condition as the essential one. Vein-thrombosis appears to occur spontaneously in certain states of blood-degradation. Certainly, flooding during labour is favourable to thrombosis.

The occurrence of the affection in persons suffering from phthisis is especially instructive, because it proves that local conditions—as inflammation, pressure or extension of clotting—in the uterine or pelvic veins, are not necessary to its production. Cases of phlegmasia dolens arising in tubercular subjects are related by Bouillaud (*De l'Oblitération des Veines, et de son Influence sur la Formation des Hydropisies partielles, Archives de Méd.*), by Velpeau (*Arch. de Méd.*), by Cursham (*Med. Chir. Trans.* 1860); by G. M. Humphry, 1859, after dysentery. Phlegmasia dolens in connection with cancer of the uterus has been described by Willan, Girdwood, R. Lee (*Méd. Chir. Trans.* 1829), and many others. A woman lately died in St. Thomas's Hospital, under the writer's care, with phlegmasia dolens supervening on cancer of the uterus.

Virchow, indeed, describes puerperal thromboses as occurring in the venous system primarily or secondarily. The primary, he says, form as continuations from the placental cicatrix, or as thrombi from compression, dilatation, or septic infection; from dilatation, thrombi form in the pampiniform plexus and utero-vaginal plexus, which, being much distended during gestation, unless active contraction in them follow labour, permit the blood to stagnate and clot. Possibly clotting may take place in a similar manner, and concurrently, in the lymphatic vessels. But it seems difficult, from what has been said as to the exciting causes and early or premonitory symptoms, to be satisfied that simple clotting, from pressure or stagnation, is a common cause of phlegmasia dolens. The rapid supervention of tenderness and enlargement of the lymphatic glands clearly points to the fact that some irritating matter has been admitted. It is the function of the glands to arrest the onward progress of irritating matters into the circulation. In the endeavour to discharge this function, if the offending matter is very virulent, or comes flowing in continuously, the glands become inflamed. Just as occurs when the inguinal glands are infected by chance or gonorrhœa, and inflammation sets in, and suppuration in the surrounding cellular tissue; so in labour, when septic matter is taken up by the uterine lymphatics, the associated pelvic glands inflame, and the surrounding cellular tissue may suppurate. This is one form (perhaps the most frequent) of puerperal pelvic cellulitis. If only the veins and lymphatics within the broad ligaments are affected with thrombosis, there will be no swelling of the leg. But if, from greater virulence or more continuous supply of the offending matter, the clotting extends to the external iliac and femoral veins and lymphatics, then will the leg swell, and the typical phlegmasia

dolens will be manifested. This thrombosis is a means of segregating or closing the door against the entry of septic matter into the circulation. The writer has designated this "thrombotic puerperal fever" (*Lancet*, 1865). It is eminently a conservative process. The occurrence, then, of pelvic cellulitis or of phlegmasia dolens must be regarded as salutary. It promises and often ensures safety. It indicates one of two things, or both: either a moderate quantity or virulence of assailing septic matter, or soundness in the blood capable of repelling the assault. On the other hand, if the virus be intense and abundant, the blood poor in quality, and the circulating system athirst from the drain of flooding, absorption will be active; a feeble attempt to arrest the onward course of the veins by clotting may be made, but the imperfect barriers will be broken through, and the septicæmic form of puerperal fever will be developed. This explains both the occasional association of phlegmasia dolens with puerperal fever, and the etiological alliance of the two diseases. There is this pathological difference between the surviving and fatal cases. In the first, thrombosis does not extend higher than the external iliac vein; in the second, it extends along the common iliac and even into the vena cava, causing such hindrance to the circulation as in itself to endanger life. In some cases of this class, remote complications arise. The virus penetrates to every part of the system, producing pneumonia, pleurisy, diffuse cellular inflammation (resembling erysipelas) in the upper or lower extremities; inflammation of the joints, as the sterno-clavicular, shoulder, elbow, wrist, and knee; the kidneys, spleen, liver, present points of capillary inflammation. Sometimes the eyeball is disorganised. (Marshall Hall, *Med. Chir. Trans.* vol. xiii.) All the conditions associated with "pyæmia" are present.

In connection with this subject, it is desirable not to pass over the kindred affection of *arterial thrombosis*. This accident is not unfrequent during pregnancy and childbed. It is more grave than vein-thrombosis. The clotting of blood in the arteries of the leg in senile gangrene has long been known. In this and other conditions, this clotting was ascribed to arteritis. But arteritis, like phlebitis, is put aside. In one class of cases, at a period more or less closely approaching delivery, a woman is seized with fainting, intense pain in one or more limbs, followed by swelling, arrest of pulsation, loss of heat, gangrene in the limb, and generally death. The arteries of the limb affected are found obstructed by clots. In another class of cases, sudden faintness, irregular action of the heart, distressed breathing, quickly increasing collapse, and death (sometimes sudden) are observed. Here the pulmonic circulation is almost exclusively concerned; clot-obstructions are found in the right heart and pulmonary arteries. The clotting may be primary or secondary. Thrombosis may occur *in loco*, as in a case related by the writer as the effect of violent emotion; or it may be secondary, forming upon and around an embolus or fragment of clot or vegetation washed into the artery from a distant part, as from the valves of the heart.

*The Symptoms and Course of Phlegmasia Dolens.*—Some have been pointed out. The first appearance may be from one to thirty days after labour. The most frequent period is from eight to twelve days—that is, within the period of liability to blood-infec-



tion. It is said to be more frequent after first labours, and (Davis, White) not likely to recur in the same patient. The writer's experience, however, is at variance with both these propositions. The disease is generally ushered in by shivering, depression, irregular (sometimes intermittent) action of the heart, then fever, then stiffness and pain in the groin, and, if pressure be made, pain is brought out in the pelvic and iliac region; quickly the pain extends down the course of the femoral vein. Soon (not later than the following day) swelling is apparent in the thigh, the leg, and foot. White says the pathognomonic symptom is a swelling of the whole labium pudendi on the same side only as that on which the tense, shining, white swelling of the leg exists. Tenderness and hardness are now felt—sometimes at the onset—in the calf, the venæ comites, and lymphatics here being involved. Which is the antecedent—the febrile movement, or the thrombosis? They are almost simultaneous, but it seems certain that the sudden commotion in the circulation caused by the clotting is enough to excite the slight febrile movement commonly observed. Thus the writer has observed a succession of secondary thromboses attacking the smaller veins, the superficial branches of the saphena, some days after the closure of the femoral, each attack being manifested by pain and hardening of the vein into a cord, and renewed febrile movement. The œdema increases rapidly but gradually during the next three to eight days. The limb is tense, shining, white; it scarcely pits on pressure. The pain does not always continue, except when the limb is so placed as to put the vessels on the stretch. The swelling subsides gradually, taking usually from twenty to thirty or even forty days to disappear. During all this time, the affected veins will be felt like knotted cords; and here and there the superficial veins will remain dilated—varicose.

The lochia and the milk are not commonly suppressed in the simple cases of thrombotic puerperal fever. Many patients continue to suckle throughout. In some the milk is only partially suppressed for a few days. This circumstance is enough to show that there is no serious toxæmia. The exquisite sensibility of the early stage is succeeded by impairment of sensation and of motion in the limb. The intermuscular cellular tissue, and the tissue in which the peripheral nervous fibrillæ are distributed, are clogged and compressed by the gelatinous serous effusion. Hence the limb is paralysed. Not uncommonly one leg is affected after the other. To range the limbs in the order of liability, they would stand thus: left leg, right leg, arms. The greater liability of the left leg is supposed to be explained by the greater frequency of the placental attachment on the left side of the uterus; by the more frequent left decubitus; by the more frequent left occipital presentation entailing greater injury to the uterine veins on the left side (*Velpeau*). After a time the lymphatic and venous channels are gradually restored. The swelling will sometimes rapidly subside. But some loss of power in the limb, and a disposition to venectasis, will remain for some time. There is no doubt that in most cases the thrombi break down and disappear. The fibrin disintegrates by conversion into molecular fat, forming a pus-looking fluid called by Virchow "physiological milk." Gulliver long before had described

the process. This fluid is generally harmless, and can be disposed of by the circulating and excretory organs. But there is some risk of embolia—i. e., of imperfectly liquefied fragments of clot being carried into the blood, and becoming the foci of thrombi in the pulmonary arteries. Occasionally the veins become permanently obliterated, an effective collateral circulation being established by the development of superficial veins.

The treatment should be regarded from prophylactic, curative, and reparative points of view. The labour should be conducted with the least possible violence. Flooding should be carefully guarded against. Above all, vigilance is required lest any check should be encountered by the secreting apparatus—to take a light but nutritious diet, to avoid any mental perturbation. At the onset, a dozen leeches may be usefully applied to the groin. The limb should be wrapped up in cotton-wool surrounded by oilsilk. This maintains uniform temperature, and promotes exhalation. The limb should be slightly raised from the heel, and rotated inwards so as to relax the femoral vessels. Rubbing should be avoided, especially in the early stage. When the swelling has subsided, rubbing with soap-liniment, or oil may be serviceable in promoting the return of muscular power, but there is some danger lest embolia be caused by breaking up the softening clots. Flannel rollers are useful, and commonly, when the erect posture is resumed, elastic stockings, to support the distended vessels and weakened skin, are desirable.

In the early febrile stage, salines with opiate sedatives constitute the best internal remedies. Davis spoke highly of digitalis and blue-pill.

At a later stage, mineral acids are useful—bark, then iron. The diet should be generous, and include wine. The state of the limb should be watched for some time after apparent recovery. Some degree of venectasis often persists. The parts so affected are liable, long after convalescence, to become the seat of secondary or tertiary thrombosis. Some of the phenomena of phlegmasia dolens may be reproduced. Inflammation (sometimes erysipelatoïd) springs up around the knotted and thrombosed veins. Sloughing may take place over the seat of the obstructed vessel, and a deep indolent ulcer is formed. A process, strictly of necrosis, has occurred as the consequence of arrested circulation and nutrition in the part.]

R. Barnes, M.D.

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**PHLEGMON** (from φλέγω, to burn). Healthy inflammation. (See INFLAMMATION.)

**PHLOGOSIS** (from φλογώ, to inflame). Inflammation.

**PHTHIRIASIS.** The presence of crab-lice among the eyebrows and eyelashes. The crab-louse (Phthirius). Its pear-shaped eggs are attached to the hair, close to the skin, by means of a transparent cement. A lid found at the broad end of the shell of the egg, falls off on completion of the growth of the foetus. The lice and their eggs, when present in large numbers, give rise to an appearance as if the eyelashes were covered with yellowish grey and brown crusts, as observed in Tinea. These crusts, on close inspection, present a marked beaded form, and when pressed between the nails, burst suddenly.

*Treatment.*—The daily application of the unguentum hydrargyri nitratis mitius, or of a solution of the hydrarg. bichloridi (gr. j. ad aquæ ʒj.) by means of a camel-hair brush to the "crusts" on the eyebrows and eyelashes, suffices to destroy the lice within a few days. C. Bader.

**PILES.** A disease of the rectum frequently attended with hæmorrhage. (See RECTUM, diseases of.)

**PLANTARIS MUSCLE.** This long slender muscle is sometimes ruptured in dancing and leaping. The surgeon can do little more than advise rest, antiphlogistic remedies, and the same posture of the limb, as in the rupture of the tendo achillis. (See Tendon.)

[**PLETHORA** (from πληθώρα). *Polycæmia. Hypercæmia.* Excess of blood in the whole or in a portion of the bloodvessels. This may be permanent—the true plethora, or *plethora ad vasa*; or temporary—the false plethora, or *plethora ad volumen* of the early writers. It may also be general or partial. Individuals of a sanguine temperament, and particularly those of a lax fibre, are most liable to plethora. General plethora is most apt to occur in the prime of life, and is more frequent in females than males. It is met with especially in those who live highly, drink immoderately of stimulants, are most exposed to the open air, and take but little severe exercise. The blood-making process in such persons is vigorous, and the blood has always been described as "rich," or of a "thick crasis."

The more accurate researches of the moderns have shown that frequently in plethoric persons the proportion of the solid constituents of the blood is increased, and that this increase is due to a large proportion of the red-corpuscles without any increase of the fibrine or albumen. From the analyses of Becquerel and Rhodier, we may infer, however, that plethora often occurs without any change in the composition of the blood.

General plethora may accordingly be induced by—1. An hereditary or acquired tendency to an excessively rapid reproduction of red-corpuscles and the consequent accumulation of an excess of blood in the bloodvessels, and when this tendency exists in a high degree, a plethoric state may occur independently of exciting causes. 2. Too great a supply owing to habitual excessive repletion, often promoted by a very vigorous primary digestion. 3. Diminished waste, owing to inactivity and a sluggishness of the nutritive processes, often resulting from insufficient exercise. 4. Diminished secretion and excretion;

but since it seldom happens that all the eliminating organs are alike at fault, and a failure in the function of either of the depurating organs is for the most part followed by a poisoned state of the blood, when plethora results from this cause, the proportions and the composition of the constituents of the blood are changed and the morbid condition ceases to be simple plethora. 5. The cessation or artificial arrest of habitual discharges, especially when suddenly effected and without any compensating change in the system. Plethora induced by this cause is often well marked and not well tolerated; its effects are also, as in the last case, most frequently complicated with morbid qualities of the blood.

The more prominent symptoms of general plethora are: fulness of pulse, turgescence of the capillaries observed on the surface generally and in the countenance in particular, suffusion of the eyes; fulness of the veins; sometimes diminished aptitude to mental or corporeal exertion, or general lassitude, or increased disposition to sleep, the sleep being often heavy, snoring and unrefreshing. There is frequently vertigo, weight or pain in the head, and throbbings of the larger vessels or palpitations, but in well-constituted subjects the tendency to these latter symptoms is kept greatly in check by the equal distribution of the blood. In the more decided cases the respiration is increased so as to produce a degree of discomfort, and if the blood should not be fully oxygenized, as shown by lividity of the lips, this will amount to dyspnoea; but a continuance of these symptoms indicates a deterioration of the blood in addition to the state of plethora. In simple plethora the abstraction of blood is not only well borne but always attended with sensible relief to the patient, and from fifty to seventy ounces or more have been drawn without producing fainting. The blood drawn may be perfectly healthy or, owing to the increased proportion of the corpuscles to the fibrin, the clot may be larger and less firm than usual. Plethora frequently tends to a deposit of fat in the adipose tissue and general obesity, and it has been held that such deposit may act as a kind of safety-valve for the diversion of the superfluous fluid (Dr. Watson), but the proportions of the blood constituents are most probably altered before this effect is produced.

The consequences of plethora are chiefly such as result from the increased and unequal nutrition of particular parts and over-distension of the vascular system. The increased mass of blood requires an increase in the capacity of the heart's cavities and an augmented force of propulsion; hence, either hypertrophy or dilatation of the heart, or both, may be gradually produced. Plethora predisposes to a certain extent to visceral congestion, particularly of the brain, and this may be followed, particularly when the heart is excited to undue action, by rupture of the vessels or hæmorrhagic effusion. Congestion and hypertrophy of the liver, particularly when from any cause the blood is not freely transmitted through the heart, or congestion of the lungs, hæmorrhoids owing to the retardation of the blood in the portal system, epistaxis or menorrhagia owing to the increased tension of the vascular system, may also be produced. When the distribution of the blood is equal, it may be doubtful whether plethora predisposes to inflammation; but when it occurs, particularly in the viscera, it runs high and requires active treatment.

Surgical diseases and accidents may occur, and



operations may be necessary in a plethoric state of the system, and it behoves the surgeon to pay due regard to this circumstance. It not only influences the progress and results of such cases in a general way, but it may affect injuriously the healing of wounds by its direct effects owing to the quality of the blood, the congestive tendency, and the force of the circulation. Hence it is a rule of practice, where time permits, to correct plethora before proceeding to important operations, by its appropriate remedies—abstinence from a full and too nutritious diet, and from stimulants; active muscular and mental exertion, and a diminished amount of sleep in cases where this is admissible; the use of cooling diluents, and by promoting the secretions and excretions. Where time will not allow of the full operation of these remedies, the surgeon will often find it necessary to resort to the more direct plan of purging and venesection, which latter not only reduces the quantity of blood, but the proportion of red-corpuscles; for, although simple plethora is not often permanently benefited by vascular depletion, the effect may be produced temporarily with the greatest certainty.

Temporary or false plethora may be produced by various causes, as the sudden elevation of the temperature to which the body is subjected, increasing the bulk of the circulating fluids. Nature has provided extensively for the prevention of this effect by increasing the force and velocity of the circulation and augmenting the pulmonary and cutaneous transpiration and the perspiration, or, failing this, by an increase of the urinary and alvine excretions. But these physiological processes, again, are influenced by so many circumstances that they may fail to operate as safety-valves. Transpiration, for instance, may be augmented by the dryness of the atmosphere, or reduced to a minimum by an excess of moisture. So, also, the heat and concentration of the blood from the loss of its more fluid parts acts variously on the nervous system, inducing thirst, and a plethoric tendency may be sustained and aggravated by the quantity of liquid imbibed. This temporary plethora is often produced in a marked degree by the hot bath. Sometimes it follows a full meal. The effect of all the causes producing plethora temporarily are always greater in individuals who are permanently plethoric, and these circumstances have to be taken into consideration by the surgeon in all cases in which the fulness and tension of the vascular system or the energy of the molecular actions of the blood are important, as in inflammations, hæmorrhages, or aneurisms.

*Partial Plethora—Hyperæmia.*—This may occur in almost any part of the system, either with or without an increase of the general mass of the blood and even when there is a deficiency, or coincidently with various morbid states of the blood as respects its constituents and their proportions. Where the smaller vessels of a part are principally affected the term hyperæmia is now generally employed, and partial plethora is seldom spoken of, but if the term plethora is to be retained in pathology, the word partial may be still advantageously employed to designate cases wherein fulness of blood occurs in some of the larger vessels, or in a considerable portion of the vascular system, but not in the whole body, as where constriction of the vessels of the external surface produces a plethora of the viscera, or obstruction of the circulation through

the heart is attended with a plethora of the portal or the renal vessels. After the amputation of a limb, the same quantity of blood continuing to be formed, a plethora is produced, which may be general or partial. The plethora of early life is in a great measure arterial, that of advanced life venous. (*Vide* HYPERÆMIA.)] *H. Ansell.*

**PNEUMOTHORAX** (from πνεῦμα, and θώραξ). An accumulation of air in the sac of the pleura. Air may pass into this situation either from the lung or bronchial tubes, or through the parietes of the chest. An example of the former is afforded by the rupture of the pleura pulmonalis by the bursting of a tubercular cavity communicating with the bronchial tubes; and an instance of the latter is afforded by the pneumothorax following certain penetrating wounds of the chest. Air is also stated by M. Itard to be sometimes generated within the sac of the pleura. This last occurrence is rare: and Dr. Houghton considers that the doctrine of pneumothorax being ever formed by the decomposition of a pleuritic effusion, by no means satisfactorily proved. (*See Cyclop. of Pract. Med.*, art. *Pneumothorax*.) According to Laennec, the pleura, in some very uncommon instances, secretes air: and the air so produced is occasionally accompanied by an effusion of serous or purulent fluid. "This variety (Dr. Houghton remarks) has not been decidedly established by the observation of other pathologists, and we record its existence merely on his authority and on that of Andral, who relates a case of it (*Clin. Med.* t. ii. p. 512), in which, however, this origin was not unquestionably proved." (*Op. cit.*)

In cases of pneumothorax produced by the bursting of a tubercular abscess into the pleura, the existence of a large cavity, or even of numerous tubercles, is by no means essential. Dr. Houghton has known pneumothorax occur, where the cavity, which led to the perforation was smaller than a nut. Andral and others met with cases, where only five or six tubercles existed in the lung; and Dr. Townsend had one remarkable case, where it followed the bursting of a single tubercle which had been formed immediately under the pleura, all the rest of the lung being perfectly free from tubercles. The passage of the contents of the tubercle, and of the air, into the sac of the pleura, which mostly happens on the left side, always brings on a severe attack of acute pleuritis. If this be not speedily mortal, the effused lymph soon becomes organised, and forms a factitious membrane, overlaying the whole surface of the compressed lung, as a deposition upon the pleura, which lies under it, of its natural thickness. The lung itself lies compressed and flattened against the spinal column and mediastinum; and in cases which have lasted some time, it generally becomes reduced to about one fourth of its natural dimensions; and then, if cut into, its substance is found to be so condensed as to present the appearance of what is termed carnified lung. The perforation, by which the air escapes from the lung into the sac of the pleura during inspiration, becomes fistulous; and as for the air itself, if it be discharged by puncturing the thorax, it is found to be generally an inodorous gas, little different from the atmospheric air, whence it was originally derived. (*See Dr. John Davy, in Phil. Trans.* 1824; and *Dr. Apjohn, in Trans. of Assoc. of College of Physicians, Dublin*, vol. v.)

In the majority of cases, the air, although it has a free passage into the sac of the pleura, cannot return into the lung during expiration, owing to the valvular disposition of the fistula; and if this impediment did not exist, still the air could not return into the lung, because the aircells are full of air. The fistula is closed, exactly in the same manner as the valve of the bellows prevents the air from going out by the aperture through which it entered. The consequence is, that the air exerts a pressure within the sac, and that such pressure continues to increase so long as the communication remains open. The space, occupied by the air, is much greater than that occupied by pus, or other fluid: and it seems evident to Dr. Houghton, that the chief part of the pressure must be produced by the air, and not by the other fluid.

This species of pneumothorax is almost invariably preceded by the usual symptoms of phthisis, cough, hæmoptysis, emaciation, night sweats, &c. Then, at the moment when the air first insinuates itself into the sac of the pleura, the patient is sometimes conscious of the occurrence, or has a sensation of something having suddenly given way in the chest. Empyema, as Dr. Houghton observes, being constantly an accompaniment of this variety of pneumothorax, the symptoms of the latter are necessarily joined with those of the former. Hence, the insufficiency of the rational symptoms for the diagnosis. "We find the symptoms of empyema set down as dyspnoea and pain (cough and expectoration), decubitus on the side affected, dilatation of that side, displacement of the heart, depression of the diaphragm, and hectic fever." (See *Empyema*.) The same catalogue precisely makes up the rational symptoms in pneumothorax.

The dyspnoea and pain which immediately follow the bursting of the tubercle, and the first entrance of air into the sac of the pleura, are nearly simultaneous with the sensation above described; but they are still more constantly present, and therefore (as Dr. Houghton observes) of more value in the diagnosis. Yet, pneumothorax has been known to take place without either violent pain or sudden dyspnoea. (*Townsend*, in *Trans. of Dublin College*, vol. v.; and *Houghton*, in *Dublin Journ. of Med. Science*, No. 3.)

The dyspnoea, which usually continues during the whole course of pneumothorax, is more urgent and distressing than that attending chronic empyema. This is accounted for by the great elasticity and condensation of the air, so that even the greatest expansion of the thorax in inspiration can but very partially overcome its reaction, and therefore dyspnoea, resulting from compression, is thus but trivially mitigated. (See *Cyclop. of Pract. Med.*, art. *Pneumothorax*.)

Different writers give different accounts of the side on which a patient with pneumothorax prefers to lie. "In empyema (Dr. Duncan observes), the patients commonly lie on the affected side; and in pneumothorax, on the sound one." (*Ed. Med. Journ.* No. 28, p. 327.) In relation to this point, Dr. Houghton admits the fact, that, in empyema, the dyspnoea is caused by the pressure of fluid alone, and that it is chiefly for the purpose of relieving the mediastinum, and opposite lung, of its weight and pressure, that decubitus takes place on the affected side. (See *Empyema*.) But, he observes, in pneumothorax, the compression of the internal organs is as complete, if not more so, al-

though caused by air; and, if the weight of even an inconsiderable quantity of fluid should be added to them, already suffering under this great compression, the patient will instinctively obviate this by lying on the affected side. According to Dr. Houghton's experience, this position, *cæteris paribus*, is always preferred.

The side where pneumothorax exists, is but slightly or not at all elevated during inspiration; and, on being measured, generally is found to be larger than the opposite one. But in other disorders and in empyema, the intercostal spaces are widened and occasionally protrude beyond the level of the ribs. But, the oedema of the integuments of the side, sometimes noticed in empyema, is not observed in pneumothorax, although M. Louis and others have remarked an cedematous state of the corresponding arm.

According to Dr. Houghton, less compression seems requisite to produce displacement of the heart, and depression of the diaphragm than dilatation of the side; for the latter has been absent where the heart has been thrust considerably out of its place, and a sensible fullness produced in the corresponding hypochondrium by the depression of the diaphragm.

In addition to the foregoing *rational* symptoms of pneumothorax, is the febrile disturbance, which always speedily follows the escape of air by perforation of the tubercular cavity, and is in fact the fever of pleuritis. If the immediate consequences of it are not fatal, this fever subsides into the hectic of phthisis, which existed previously to the bursting of the tubercle.

The *physical* symptoms of pneumothorax are highly deserving of attention. Whenever air and fluid exist together in the sac of the pleura, if the trunk be shaken abruptly, the splash of the liquid against the walls of the thorax is often distinctly heard by the patient, or by any one who places his ear on, or near, the chest. This sound can only be produced where air and fluid are both present: if either is absent, no splashing sound is heard. The action of suddenly shaking the trunk to acquire this information, is termed *succussion*.

One of the positive signs of pneumothorax is a metallic tinkling, or ringing sound, discerned with the naked ear, and still better with the stethoscope. It is compared to the sound occasioned by the dropping of a pin into a large wine-glass, or touching gently a sonorous porcelain vase with a quill. It is audible during coughing, speaking, and sometimes during respiration.

The general result of pneumothorax from perforation of the lung by tubercle, is death. Laennec is well known to have believed in the possibility of the cicatrization of tubercular cavities; and hence it has been conceived, that, in this case, a recovery is not absolutely prohibited. The chances of it, however, appear exceedingly slight. Even Laennec himself admits, that the effusion of air cannot exist for any length of time, without giving rise to very severe symptoms, and even death. M. Louis only speaks of the result, with the view of calculating the time which elapses between the period of perforation and death. (*Recherches sur la Phthisie*, p. 487.) Dr. Stokes relates a case, which lasted five months, as the longest at that time on record. (*Trans. of King's and Queen's College*, vol. v.; and *Houghton*, in *Cyclop. of Pract. Med.*)



These circumstances are very discouraging to the performance of any operation for the discharge of the air. Cases will occur, where venesection, leeches, anodynes, &c. will fail to prevent the dyspnoea from increasing to such a pitch as to threaten the patient with suffocation. Then the only means of enabling the patient to live longer, is making a small puncture in the chest. This is mostly followed by great relief; which, however, is only temporary. The failure of the operation is ascribed by Dr. Houghton to the readiness with which, in such cases, the false membrane and pleura inflame and become gangrenous.

*Pneumothorax, from the bursting of an abscess of the lung*, is rare; and when it happens, the empyema is generally circumscribed. Dr. Houghton suspects, that this must have been the case in the examples of recovery recorded by Dr. Archer (*Trans. of King's and Queen's College*); and Dr. Hawthorne (*Edinb. Med. Journ.* No. 61).

For additional information, see EMPHYSEMA, EMPYEMA, and PARACENTESIS.

**POLYPUS** (from *πολύς*, many, and *πούς*, a foot). A tumor, generally of a pyriform shape, most commonly met with in the nose, but sometimes in the uterus, vagina, antrum, rectum, larynx, and meatus auditorius, and named from an erroneous idea that it has several roots, or feet, like polypi.

Polypi more frequently grow in the cavity of the nose than in any other situation, and are visibly of different kinds. One polypus is of a pale red colour and soft consistence, and free from pain; this is the *fleshy polypus*. When this kind of polypus is of yet softer consistence, semitransparent, and of a pale yellowish or grey colour, in consequence of being less vascular, it is called the *gelatinous polypus*, and usually arises from the mucous membrane of the side of the antrum, or the middle of the cavity of the nostril, between the upper and lower turbinated bones. Sir Astley Cooper has never seen a polypus growing from the mucous membrane of the septum narium. (*Lectures, &c.*, vol. ii. p. 348.) Other polypi are called *malignant*, being hard, scirrhus, and painful: *carcinomatous polypi* are regarded by Sir Astley Cooper as a disease of old age. Another malignant polypus, which he calls *fungoid*, and is in fact the medullary cancer, may occur at any period of life. It is more frequent than a true scirrhus tumor within the nose; and, though like the latter in bleeding copiously, it is less painful. (*Lectures, &c.* vol. ii. p. 354.) [Fibroid polypi, though not noticed here by Mr. Cooper, occur in the nostrils more frequently than either the scirrhus or fungoid—they grow to a very considerable size, destroying the bones and extending into the orbits, lachrymal passages, and frontal sinuses. Unlike the malignant kind, however, they do not return when completely removed. The editor has met with several instances, one of which will be related in this article. See also NOSE.]

Sir Astley Cooper likewise describes *hydatid polypi*, which generally occur in young people, and the cysts of which may be burst by pressure, and the fluid in them discharged. Richter mentions another kind of nasal polypus, which is pale, very tough, and secretes a viscid discharge; which undergoes an alteration of its size with every change of the weather; and which is rather a relaxation, or elongation of a part of the Schnei-

derian membrane, than a polypus excrescence. The whole membranous lining of the nostrils is sometimes thus relaxed and thickened. (*Aufzingsgr. der Wundarzn.* b. 1. kap. 21.) Besides the preceding varieties of polypi, children are subject to red projections within the nose, which are liable to be mistaken for polypi, but are of a different nature, and may be cured by touching them with the end of a bougie, armed with the *argentum nitratum*. (Sir Astley Cooper.)

Mr. Pott has taken great pains to explain, that there is one kind of polypus originally *benign*; another originally *malignant*. He states, that those which begin with, or are preceded by, considerable or frequent pain in the forehead and upper part of the nose, and which, as soon as they can be seen, are either highly red, or of a dark purple colour; those which, from the time of their being first noticed, have never been observed to be sometimes bigger, sometimes less, but have constantly rather increased; those, in which coughing, sneezing, or blowing the nose, gives pain, or produces a very disagreeable sensation in the nostril, or forehead; those which, when within reach, are painful to the touch, or which, upon being slightly touched, are apt to bleed; those which seem to be fixed, and not moveable by the action of blowing the nose, or of driving the air through the affected nostril only (when the polypus is only on one side); those which are incompressibly hard, and which, when pressed, occasion pain in the corner of the eye and forehead, and which, if they shed anything, shed blood; those which by adhesion occupy a very considerable space, and seem to consist of a thickening, or of an enlargement of all the membrane covering the septum narium; those which sometimes shed an ichorous, offensive, discoloured discharge; and those, round whose lower part, within the nose, a probe cannot easily and freely be passed, and that to some height, ought not to be operated on, at least by the forceps, nor indeed by any other means; and this for reasons obviously deducible from the nature and circumstances of the polypus. On the one hand, the very large extent and quantity of adhesion will render extirpation impracticable, even if the disease could be comprehended within the forceps, which it very frequently cannot; and on the other, the malignant nature of the distemper may render all partial removal, all unsuccessful attacks on it, and indeed any degree of irritation, productive of the most disagreeable consequences.

But, the polypi, which are of a palish or greyish light brown colour, or look like a membrane just going to be sloughy; which are seldom or never painful, nor become so upon being pressed; which have appeared to be at one time larger, at another less, as the air has happened to be moist or dry; which ascend and descend freely by the action of respiration through the nose; which the patient can make to descend by stopping the nostril which is free, or even most free, and then driving the air through that which contains the polypus; which when pressed give no pain, easily yield to such pressure, become flat thereby, and discharge a clear fluid; and round whose lower and visible part a probe can easily, and that to some height, be passed, are fit for extraction; the polypus, in these circumstances, frequently coming away entire; or, if it does not, yet it is removable

without pain, and with little hæmorrhage, or hazard of any kind.

Of the benign kind of polypus, fit for extraction, Mr. Pott notices two sorts, whose principal difference from each other consists in their different origin or attachment. That which is most freely moveable within the nostril, upon forcible respiration; which has been found to be most liable to change in size at different times and seasons; which has increased the most in the same space of time; has its origin most commonly by a stalk or peduncle, which is very small, compared with the size of the polypus. The other, which, although plainly moveable, is much less so than the one just mentioned, which has been less liable to alteration from air and seasons, and which has been rather slow at arriving at a troublesome size, is most frequently an elongation of the membrane covering one of the ossa spongiosa. These latter may be extracted with no kind of hazard, and with very little pain and hæmorrhage: but the former require the least force, and mostly come away entire; while the others often break, come away piecemeal, and stand in need of the repeated use of the forceps.

Mr. John Bell criticises the division of polypi into *benign* and *malignant* ones, and under the false impression that they are all of the same nature, declares that time, and the natural growth of the tumor, and the pressure it occasions within the soft and bony cells of the nostrils and jaws, must bring every polypus to one invariable form, in its last and fatal stage. Polypus, he admits, is indeed a dreadful disease; but, according to his views, it becomes so by a slow progression, and advances by gradations easily characterised. [The following description is so graphic, particularly of the more severe forms of the disease, that notwithstanding the erroneous pathology implied, it has been thought right to retain it.] Every polypus in its early stage is, according to this writer, a small moveable tumor, attended with a sneezing and watering of the eyes; swelling in moist weather; descending with the breath; but easily repressed with the point of the finger. It is void of pain, and not at all alarming; it may also be easily extracted, so as to clear for a time the passage for the breath. Yet this little tumor, simple as it may appear, is the germ of a very fatal and loathsome disease, and this easy extraction often the very cause of its appearing in its most malignant form. The more easily it is extracted (says Mr. J. Bell), the more easily does it return; and whether carelessly extracted, or altogether neglected, it soon returns. But, when it does return, it has not really changed its nature; it has not ceased to be in itself mild; it is then to be feared, not from its malignity, but from its pressure among the delicate cells and membranes of the nose. It soon fills the nostrils, obstructs the breathing, and causes indescribable anxieties. The tears are obstructed, and the eyes become watery from the pressure on the lachrymal sac; the hearing is in like manner injured, by the pressure of the tumor against the mouth of the Eustachian tube; the voice is changed, and its resonance and tone entirely lost, by the sound no longer passing through the cells of the nose and face. The swallowing is in some degree affected by the soft palate being depressed by the tumor. The pains, arising from such slow and irresistible pressure, are unceasing. From the same

pressure, the bones become carious, and the cells of the face and nose are destroyed by the slow growth of the swelling. It is not long before the tumor begins to project from the nostril in front, and over the arch of the palate behind. One nostril becomes widened and thickened; the nose is turned towards the opposite side of the face, and the whole countenance seems distorted. The root of the nose swells, and becomes puffy, the features become tumid and flabby, the face yellow, and the parts round the eye livid. The patient is affected with headaches, which seem to rend the bones asunder, and with perpetual stupor and dozing. The bones are now absorbed, and the membranes ulcerate; a foul and foetid matter, blackened with blood, being discharged from the nostrils, and excoriating them. The bloodvessels next give way, and sudden impetuous hæmorrhages weaken the patient; the teeth fall from the sockets, and, through the empty sockets, a foul and foetid matter issues from the antrum.

Now the disease verges to its conclusion. The patient has terrible nights, and experiences a sense of suffocation. The repeated loss of blood renders him so weak that he cannot quit his bed for several days together; and when he does get up, he is (to use Mr. Bell's words) pale as a spectre, his lips colourless, and his face like wax, yellow and transparent. He now suffers intolerable pain, while his saliva is continually dribbling from his mouth, and a foetid discharge from his nose. In this state, he survives a few weeks; during the last days of his illness, lying in a state of perpetual stupor, and dying lethargic. Mr. J. Bell afterwards observes, that "if horrid symptoms could establish the fact of malignity, there is not to be found in all nosology a more malignant disease than this; but aneurism, though it destroys the thigh-bone, the sternum, or the cranium, is not accounted malignant; neither is polypus malignant, though it destroys the cells of the face, and penetrates even through the ethmoid bone to the brain. These consequences result merely from pressure." (*John Bell's Principles of Surgery*, vol. iii. part 1. pp. 90—92.) That this talented writer erred in not recognising some polypi as fibrous or as originally cancerous, and of the nature of fungus hæmatodes, or the medullary tumor, requires at the present day no observations of mine to render doubtless.

In April 1817, there was a boy in St. Bartholomew's Hospital, only twelve years old, who fell a victim to the ravages of this form of disease. The tumor before death had expanded the upper part of the nose to an enormous size, while below the left nostril was immensely enlarged. The distance between the eyes was extraordinary, being more than four inches. The left eye was affected with amaurosis, brought on by the pressure of the swelling; the right retained to the last the faculty of seeing. The tumor nearly covered the mouth, so that food could only be introduced with a spoon, and an examination of the state of the palate was impossible. About a fortnight before death, the legs became paralytic, and during the last week of the boy's existence, an incontinence of the urine and fæces prevailed. On examination of the head after death, a good deal of the tumor was found to be of a cartilaginous consistence, and, what was most remarkable, a portion of it, which was as large as an orange, extended within the cranium,



where it had annihilated the anterior lobe of the left hemisphere of the brain. Yet, notwithstanding this effect, the boy was not comatose, nor insensible, till a few hours before his decease. All the surrounding bones had been more or less absorbed, and the place from which the excrescence first grew could not be determined.

Richter has denied the validity of the objections urged by Pott against attempting to relieve some forms of nasal polypi; and he declares that neither the malignant nature of a polypus, its adhesions, immovableness, ulcerations, nor disposition to hæmorrhage, &c. are any just reason for leaving the disease to itself. (See *Anfangsgr. der Wundarzn.* b. i. kap. 21.) This declaration, however, at least with reference to any operation, is quite repugnant to the advice delivered by all the most experienced surgeons in England, who, in cases of decidedly malignant polypi, always restrict their interference to palliative means.

[As Mr. Cooper does not refer to polypi of a fibrous character, the editor relates a case which occurred in his own practice, and which will contrast well with the one just described by Mr. Cooper. For two other cases see NOSE. In all these, operative procedure was had recourse to, and proved successful where the disease could be completely removed.

A patient was admitted into St. Mary's Hospital, in 1860, with a large tumor implicating the two superior maxillary bones, filling both nostrils, and encroaching considerably on the cavity of the mouth. The features were much distorted by the growth, the nose being projected forwards and the superior maxillary bones made to bulge both forwards and laterally, so as to produce a very peculiar and hideous deformity. On examining the growth in the buccal cavity, it was found to form an extensive convex, irregular swelling, pressing down the tongue and completely concealing the soft palate. Three loose teeth still remained attached to the alveolar process on the right side; on the left the teeth had all disappeared. The position of the orbital plates was but slightly interfered with—very little bony material could be distinguished by the finger in the position of the palatine processes of the superior maxillary or palate bones. The growth which occupied their place was soft and elastic, and was ulcerated in two or three spots of the size of a fourpenny piece. A small portion of the tumor taken from one of these spots was submitted to examination under the microscope by Dr. Handfield Jones, and was considered by him to be a specimen of albuminous sarcoma. Deglutition and respiration were seriously interfered with by the locality of the growth. The senses of taste and smell were greatly impaired, the eyelids were occasionally œdematous and the conjunctivæ inflamed; but the sight remained perfect, indeed the floors of the orbits were but slightly, if at all, displaced. The growth first showed itself within the left nostril five or six years ago, and presented the appearance of an ordinary nasal polypus. It gave him no pain at this early date, but as it inconvenienced him by blocking up the nostril, he applied as an out-patient at this hospital, where he was under the care of Mr. Spencer Smith. The polypoid growth was removed several times by Mr. Smith, at intervals of four or six months, always with considerable relief, and was attended by no unusual symptoms either at the time of the operation or afterwards which could

lead to the suspicion that it would ultimately involve the bones of the face.

Both superior maxillary bones, both palate bones, both inferior turbinated bones, the vomer, and a considerable portion of the ethmoid bone, were involved in the tumor. These, together with the entire mass of the tumor, were removed by operative procedure on the 21st of November. The patient was placed in the sitting position, and chloroform having been administered, two corresponding incisions were made on either side of the face, commencing a few lines internal to the angles of the mouth, and continued upwards and slightly inwards by the side of the nose to the inner margins of the orbits. These incisions allowed of the reflection of a central and two lateral flaps. The lateral flaps, composed of a small portion of the upper lip and of the cheek, served when reflected to expose the portions of the tumor corresponding to the tuberosities of the superior maxillary bones; while the central flap, composed of the bulk of the upper lip and of the soft parts of the entire nose, when dissected up, fully laid bare the cavities and osseous boundaries of both nostrils. A strong pair of bone forceps were now used to detach the superior maxillary bones from the malar bones at the infra orbital fissure on either side. The ascending nasal processes of the former bones were next divided. Pressure being now made on the entire mass in the downward direction, the substance of the tumor gave way, leaving about one third of its bulk connected with the palate bones and part of the tuberosities of the superior maxillary bones. In order to remove the remainder of the tumor, the forceps were again used on either side between what remained of the tuberosities of the maxillary bones and the pterygoid processes of the sphenoid and palate bones. The rest of the tumor was now displaced, but was still held by the soft palate. This was divided by a scalpel, and the whole removed. On examining carefully the immense cavity from which the diseased structures had been removed, the mucous membrane covering the vomer, where it is attached to the body of the sphenoid bone, was found thickened and diseased; the vomer, with its diseased covering, was consequently taken away. This state of membrane, however, was continued on to the basilar process of the occipital bone, and could not be entirely removed. The hæmorrhage, though profuse, was much less than could have been expected, and no ligatures were required. The flaps were supported by compresses of lint introduced into the mouth and nostrils, and their edges were brought together by interrupted sutures. No hare-lip pins were used.

The patient recovered after two separate attacks of erysipelas, which however did not prevent the flaps uniting, although they endangered his life and rendered his convalescence very tedious. The portion of the tumor attached to the occipital bone was, at a later date, when he had recovered his strength, touched weekly with the potassa fusa. The whole had sloughed away before he left the hospital in April, 1861. He is now, six years from the date of the operation, living, and has had no return of the disease. Two other cases of fibroid polypus of less extent, but implicating the lachrymal passages, orbits, and frontal sinuses occurring in the practice of the writer, and requiring to be removed by operation, may be read in article NOSE of this dictionary. Three other very inter-

esting cases of fibroid polypus operated on by Mr. Tatum and Mr. Birkett will be met with in the *British Medical Journal* for 1858, pp. 61 and 119, in which it was found necessary to remove the superior maxillary bone in order to reach the disease. It is remarkable that these, as well as the one already related, had an attachment to the basilar process of the occipital bone; and from hanging down into the pharynx while they extended also into the nostrils, have appropriately been named naso-pharyngeal. Another case of the kind, where no operation was performed, proved fatal by pressure, causing caries of the body of the sphenoid and basilar portion of the occipital bones, associated with abscesses in the brain.]

Mr. J. Bell refutes the common notions, that polypi may be caused by picking the nose, blowing it too forcibly, colds, and local injuries. He asserts that a polypus is not in general a local, solitary tumor: he has only found it so in three or four instances. Both nostrils are usually affected. He states that no finger can reach that part of the nostril where the root of the swelling is situated, as it is deep and high in the nostrils, towards the throat, and near the opening of the Eustachian tube. The finger cannot be introduced further than the cartilaginous wing of the nose extends, and can hardly touch the anterior point of the lower spongy bone. The anterior and posterior chambers of the nostril are separated from each other by a narrow slit, which the finger can never pass, and which is divided, in consequence of the projection of the lower spongy bone, into two openings, one above, the other below. Through these the heads of the polypus project. These tangible parts of the tumor, however, are very distant from its root, which is in the highest and narrowest part of the nostril. (See pp. 103, 104.) Mr. J. Bell also says, that three or four polypi are often crowded together in one nostril, while more are formed, or forming, in the other.

He dwells upon the difficulty and impracticableness of tying the root of a polypus; and explains that, in all attempts to extirpate such tumors, the surgeon's aim should be to reach a point nearly under the socket of the eye, in the deepest and highest part of the nostrils, and that instruments can only do good when introduced beyond the narrow cleft, formed by the projection of the spongy bone. (P. 108.)

Though Mr. John Bell is probably right in his opinion, that polypi do not proceed from the several circumstances which have been above noticed, yet most of them seem, except those of a malignant type, to be diseases entirely local. Certainly, in general, it is very difficult to say what is the cause of a nasal polypus. Frequently the patient is, in other respects, perfectly well; and, after the removal of the tumor, no new one may make its appearance. In this circumstance, it must originate from a local cause, though it is generally difficult to define what the nature of this is.

Four modes of extirpating the ordinary benign nasal polypi have been practised: viz., extracting them with forceps; tying them with a ligature; cutting them out; and destroying them with caustic.

*Extraction* is the most common method, and performed with forceps, the blades of which have holes in them, and are internally rather rough, or serrated at their edges, in order that they may take hold of the tumor more firmly, and not easily

slip off it. Some are straight; others slightly curved. The make of them has been of late years greatly improved, and especially by the construction, which lets them be opened without expanding the nostril too much.

It is generally deemed of importance to take hold of the polypus with the forceps close to its root; and, indeed, when this rule is observed, the whole of the polypus, together with its root, is extracted. When the polypus is not too large, the foregoing plan is often practicable. With respect to common *gelatinous polypi*, they usually originate from between the upper and lower turbinated bones, on the side of the antrum; and the best plan is, first to endeavour to ascertain with a probe the precise situation of the pedicle, which the forceps, guided by the probe, will then more readily grasp. Sir A. Cooper has never known an instance of the growth of a gelatinous polypus from the septum narium; a fact highly worthy of recollection. In many instances, the tumor is so large, and the nostril so completely occupied by it, that its root can neither be felt, nor taken hold of with forceps. The polypus should then be grasped as high as possible. The consequences are of two kinds. The tumor sometimes gives way at its root, though it be only taken hold of at its anterior part; and, in other cases, breaks where it is grasped, a portion being left behind, in either case more or less profuse hæmorrhage ensuing. This is, however, void of danger, and the surgeon need not waste time in endeavouring to suppress the effusion of blood. In this way, a large polypus is frequently extracted, piecemeal, without any serious loss of blood.

In some cases, after the polypus has been propelled as far forward into the nostrils as it can be by the patient blowing his nose, and the place of its root felt with a probe, its anterior part may be taken hold of with a tenaculum forceps, held in the left hand; and if large may be drawn gradually and slowly out, to make room for the introduction of the polypus-forceps into the nostril. The more slowly we proceed in this manœuvre, the more the polypus is elongated, and the narrower it becomes, the greater is the space in the nostril for the introduction of the polypus-forceps, and the higher can this instrument grasp the tumor. After the root of the polypus has been taken hold of with the polypus-forceps, or if this cannot be done, after the tumor has been grasped with the latter forceps, as high as possible, it is to be twisted slowly round, and, at the same time, pulled outward, till it breaks. When the body of the polypus, and not the root, is grasped, it is a very important maxim, rather to twist the instrument than to pull it; and thus, rather to writhe the polypus off, than to drag it out. The longer and more slowly the polypus-forceps is twisted, the more the part where the excrescence separates is bruised, the less is the danger of hæmorrhage, and the more certainly does the tumor break at its thinnest part, or root. When the extraction is done with violence, and celerity, only a piece is usually brought away. Sir A. Cooper recommends tearing polypi from their attachment with a sudden jerk, as the most likely mode to bring away the whole of the root, and even a portion of the Schneiderian membrane and bone, so as to hinder a relapse: a piece of advice, however, which he seems to intend for cases in which the pedicle is grasped by the forceps, as it



Ought always to be, if possible; but, when circumstances oblige the surgeon to take hold of any other more accessible portion of the tumor, the rule of slowly and gradually twisting off the polypus, instead of using a sudden jerk, is what I consider the most likely method of extracting the tumor in a mass.

As soon as the polypus has given way, the surgeon is to examine whether any part remains behind. When the polypus is very narrow at the place where it has been broken, and the patient can breathe through the nose freely, there is reason to presume that the polypus has given way at its root, and that none continues behind. The finger, if it can be introduced, procures the most certain information; or the probe, when the finger, for want of room, cannot be employed. When a piece of the root is left, it is best to introduce the forceps again, under the guidance of the finger, or probe, and thus, if possible, pinch and twist off the remnant of the disease.

Some hæmorrhage always follows the operation; and by many writers it is represented as perilous. But this is not the case in common gelatinous polypi, which are not furnished with large vessels, and are the instances in which the operation is most proper. Cases are met with, however, in which the bleeding is really serious; and therefore the surgeon should take care to furnish himself, before the operation, with the most effectual means for its suppression. The risk of profuse hæmorrhage may always be lessened by slowly twisting the polypus at its root, in preference to pulling it directly out. After the polypus has given way at its root, if the bleeding should still be profuse, ice-cold water or strong brandy may be sucked or injected into the nose. These applications mostly prove effectual. If the hæmorrhage should still prevail, it may usually be checked in the following manner. Twist a dossil of lint round the extremity of a probe; wet it completely through, with a strong solution of the sulphate of zinc; introduce it into the nostril, and press it against the part whence the blood issues.

When this method fails, the nostril may be plugged in the following way:—A piece of catgut or wire may be introduced into the nostril, and, by means of a pair of forceps, be brought out of the mouth, or what is still better, a ligature may be attached to the end of a bougie and passed by means of this instrument, through the nostril, to the back of the pharynx, where it is at once seen, and, with a pair of forceps, brought out of the mouth. A roll of lint is then to be attached to it, and drawn through the mouth into the nose; thus the posterior aperture of the nose may be stopped up. Then the nostril is to be filled with lint. (See NOSE.)

Sometimes, the greatest part of the polypus extends backward, hanging down behind the soft palate towards the pharynx. If there should be but little of the polypus visible in the nostril, its extraction must be performed backward, in the throat. This is usually done with a pair of curved polypus-forceps, which is to be introduced through the mouth, in order to seize and tear off the tumor as high as possible above the soft palate. As, by this mode, the polypus is not twisted, but pulled away, the hæmorrhage is generally copious. If a fragment of the tumor should remain behind, it may now be extracted through the nose.

Frequently the polypus grows again. Some of the root remaining behind may often be a cause of the relapse. But, in the operation itself, if the root can be grasped with the forceps, it may be torn away with a sudden jerk, as recommended by Sir A. Cooper, for the express purpose of bringing away with the root the portion of Schneiderian membrane, and even a scale of bone from which the tumor originates, so as to prevent its growing again. The recurrence of the disease, however, may occasionally arise from other causes. The polypus, observed subsequently to the operation, is frequently not a new substance, but only a part of the original tumor. Sometimes a smaller and a larger polypus are found in the nose at the same time. The larger one is extracted, while the other remains undiscovered; and, when it has increased in magnitude, it is apt to be mistaken for a reproduction of the one previously extirpated.

*Ligature.*—The plan is to tie the root of the tumor, by which means the polypus is thrown into the state of sphacelus, and at length becomes detached. Many instruments have been invented for this purpose, but Levret's double canula, or the ligature-encircling apparatus of Graefe, seem to be the best. Through Levret's double canula a silver wire is to be introduced, so as to form a noose at the upper end of the instrument, proportioned in size to the anterior part of the tumor, situated in the nostril. The two ends of the wire are to hang out of the two lower apertures of the double canula; and one of them is to be fastened to a small ring on its own side of the instrument. The other is to remain loose. The wire must be made of the purest silver, and ought to be as flexible as possible, that it may not readily break. It must, also, not be too thin, lest it cut through the root of the polypus. The canula is to be somewhat less than five inches long. By the assistance of this canula, the noose is to be introduced into the nose, and put round the polypus. But, as the canula, which is usually constructed of silver, is straight and inflexible, while the inner surface of the nostril is preternaturally arched, especially when much distended by the polypus, its introduction must be attended with considerable difficulty. In fact, it can seldom be introduced as deeply as the root of the polypus.

After the noose has been introduced as deeply as possible, the loose extremity of the wire is to be drawn out of the lower aperture of the canula, and rolled round the ring on that side of the instrument, or tightened by means of the small windlass on Graefe's apparatus. Thus the root of the polypus is constricted. As the noose gradually makes a furrow, where it surrounds the polypus, it grows slack after a short time, and no longer constricts the tumor. The wire, therefore, is to be tightened daily. The more tense it is kept, the sooner the separation of the polypus is brought about.

When the tumor has begun to slough, and a fœtid discharge has commenced, a solution of alum, or of chloride of lime, or soda, should be repeatedly injected into the nostril, for the sake of cleanliness; and immediately the dead mass is sufficiently loose, it should be removed.

The ligature is attended with so many difficulties, that, in the majority of cases, the use of forceps is infinitely preferable. Hæmorrhage is the only inconvenience, for which extraction is aban-

doned for the employment of the ligature. But this is much less dangerous than is represented; while the inconveniences of the ligature are serious and numerous. [Those cases in which the polypus hangs down from the posterior nares into the pharynx are the most suitable for the application of the wire noose. They can be seen from the mouth, and the noose can be directed over the tumor by the fingers or by the aid of an appropriate instrument. The wire can be more conveniently adjusted around the tumor without the canula in the first instance, and the ends of the wire afterwards passed through it. It is also better to use the canula and noose as an *écraseur* and to remove the tumor at once than to have it slough in the nostril.]

*Cauties.*—The cautery, formerly recommended for the cure of the polypus nasi, is now entirely rejected; but red projections, not of the nature of a polypus, sometimes noticed within the nostrils of children, Sir A. Cooper cures by touching with a bougie armed with the *argentum nitratum*. The cysts of the hydatid polypus he also destroys by applying the muriate of antimony to them with a camel-hair pencil.

*Excision.*—Sir A. Cooper has sometimes removed polypi by dividing their pedicle with a pair of probe-pointed scissors; but his experience has taught him that the disease, when thus extirpated, is more likely to return than when cured by extraction. When a polypus is very large, and the pedicle grows from the side of the antrum, he also sometimes cuts through the root with a pair of curved scissors, and presses down the polypus at the back of the mouth with his finger, from over the *velum pendulum palati*, and thus removes it. He has never seen danger or difficulty arise from the plan, but, on the contrary, has known it answer in several instances in which the forceps had been employed through the nostrils in vain. (*Lectures, &c.* vol. ii. p. 352.)

In the polypus, which arises from a relaxation of the Schneiderian membrane, external astringent applications may be first tried; such as ice-cold water, solutions of alum, muriate of ammonia, the tincture of muriate of iron, &c. These remedies (says Richter) commonly lessen it, and frequently, when it is not very large, accomplish its entire removal. If this should not happen, there is no reason against putting a ligature round it. Here also we may venture to employ a cutting instrument, if it be in our power to do so. But the practice of extraction is not applicable in such cases. A strong solution of alum, introduced into the nostril with a dossil of lint, will also remove the hydatid polypus of young persons, as Sir Astley Cooper has explained. These polypi he compares to wet bladders hanging within the nose; they are not attended with pain, though with the inconvenience of obstruction. When pressed with the forceps, they burst, and discharge a fluid resembling mucus. The nose may be frequently cleared of them by instruments; but they are always regenerated. Whether astringents will cure them permanently, he cannot say positively. (*Lectures, &c.* vol. ii. p. 353.)

[Mr. Bryant of Guy's Hospital has lately introduced a new method of curing the ordinary gelatinous polypus by a powerful astringent (tannin) used as a snuff or propelled by sufflation into the nostril. This mode of treatment is far preferable

to all operative procedure, and if it prove as successful in the hands of others as in his, the profession and the sufferers from this malady will be greatly indebted to him for a vast improvement in the treatment of a most distressing disease, the management of which by the means hitherto in use every surgeon must confess to be tedious and unsatisfactory. The importance of Mr. Bryant's suggestion, as well as the able and concise manner in which he has introduced it to the profession, render it a matter of justice to him that it should be here fully stated in his own words, and attested by his own cases.

"There has hitherto been," he writes, "but one kind of practice adopted for the treatment of these nasal polypi to which anything like success can be attributed; and that is, their forcible abruption by means of instruments. Some surgeons employ a large pair of well-made forceps, which are carefully applied to the peduncles of the growths; whilst others prefer the noose, or instrument by which a wire or cord is slipped over the body of the polypus and its neck encircled. In both instances the growth is forcibly torn away from its attachments and relief afforded. As far as it goes, this treatment is doubtless good; and may be employed whenever the polypus is of sufficient size to require interference; but all surgeons are aware of the unsatisfactory condition of patients who have been thus treated. It is true the chief portions of the disease for which the surgeon has been consulted may be removed, and a certain measure of relief afforded to the patients; but how long can this relief be promised? How soon will the same symptoms of the disease reappear, and a fresh operation be demanded, to be followed by the same relief, relapse, and surgical interference? We all know that these cases may go on during the patient's life, that the period of immunity from the disease may vary in different patients, or even in the same patient at different periods; but we also know that, as a rule, a return will take place, and that sooner or later a repetition of surgical treatment will be called for.

"It was this unsatisfactory state of matters which induced me to look about for a different plan of treatment; and having now employed it for some years with invariable success, I can with considerable confidence recommend it for general adoption. I am disposed to regard it as a practical wrinkle of no mean value in the treatment of a hitherto very intractable affection, and it is with some little pleasure that I now bring it publicly before my professional brethren. I propose to demonstrate the practice by the quotation of cases.

"*Case I.* The first case in which I was led to adopt the practice, in the year 1862, was in a young woman, E. C—, aged thirty-two, who had been under my care at Guy's Hospital for several years. She had both nostrils affected with polypi, and for this she sought relief about every three months. Her nostrils were remarkably small, so that the operation for removal was one of difficulty. I had tried the injection of astringent lotions with no success, or with so little that it was not worth describing under that name, and gave them up. I then looked about for some powerful astringent that might be locally applied, and that would yet be innocuous to healthy mucous membrane, and found it in tannin. I ordered this to be used as a snuff, the patient to get some



friend to blow it daily up the nostril through a quill. In one month this patient came to me well. Both nostrils were quite clear, and free from all signs of disease. This patient was under my observation for three years afterwards, and no return of the affection made its appearance.

"*Case II.*—The second case I propose to quote occurred in the person of a gentleman, aged fifty-five, who had polypoid growths in both nostrils for ten years. When he came under my care in July, 1864, both nostrils were completely plugged. On the left side the nose was filled, even to its external orifice; on the right the growth occupied the posterior nares, and was not visible in front. I cleared the left nostril with tolerable ease by means of the instrument I generally employ, the 'noose' taking away one of the largest polypi I ever removed. Some bleeding followed the operation, and as the polypus of the right side could not be brought forwards for manipulation, its removal was postponed for one week. I thought, however, it would be well to try the effects of the tannin in this case, and prescribed it as in the last. The following week, when I saw this gentleman again, he came into my consulting room with some spirit, saying that he was all right, that on the third day after the use of the snuff, a polypus as large as the one I had removed from the left nostril had come away from the right, and that he was quite well. This gentleman was ordered to keep some of the snuff by him, and to use it on the slightest indications of obstruction to his nose. He has remained well ever since, and when I saw him early this year he was quite free from the disease.

"*Case III.*—Sarah S——, aged sixty, had been the subject of a polypus in both nostrils for many years. She had been under my care for several years, and had been operated upon five times, the last operation having been performed three months previously. When I saw her on the 19th of February, 1866, her nose was full of polypi, even to the external orifice. Although an extreme case of the disease, I deemed it right, as an experiment, to try the effect of the 'tannin' used as a snuff, and on March 12th (three weeks afterwards), the nose was quite clear. From the day of its use the growth began to wither and to slough off. By the 26th March, on a careful examination of the nostrils, no signs of the disease could be made out. The mucous membrane also appeared healthy. I saw this patient on the 28th May, and she was still well.

"*Case IV.*—Stephen B——, aged thirty-one, came to me on the 24th of March, 1866, with nasal polypi, completely occluding the right nostril. He had had the disease six or seven years, and had been operated upon many times, the last being about a year ago. Tannin was ordered as a snuff, and on the fourth day (March 29) the growth had much diminished: it was evidently withering. He had then a slight passage. On the 5th of April the polypus had disappeared, and he could breathe freely through the nostril. On the 5th of May he was still well.

"*Case V.*—James S——, aged sixty, came under my care on the 10th of May, 1866. He had been the subject of nasal polypi in both nostrils for about five years, and had been operated upon three times. Both nostrils were completely filled, no passage existing through either side. Tannin

was ordered, and on the 20th of June, he could blow through both nostrils, no signs of the disease existing. On the 10th of July he was quite well, the nose looking as healthy as it could be.

"*Case VI.*—George G——, aged fifty-six, came under my care at Guy's Hospital, on Oct. 8th, 1866. He had had polypi of both nostrils for some years. He was operated upon in November, 1865, and again in April, 1866. When he came under my notice, both nostrils were completely filled with small polypi. Tannin was ordered as a snuff, and in two weeks the nose was clear, no signs of disease existing. I saw him one month subsequently, when he was well.

"It is unnecessary for me to quote other cases to prove the value of the practice I have recommended. The examples I have given appear to be conclusive as to the power of 'tannin' to cause destruction of the gelatiniform polypus. When I first employed the snuff, I thought it would be useful only in destroying small polypi, and in thus retarding the growth, if not preventing a recurrence, of the disease, after it had once been surgically removed; but subsequent experience has proved that it does much more—that it has the power of destroying even the largest growths, and of preventing the recurrence of a troublesome and obstinate affection."—*Lancet*, Feb. 23, 1867, p. 235.]

**POLYPUS OF THE UTERUS.**—[Under this name are included all tumors, stalked or sessile, which hang from the inner wall of the uterus or vagina. It is, however, convenient to exclude cancerous growths and the cauliflower excrescence. Polypi may be found at any age and in any social condition, in the married and in the virgin. They are most common during the period of reproductive capacity. There are four principal varieties. 1. The most common and typical has been called successively fibrous, fibroid, or muscular (myoma), according to the current pathological doctrines. It is in reality nothing else than a fibroid tumor formed in the muscular wall of the uterus in process of extrusion. It is identical in structure with the ordinary fibroid of the uterus, as Vogel (*Erläuterungstafeln zur Pathologischen Histologie*, 1843) has demonstrated, and Oldham (*Guy's Reports*, 1844), the writer, and Dr. Hassall (*Trans. of Lond. Med. Soc.*, *Lancet*, 1851), Bristowe (*Trans. Pathol. Soc.*, 1853), and others since. The structure of the uterine fibroid is closely analogous to the proper muscular tissue of the uterus in which it is found, and from which it appears to be formed. Vogel's description of one case is so illustrative of the structure and other features of fibroid polypus, that the relation of it becomes especially instructive. In describing Fig. 5, Plate IX., he says: "It represents the primigenous cells of a fibrous tumor arising in the uterus. These cells are doubtless the rudiments of organic muscular fibres. The history of the disease is as follows:—A single woman, aged forty-four, was admitted into the hospital, after having suffered for several years from a fluctuating swelling in the right side of the abdomen, which hitherto had caused no pain, a dragging sensation, as if the patient were about to bring forth, only excepted. Suddenly violent pains came on in the abdomen, increased by pressure. These continued, and the patient died after three days. The autopsy gave the following results: The omentum was considerably thickened on the right side, and adherent

both to the abdominal walls and to a hard tumor which reached below into the pelvis, and was of the size of two fists. The tumor was knobby on the surface, of a white colour, and hard; it was intimately connected with the fundus of the uterus, from which it seemed to spring. The inner surface of the uterus appeared natural, the mucous membrane unaltered. In its cavity, however, was a round tumor the size of a billiard-ball, hard, of a bluish-white colour, and covered with a yellowish purulent matter. It lay free in the cavity of the womb, without any attachment to the walls. The substance of the uterus was much thickened; the thickness was not uniform, but in many places it was three inches. In the substance were many round tumors of the size of a pea, a bean, a walnut, up to that of a billiard-ball. These tumors were for the most part free, or at least could be easily detached from the surrounding substance of the uterus. They were of a white colour, and very firm texture. They were in general bullet-shaped, but most of them knobby. On section they showed interiorly the same hard glistening tissue as the outside; but a fibrillation or distinct texture could not be distinguished by the naked eye. The large tumor first described as arising from the fundus was softened in parts; it exhibited irregular, eroded excavations, traversed by bands which were soft at the surface, but hard in the interior. These cavities were some empty, some filled with a soft blood-coagulum, or a greasy, purulent grey matter. The softened tumor was broken above, and had emptied a part of its contents into the cavity of the peritoneum, whence secondary peritonitis and death. Another tumor of the size of a pigeon's egg was found in the vaginal portion of the uterus; this was softer, and could not be separated from the uterine substance. It was white, and consisted of a fibrous web with large meshes filled with a thick albuminous fluid. The substance of the uterus consisted of the ordinary organic muscular fibres. In some places brownish cells in great numbers were found between these fibres. The mass contained in the cavity of the uterus showed quite the same structure, the same fibres, and the same brown cells. The tumors in the substance of the uterus, both great and small, were exactly similar. The upper softened part of the large tumor contained, together with blood-clots and isolated blood-corpuscles, many pus-globules, which underwent the ordinary change with acetic acid. The softening of the tumor was plainly occasioned by inflammation. The traversing bands and threads in the cavities of the softened portion were recognised as the débris of organic muscular fibres and connective tissue which had withstood the destruction of the surrounding tissue. The softer tumor in the vaginal portion appeared to be a fibrous tumor; the fibrous portion consisted of organic muscular fibres and connective tissue; the albuminous-looking fluid in the meshes showed numerous round or elongated cells, sometimes solitary, sometimes in groups, probably primary, which, later, would have been developed into muscular cells and fibres. Some of the tumors in the substance of the uterus were carefully enucleated, cut into small pieces, repeatedly washed in water, and submitted to chemical investigation. They were gradually dissolved in boiling concentrated hydrochloric acid; the solution was colourless. In

acetic acid they swelled up, became translucent and gelatinous; but a perfect solution was not obtained at the end of a week's treatment. Similar pieces, carefully washed with water, then dried between pieces of blotting-paper, were weighed and completely dried at 100° in a water bath, and again weighed. 1000 parts of the fresh substance gave 220 of dried residuum."

Lebert (1852) describes these fibroid polypi as consisting of: 1. cellular tissue and fibro-plastic elements; 2. of muscular fibre-cells like those of the uterus. Robin (1854) says the muscular fibre-cells are larger than those of the empty uterus, but smaller than those of the gravid uterus; that they constitute from a fourth to a half of the morbid mass; they further contain a large proportion of finely-granular amorphous matter, very tenacious, half-solid, binding the fibres of the cellular tissue together, and also the fibre-cells. This granular amorphous matter tends to grow with the growth of the tumor. These tumors form distinct masses of uterine tissue, surrounded by a species of envelope or capsule formed of connective tissue, and a layer of the proper muscular wall. It is owing to this encapsulation that they become capable of travelling from their primary seat. How are these growths fed? Their structure is dense, possessing commonly no vessels of any size, and they are quite insensible. Cruveilhier pointed out that it is in these tumors that the vascular system of fibrous bodies in general can best be studied. A considerable vascular network envelopes them. This is entirely venous, and communicates with the veins of the uterus, which acquire a calibre proportionate to the development of the tumors. Occasionally, however, vessels of considerable size have been seen penetrating the substance of fibroid polypi. The growth of fibroid polypi, like that of fibroids still imbedded in the uterine wall, is stimulated by the ovarian or menstrual nusus, and still more actively by pregnancy, the same impulse as that which governs the cognate muscular tissue. In like manner, they are disposed to undergo a similar retrogression or decline when pregnancy has passed, and even atrophy or calcareous degeneration when the period of menstrual life has ended. The fibroid polypus having undergone a certain degree of severance from the uterus, is in corresponding measure withdrawn from this influence, but never entirely. Dr. R. Lee (*Med. Chir. Trans.* vol. xix.) cites Dr. Sims as describing the distinction of a fibroid tumor in the following manner:—1st. If it happen to be developed in the centre of the muscular wall, it grows there; 2nd. if near the outer wall, it expands into the cavity of the abdomen, covered by the peritoneum; 3rd. if near the mucous surface, then it projects into the uterine cavity, protruding before it a layer of muscular tissue, so that the neck of the tumor would be formed by a portion of the substance of the uterus. Boivin, Dugès, Breschet, and others have entertained the same view. Two factors concur in the production of this migration. Sometimes this takes place as the result of the different ratio of growth of the tumor and of the uterus. A dense solid substance, distinct from the uterine wall in which it is imbedded, and continuing to grow, whilst the uterus itself partakes to a less degree in the process of enlargement, will in time form a projection upon one or other surface of the



organ. When it begins to bulge prominently in the cavity of the uterus, active contraction of this organ will tend to cast it off. For this purpose, the uterine muscular tissue has become developed under the stimulus of what may be regarded as a parasitic growth. The carrying a polypus is a species of gestation; and there is always a preparation for expelling the polypus, which occasionally ends successfully—labour completing the analogy. Dr. Montgomery relates a case in which the gradual conversion of a fibrous tumor into a polypus, and its expulsion into the vagina, was clearly traced. The likeness to ordinary gestation is seen in the growth the uterus undergoes. Mr. Paget (*Surgical Pathology*) thus contrasts the growth of a fibroid tumor and that of the uterus: "A tumor may resemble in its tissues the uterus itself, having well-formed muscular and fibrous tissue, and so far as the structures formed in excess are concerned, we might regard the tumor as the result of an hypertrophy not essentially different from that which, at the same time and rate, may take place in the uterine walls around it. But an essential difference is in this: the uterus, in its growth around the tumor, maintains a normal type, though excited to its growth, if we may so speak, by an abnormal stimulus; it exactly imitates in vascularity and muscular development the pregnant uterus, and may even acquire the like power; and at length, by contractions like those of parturition, may expel the tumor spontaneously separated. But the tumor imitates in its growth no natural shape or construction; the longer it grows the greater is its deformity." To this it may be added that, after the expulsion of the tumor, the uterus undergoes the same processes of contraction and involution by degradation and absorption of the now superfluous muscular fibre-cells as after ordinary labour. The stimulus to developmental activity being withdrawn, superabundant blood is no longer attracted to the organ, the blood-vessels shrink, and the tendency to floodings is checked.

The similarity between polypoid and ordinary gestation is sometimes so close as to cause mistakes that might lead to serious imputation against moral character. Following upon many of the more obvious signs of pregnancy, a substance resembling an altered aborted ovum is expelled with hæmorrhage. It is only by section and microscopical examination that such a "fleshy mole" can be distinguished from an ovum. If the proper elements of the ovum, especially the chorion-villi or placental-tufts, are made out, we may form a positive opinion, for nothing in nature exactly resembles these structures. On the other hand, an ovum has been mistaken for a polypus.

Several cases of complete extrusion of fibrous polypi, effecting a spontaneous cure, are related. Cruveilhier gives the following: "A young woman was seized nineteen days after a laborious delivery with pains exactly simulating those of parturition. After three days of sympathetic phenomena, so severe that her life was despaired of, she passed three flattened bodies of firm consistence, which were altered fibrous tumors. The patient perfectly recovered." Another case, also by Cruveilhier, was independent of pregnancy: "A young woman had suffered during four months from uterine hæmorrhage, followed by a horribly fetid discharge. At the end of this time she expelled

some small masses recognised as fibrous tumors. This patient, whose health was undermined by hectic, and who presented all the marks of cancerous cachexia, recovered, contrary to all expectations! The writer exhibited (*Obstetr. Trans.* 1865) a large polypus which had been expelled several weeks after labour, and (*ibid.* 1862) a small one which was expelled under symptoms taken to be those of an abortion. Sometimes, when pregnancy is complicated with a polypus, hæmorrhage recurs, uterine contraction is set up, and abortion follows. Sometimes the pregnancy goes on to term; severe hæmorrhage attends, owing to the hindrance caused to the equable contraction of the womb, and the tumor descends into the vagina, maintaining its connection. An interesting case of this kind is related by Mr. E. Crisp (Dr. Oldham, *Guy's Rep.* 1844). The placenta being retained Mr. Crisp removed it by hand. In withdrawing his hand he felt another child enclosed in its membranes, and endeavoured to pull away from the side of the uterus what appeared to be the placenta, but failing in this, he perforated it; was again foiled. Dr. Chowne and Mr. Bristowe being called, discovered that there was a large polypoid growth within the womb, causing violent expulsive efforts, and greatly exhausting the patient. The energetic action of the womb forced the polypus so low down in the vagina as to interfere with the passage of the catheter. The patient died collapsed, worn out with the constant uterine action, though unattended with hæmorrhage." Generally, however, polypi prevent pregnancy, and a curious case occurred to the writer, of a uterus removed in the dissecting-room, in which a polypus the size of a filbert grew at the orifice of each Fallopian tube, both being completely closed. In another case the tumor had been driven outside the vulva, quite closing the entrance to the vagina. And in the common case of the polypus filling the vagina, sterility almost necessarily follows.

In the process of extrusion a pedicle is formed which is sometimes capable of elongation, permitting the tumor to descend lower and lower. The thin layer of proper uterine tissue which forms the shell stretches out, and through the stalk the vascular connection with the uterus is maintained, and at the same time the connection is further aided by the investing mucous membrane. At other times the connection is more intimate; the fibroid structure of the tumor is extended into the substance of the uterus, forming a dense, short, thick, unyielding stalk. Under uterine action, since the tumor will not separate, and the stalk will not lengthen, the uterus itself is dragged down, producing partial or complete procidentia of tumor and vagina and uterus. Such a case simulating inversion of the uterus is figured in *Obstetr. Trans.*, vol. iii., by the writer. It was only after considerable trouble that the os uteri was found, when a sound being passed up into the uterus, this organ was distinguished from the tumor.

The symptoms differ in the cases of polypus still retained within the cavity of the womb, and of polypus which has escaped through the os uteri into the vagina. In the latter case we have the advantage of digital examination to aid the subjective symptoms. When the tumor is locked up in the uterine cavity we may have to depend upon the subjective symptoms alone. The general symptoms are these: 1. Hæmorrhage, intermitting

or menorrhagic. This is very common, but not constant. 2. Leucorrhœa, of a mucous, purulent, or serous character; at times tinged with blood, and very offensive, owing to the discharge being retained in the vagina and decomposing there. 3. Bearing-down or expulsive pains. 4. Perhaps some distress in micturition or irritability of the bladder; and in some cases where the tumor has been very large, so as to compress the bladder and rectum against the walls of the pelvis, symptoms like those of retroversion of the gravid womb have been developed, as retention of urine, uræmia, and intense pelvic pain. Gangrene and sloughing of the vagina have even been known. 5. When hæmorrhage and leucorrhœa have continued some time, the phenomena of anæmia, blood-degradation, and impairment of digestion follow. The aspect may become sallow, the patient emaciated, and the discharges offensive. These, together with pain, constitute a series of symptoms that have often given rise to the conclusion that the disease was cancer. In the case of intra-uterine polypus, all the foregoing symptoms may be present; but in addition there will commonly be enlargement of the body of the uterus, and expulsive pains of a spasmodic character—uterine colic. Another not uncommon symptom is vomiting. This appears to be due to distension of the uterine fibre.

Physical exploration is essential in all cases to arrive at a safe conclusion. This is carried out by the hand, the uterine sound, and speculum.]

A polypus situated in the vagina, or protruding from it externally, is liable to be mistaken for a prolapsus uteri. The polypus is softer and less sensible than the uterus in the state of prolapsus. The imperfect prolapsus uteri, in which this viscus is not turned inside out, is betrayed by the *os tincæ*, which is plainly perceptible at its lower part. In this situation the polypus may have a depression resembling the mouth of the womb, but easy of discrimination from it. A probe can be passed deeply into the *os tincæ*; but not so into this other opening. The polypus resembles an inverted pear; that is, it is thickest below, and becomes gradually thinner upward. The above species of the prolapsus uteri is thinnest below, and gradually increases in width upward. The fallen uterus may easily be pressed back, and when it is so, the patient experiences relief. The polypus does not admit of being pressed back, and during an attempt to do this, the patient is put to much inconvenience. A probe may be introduced by the side of the polypus deeply to the fundus uteri. When passed by the side of the fallen uterus, it is very soon stopped at the upper part of the vagina, which has sunk down with the cervix of the uterus.

A polypus, protruding externally from the vagina, may be much more easily distinguished from a perfect prolapsus uteri, without inversion. The *os tincæ* at once characterises the uterus, as it can not only be felt, but seen. A probe may be passed deeply into the vagina, along the side of the polypus; but not so by the side of the uterus, for reasons easy of comprehension. The figure of the tumor, and the state of the patient, on an effort being made to reduce the protruded part, also betray its real nature.

With the exception of a few examples, in which an inversion of the uterus is caused by the descent of a large polypus into the vagina, it happens only

in women who have been recently delivered, and has generally been preceded by a very rapid delivery, or the use of too much violence in the extraction of the placenta. While the inverted uterus lies in the vagina its shape is broad above and narrow below; whereas the polypus is thin above and broad below. Hence, in cases of very large polypi in the vagina, the *os uteri* is but little dilated; while it is extremely distended by the incomplete descent of the inverted uterus itself. Here, likewise, the reduction of the part is attended with relief; while every effort to push back a polypus causes an aggravation of all the complaints.

When the inverted uterus hangs out of the vagina, its figure, like that of the polypus, is thin upward and broad downward; and, like the latter tumor, has no aperture at its lowest part. An attentive observer, however, will easily avoid a mistake. The inverted uterus includes a circular fold at its upper part, next to the orifice of the vagina. This fold is nothing less than the *os uteri* itself, through which the body of this viscus has descended. There is nothing of this kind to be felt in cases of polypi. By the side of a polypus the finger or probe may be passed deeply into the vagina; but not so by the side of the uterus. The root of the polypus is firm and hard to the touch; the upper thin part of the uterus, which is hollow, has a soft flabby feel.

[Many cases are notwithstanding recorded in which the inverted uterus has been ligatured in mistake for polypus. See Denman, Gooch (pp. 131. 137), Wm. Hunter.

The intra-uterine polypus may, under certain favourable circumstances, be felt or seen; for example, at the menstrual periods, under the combined influences of increased turgescence of the uterus, in which the polypus shares, and of uterine contraction, the *os* opens a little, the polypus is forced down upon it, and even a little through it. Examination at this time will enable the finger to feel a ball resting on the ring of the *os uteri*, and through the speculum it may be seen. The colour is usually pale pink. After the menstrual epoch, the *os* closes, and the tumor recedes out of touch and sight. Repeated hæmorrhages, uterine colics, and enlarged uterus, should, however, lead to further exploration. The sound will gauge the length of the cavity, and perhaps reveal the presence of a globular movable body inside. Or the cervix may be dilated by inserting in it sponge-tents, or the laminaria tent, or by incisions. In this way room may be easily made to admit the finger, either with or without passing the hand into the vagina. Ergot or galvanism has occasionally so far aided the contractions of the uterus as to drive the polypus down within reach.

Polypi in which the fibrous element predominates occasionally grow from the walls of the vagina. They are not so apt to cause hæmorrhage as are the uterine; but sometimes occasion distress by their bulk and pressure upon the pelvic organs.

2. Another form of polypus is the *villous*. It appears to be simply the result of hypertrophy, or projection of the cervical mucous membrane. All the elements of mucous membrane are found in it. It occurs as the result of the partial eversion of the cervix attending congestion and prolapsus. It is very common in senile prolapsus or hypertrophic elongation of the cervix uteri.



3. The *glandular* or *mucous* polypus generally grows from the os uteri, varying in size from a filbert to a walnut. It is smooth and vascular, and contains in some instances a curdy matter, or yellowish viscid fluid. Herbiniaux describes this form. It is not uncommon.

4. The *vascular* polypus takes its rise from a dilatation or varicosity of the vessels running under the mucous membrane. All these three forms are found in the cervix or os uteri. Among conditions simulating polypus may be mentioned a mushroom-like hypertrophy of the os uteri. It is referred to by Dance, Bérard, Cruveilhier, Mayer, Meissner, Malgaigne, and Montgomery. Malignant growths of the os also often resemble polypus by their form.

In addition to the above recognised forms, Rokitsansky, Kiwisch, Scanzoni, and C. Braun have described other varieties. C. Braun (1851) describes the "*placental polypus*." This results from the remains of the placenta, consisting of hypertrophied decidua, which projecting into the uterine cavity form a polypoid mass. Braun relates five cases in which violent hæmorrhage broke out some time after delivery. Polypi of the kind described were found. In four cases they were extracted with the finger; in one the polypus separated spontaneously. The *fongosités intra-utérines* of Nonat, according to Stadtfeld, of Copenhagen (*Dubl. Q. Journ. of Med.* 1863), are placental remains. Such a case was sent to the writer by Dr. Woodman. Arthur Farre (Todd's *Cyclop. of Anat.*) says he has satisfied himself of the correctness of Heschl's opinion, which agrees with the above, upon the formation of the placental polypus. Malgaigne describes "*moliform polypi*," containing hair. Rokitsansky and Kiwisch describe "*fibrinous polypi*." Kiwisch says when menstruation has been retarded six weeks, fibrinous polypi may arise from long persistent hæmorrhage, a large coagulum forming, the upper part consisting mostly of fibrine, and adhering by a stalk to the uterine wall, whilst the lower part consists of red soft coagulum having a coat of firm fibrine. These polypi always occasion profuse menorrhagia. Scanzoni and Rokitsansky, however, do not admit this view. They say these are cases of abortion. An ovum, after fixing itself in the mucous membrane of the uterus, and after being quite clothed with a decidua reflexa, is soon driven down by uterine contraction into the cervical canal, its attachment lengthening into a stalk by the stretching and growth of the tissues. The embryo escapes, whilst a portion of the membranes or stalk remains, and by accretions of fibrin-coagula forms the basis of fibrinous polypus.

The source of the bleeding has been the occasion of much controversy. Mr. Langstaff (*Med. Chir. Trans.* vol. xvii. p. 63) described a case in which the polypus coming through the os uteri had its mucous surface destroyed by the ulcerative process, and as this part was covered with coagulated blood, Mr. Langstaff inferred that the hæmorrhage proceeded chiefly from the tumor, and not from the inner surface of the uterus. Dr. R. Lee refers to a specimen (*Med. Chir. Trans.* vol. xix.) in which the tumor contained a coagulum of blood in a considerable cavity. Gooch says (*Most important Diseases peculiar to Women*, 1829, or *New Sydenham Society's Edition*, p. 130.): "When a tumor supplied with vessels, and consequently

capable of bleeding, grows from an organ so subject to bleed as the uterus, it is difficult to demonstrate whether the hæmorrhage arises from the tumor or from the uterus. The strong reason for attributing the hæmorrhages to the tumor, is this. As soon as a ligature is applied and tightened round the stalk, the hæmorrhage from that time ceases, although it may be several days before the tumor comes away." Lisfranc took the same view. And it derives strength from the fact that if the tumor be seen whilst the ligature is being tightened, the surface becomes turgid with blood, some of which oozes freely. On the other hand, the writer points out (*On Uterine Polypus*, 1854) "that profuse hæmorrhage attends very small polypi as well as those of large size. Again, the hæmorrhage mostly assumes the form of profuse menstruation. Hæmorrhagic menstruation is a common consequence upon inflammation, hypertrophy, tumors, and other conditions of the womb which set up a preternatural action. The presence of a polypus seems to act in a precisely similar manner. It therefore seems difficult to avoid the conclusion, that the excess of the ordinary menstrual discharge, occurring when a polypus is present, flows, like the normal proportion, from the womb. When the polypus is very large, almost the entire mucous membrane of the uterus may be protruded before it; that is, there is no mucous membrane but that investing the tumor. In such a case it may in one sense be said truly that the hæmorrhage comes from the surface of the tumor. But this situation of the mucous membrane is accidental. It is surely more correct to say, even in such a case, that the true source of the hæmorrhage is the mucous membrane."

The reason why the hæmorrhage ceases when the polypus is removed or strangled by a ligature, is this: the source of morbid developmental activity being cut off, the stimulus to the attraction of an excessive proportion of blood to the uterus is removed; the balance of the uterine circulation is restored; accidental floodings cease, and the discharge at the menstrual periods falls to the usual amount corresponding to the physiological ovarian stimulus.

As to the consequences of polypi, much variety is observed. Velpeau (*Journ. de Méd. et de Chir. Prat.* 1859) says they are sometimes harmless, and that the consequences are not in relation with their volume. Some disappear spontaneously. But commonly repeated hæmorrhages induce such a degree of anæmia that even death follows, if the tumor be not removed. And this danger is greatly increased if pregnancy supervene. (See fatal cases in Gooch, p. 145.) Dr. Cockle relates (*Med. Times and Gaz.* 1863) a case of a large pedunculated fibrous polypus attached near the fundus uteri, distending the uterus and vagina, and giving rise to frequent bleedings and offensive discharges. The patient died after symptoms of peritonitis from perforation. The ovarian extremity of the right Fallopian tube was found distended by the discharge, some of which had escaped into the abdominal cavity. Many patients have died exhausted by bleeding caused by an intra-uterine polypus not suspected during life.

A point of great importance in the constitution of polypi, is noticed by R. Ferguson (*Introduction to New Sydenham Soc., Ed. of Gooch*), which is,

"that injury to their structure is rapidly followed by a form of decay, like that which is seen in vegetable matter. Nevertheless," he continues, "inflammation ending in suppuration has been known to take place in the very heart of these growths. Their centres are also the occasional seats of softening, of effusion of blood, and of cysts."

The treatment is generally successful, and constitutes one of the most satisfactory applications of surgical skill. The principal modes of operating resolve themselves into excision or strangulation by ligature.]

Dupuytren removed about two hundred uterine polypi by excision. In all these cases, hæmorrhage only occurred twice, and in both instances it was permanently arrested by plugging up the vagina.

When a polypus, with a pedicle attached to the fundus uteri, suddenly falls downward, it occasions a sudden inversion of this viscus. In order to relieve, as speedily as possible, the great pain and danger of this case, the surgeon must tie the root of the polypus as soon and as early as he can, and pass the ligature, by means of a needle, through the pedicle, before the place where it is tied, allowing the ends afterwards to hang down for some length. Then the polypus is to be amputated below the ligature, and the uterus immediately reduced.

Siebold and Mayer, of Berlin, only approve of the ligature in two cases: 1st, when an artery can be felt pulsating in the neck of the polypus; 2ndly, when the neck of the tumor is so thick that it probably contains large vessels. In all other examples, they prefer excision, on the ground of the difficulty of applying a ligature, and because, when applied, the symptoms are apt to be more severe, and the annoyance greater, than after excision. They operate with round-pointed scissors, curved like a Roman S both in the blades and handles, and from 9 to 10½ French inches in length. The division of the neck of the tumor is to be effected not all at once, but by repeated strokes of the instrument. In Mayer's work, six cases are related, in which polypi of the uterus were thus successfully removed by Siebold and himself.

[Sir Charles Locock advocated excision. Sir James Simpson uses a polypotome, which consists of a knife strongly curved like a reaping-hook, or the obstetric decapitating hook of Ramsbotham, surmounting a long stem. Dr. Aveling contrived (*Obstetr. Trans. and Catalogue of Obstetr. Instruments*, 1866) a hook grooved on the concave side to encircle the stalk, and a sliding knife which is pushed up to the groove by a screw, of course dividing the stalk in its progress. The ligature was for a long time applied so as to effect strangulation and slow detachment by sloughing.]

Levret contrived an instrument consisting of two silver canulæ, curved, and so united by a joint that they are shaped like a pair of forceps. A ligature is passed through the tubes, the noose is applied round the root of the polypus, and the ends are then drawn tight, and tightened daily until the tumor drops. Another instrument is described by Nissen, *De Polypis Uteri*. (See Richter's *Chir. Bibl.* b. ix., s. 613.) It consists of two silver tubes curved, carrying a ligature. The tubes are brought together by a third double canula, and then the ends of the ligature are tightened. Gooch's well-known instrument is a modification of Nissen's, the tubes being made straight.

[At the present time the wire-rope écraseur is generally preferred. It combines the advantages of excision with those of the ligature. In fact, the wire is made to cut or crush through the pedicle at once. The original of these instruments is Professor Graefe's apparatus, specimens of which are found in the armamentaria of most of the London hospitals. Simpson describes (*Edinb. Med. Journ.* 1850) an instrument given him by Dr. Sabine, of New York, by which a silver wire was made to cut through the pedicle by a screw. Chassaignac's chain-écraseur has been used, but it is not so convenient as the wire instruments. The rope has been made of strands of several fine iron or copper wires; but of late it has been found that a stout single iron wire made flexible answers better. A loop is drawn through the eye of the stem, and, by aid of the stem, and two or three fingers in the vagina, the pedicle is caught. The noose is then tightened by the travelling screw or windlass, until it comes back through the eye, when the pedicle is found to be divided. The tumor is felt rolling loose in the vagina, and may be seized and drawn out by a pair of Museux's hook-forceps. If the tumor be very large, the extraction from the vagina may be a work of some difficulty. It has been found necessary to grasp it with the midwifery forceps, and deliver it like a child's head. In noosing the pedicle it is not necessary to carry the noose beyond the tumor or up to the insertion of the root in the uterine wall. It is enough to get the noose beyond the equator of the tumor, when on drawing in the slack of the wire before tightening by the screw or windlass the noose will adjust itself at the junction of the tumor with its root. The stump decays, breaks up, and there is no probability of another tumor springing from it. Generally, when a polypus is removed, the cure is permanent. But of course a second uterine-fibroid may be converted into a polypus like the first. Should bleeding occur, it may be staunching by perchloride of iron carried on lint, and maintained by plugging. Intra-uterine polypi may be noosed and excised in like manner. If necessary the cervix uteri can be expanded beforehand by the laminaria tent, or by incision.

The advantages of the instant removal over slow strangulation of the polypus are, the speedy relief, and the infinitely less risk of systemic infection or peritonitis. When the tumor is strangled and left to slough away, most offensive discharges arise, which may produce irritative fever and even death by absorption. Abernethy says in his Lectures that he has opened the bodies of several women who have died from the ligature of the polypus of the uterus. In St. Bartholomew's Hospital museum there is a preparation showing the uterus laid open with a polypus inside, the ligature encircling the neck as applied before death. In many instances death has followed the removal of the tumor by Gooch's instrument. Dr. R. Lee records nine deaths out of fifty-nine operations, and Dr. McClintock three out of ten. A similar fatality has not attended immediate removal by the wire-rope, or even by the knife or scissors. The danger is somewhat lessened by cutting off the tumor below the ligature, leaving the root to slough away. Injections are useful to deodorise the discharges. The best are of lead, perchloride of iron, kreosote, or permanganate of potash.

The smaller polypi on the neck of the uterus



may often be removed by torsion or the scissors. The after-treatment consists in rest, generous diet, and tonics. If there is bleeding, a pledget of lint steeped in perchloride of iron can be applied to the seat of the stump through a speculum. The ulcerations caused in the mucous membrane of the cervix and vagina by the chafing of the tumor will often heal now the cause is removed. If not, occasional touching with nitrate of silver will be required. Gooch very properly insists that we should not be deterred from dealing with polypoid tumors under the doubt that they may be malignant. If cancerous growths assume the common mushroom form, admitting of being embraced by a ligature, even in part, he has found it good practice to remove them. The hæmorrhages are checked, and at least a respite is gained. The accuracy of this has been lately confirmed by many practitioners.

It is a practical question of great moment at what time a polypus complicating pregnancy should be removed. If discovered during pregnancy, and of such form and position as to be likely to obstruct labour, it should be removed at once. There is danger lest the tumor be crushed or bruised during labour, and lead to injurious dragging of the parts to which it is attached. If discovered during labour, the same rule will apply; but sometimes the polypus has been locked up in the uterus behind the child, and is only detected when the child is born. In one case (Bach) the placenta was found to grow on the tumor. Any foreign body in the uterus must prevent perfect contraction and involution; it will thus keep up an undue attraction of blood to the organ. A polypus is a source of serious danger by causing immediate and recurrent floodings. The case of Mr. Crisp is full of warning. The danger of leaving a polypus in the womb is probably greater than that of removing it at once. And removal can be effected with unusual facility when labour has expanded the uterus and vagina. The wire-rope should be preferred.]

Robert Barnes.

*Levret, Sur les Polypes, 1749. Herbiniaux, Sur les Polypes de la Matrice, Bruxelles, 1794. Malgaigne, Des Polypes Uterins, 1832. [Simpson, The Detection and Treatment of Intra-uterine Polypi, Ed. Med. Journ. 1850. Gensoul, Lyon, 1851. Dr. Barnes, On Uterine Polypus, 1854. Dr. West, Diseases of Women, 1856. Arthur Farre, Todd's Cyclopædia of Anat. Dr. McClintock, Clin. Memoirs on Diseases of Women, 1863. Marion Sims, Clinical Notes on Uterine Surgery, 1866. Other references will be seen in the text of the article.]*

**PORRIGO, TINEA CAPITIS, Scalded head, &c.** A disease of the scalp. (See SKIN, diseases of.)

**POTASSA CUM CALCE.** A powerful caustic, used for making issues, and for the destruction of fungous growths, the hard callous edges of certain ulcers, &c. It is also sometimes used, though not so often as it was formerly, for opening buboes and other abscesses. Some are in the habit of making it into a paste with soft soap; they cover the part affected with adhesive plaster, in which there is a hole of the size of the eschar intended to be made; and into this aperture they press the paste till it touches the skin. A pledget and bandage are then applied to secure the caustic substance in its situation, till the intended effect is produced.

Potassa cum calce is made by mixing equal

parts of caustic potash with lime. It should be kept in a well-stoppered vessel, and when used should be made into a paste with rectified spirit. The caustic called Vienna paste is composed of five parts of potash to six parts of lime.

**POTASSA FUSA.** *Caustic Potash.* Besides being employed in the same cases as the potassa cum calce, it was recommended to be used in a particular manner by Mr. Whateley, for the cure of strictures in the urethra. It is also prescribed for internal use in the form of liquor potassæ in cases of stone, gonorrhœa, scrofula, and various diseases in which an alkaline treatment is indicated.

**POTASSII SULPHURETUM.** *Sulphuret of Potassium, Liver of Sulphur.* Two drams, dissolved in a pint of lime or distilled water, make an excellent lotion for the cure of porrigo. Many other cutaneous affections yield also to the same remedy. It is often employed in the form of a bath, ℥ij. to ℥iv. being dissolved in about 30 gallons of water for this purpose. Sulphurated baths are specially useful in scabies.

**PREGNANCY** is set down by some writers as preventive of the union of broken bones; but many exceptions to the remark present themselves in practice: I attended a female, six months gone with child, who broke both bones of her leg, yet they grew together again in the usual time. (See FRACTURES.) Pregnant women frequently bear operations much better than might be expected. Thus M. Nicod has recorded an instance of successful amputation of the left leg during pregnancy, in a case where the right tendo Achillis was also ruptured. Both the wound and the broken tendon united very well. (See *Annuaire Méd. Chir. des Hôpitaux de Paris*, p. 509, 4to. Paris, 1819.) However, though a severe accidental injury may justify an operation in pregnancy, I consider the removal of a diseased joint, breast, or other important part, quite unjustifiable in this state of the constitution.

[The surgical relations of pregnancy that call for special attention are: 1. The *diagnosis of pregnancy*, which it is necessary to be able to establish in order to avoid performing any operation upon the gravid womb under the belief that some abnormal growth or effusion is present, and in order to determine whether or not pregnancy is complicated with any abnormal growth or effusion. 2. The *modifications wrought in the system by pregnancy, and the influence of this state upon the course of surgical diseases, and upon repair after operations.*

It would be out of place to describe minutely the signs of normal uncomplicated pregnancy. It is very true that the gravid womb has been tapped in mistake for dropsy. It may be thought culpable to fall into such an error. But to overlook the existence of pregnancy under certain abnormal conditions, and especially when it is complicated with effusion into the peritoneum, as in ascites, or with pelvic or abdominal tumors, as in cystic disease of the ovary, is an error to avoid which demands the greatest skill and circumspection. And these are the cases in which pregnancy presents its most frequent relations to surgical practice.

In making out the diagnosis of pregnancy, no reliance should be placed upon historical evidence, the belief of the patient herself, or upon the general or subjective symptoms. The surgeon can only proceed safely by acting upon the evidence revealed

to him by direct physical exploration. A brief description of the objective signs of pregnancy is therefore all that need be given here. For the first three months the signs are so indistinct that very few men experienced in these investigations would venture to give a decided opinion either in the negative or affirmative. There are, however, appearances which sometimes raise to a high degree of probability the presumption of pregnancy. These are: 1st, the presence of a deep-blue or violet injection of the whole vaginal portion of the uterus and vagina, extending to the vulva. In connection with this may be also frequently noticed a peculiar brain-like corrugation of the vaginal mucous membrane. This, Jacquemin's test, will acquire increased value if the vaginal portion of the uterus be softened, pulpy to the touch; if the bulk and weight of the uterus be found increased; if the breasts have become fuller, their areolæ dark, the glandular follicles enlarged. One sign alone will not inspire confidence, but the accumulation of several will rarely depend upon any other cause than pregnancy. It will, nevertheless, be generally discreet to postpone a positive opinion, and postpone, when possible, the decision as to surgical action, until the more marked and absolute signs of pregnancy shall be developed. At the end of four months, sometimes earlier, the uterine or placental souffle may commonly be heard. When heard, its evidence is almost conclusive. A souffle is, indeed, heard occasionally in some cases of ovarian tumors or of fibroid growth in the uterus; but as in these cases the abnormal growths will almost certainly manifest their presence by other signs, the possibility that the souffle is dependent upon other causes than pregnancy may be practically disregarded. After the fifteenth week we may expect to hear the foetal heart. If a heart-beat or pulsation be heard or felt by the stethoscope applied to the hypogastrium, at the same time that the finger upon the radial artery keeps watch upon the woman's pulse, and the two beats are found to be not synchronous, the case is free from all ambiguity. But not to hear the foetal heart does not warrant the conclusion that there is no foetus. Even if the foetus be alive, its heart is not always heard. In very stout women it is sometimes impossible to obtain clear results from auscultatory, or any other mode of examination. Failure, then, to obtain positive evidence cannot justify an unqualified negative opinion. Another sign often available after the fifteenth week is *ballotement*. If on tapping gently with the finger on the lower segment of the uterus, a sense of a body falling down upon it, as if floating in liquid, be present, we have again almost absolute evidence, and may depend upon it, even when auscultation tells nothing. Less confidence can be placed upon the evidence drawn from the inspection of the abdomen, and the changes of form and size of the abdominal enlargement presumed to arise from the growth of the uterus. The uterus may grow out of the pelvis, and rise into the abdominal cavity under the influence of a fibroid tumor in its walls, and this so gradually and so uniformly as to simulate pregnancy. Indeed a uterus so enlarged has several times been mistaken for ovarian disease, and I have myself seen a surgeon lay open an abdomen under this error, and then remove a large portion of the uterus by the knife. In early pregnancy the uterus sinks by its weight a little lower in the

pelvis, compressing and irritating the bladder. But between three and four months, the fundus, growing, rises out of the pelvis. The lumbar vertebræ being connected with the sacrum at an angle, the rising uterus is directed forwards towards the umbilicus, and the os uteri is found high up inclined backwards near the promontory of the sacrum. Generally, the uterus at five months and afterwards holds a slight lateral obliquity, the fundus being directed to the right. Space is gained for the growing uterus, mainly by the stretching of the abdominal walls, so that there is rarely any injurious pressure upon the great vessels, intestines, liver, or stomach, and the action of the diaphragm is not materially impeded. At the end of pregnancy, the whole of the fore part of the abdomen is occupied by the uterus, which lies immediately behind the anterior wall of the abdomen.

This position of the uterus, and the mode in which the organ grows from below upwards and forwards, furnish the best means of distinguishing pregnancy from ovarian cystic tumors and ascites. In pregnancy the intestines are pushed backwards and upwards almost equally on both sides. Percussion therefore will yield a dull sound in front from the pelvis upwards to the level of the fundus, and a clear sound in the loins between the crests of the ilia and the false ribs on *either side*. In the case of ovarian cystic tumors, there is this difference; the tumor begins on one side, and enlarging, not upwards only, but in its equatorial and lower zones also, spreads across from the site of origin, pushing the intestines over to the opposite side. Percussion will yield dull sound in front according to the extent of the tumors, and there will also be dulness in the side and behind, between the crest of the ilium and the false ribs of the side where the tumor began, whilst on the opposite side, where the intestines are driven to, there will be clear resonance. In the case of ascites, the fluid does not, except in some cases of plastic effusions and adhesions, force the intestines backwards or to one side. They tend to float forwards when the patient lies supine. Resonance, therefore, is found in front. Ovarian dropsy, again, has in addition its peculiar characters, as fluctuation, if one cyst be largely developed and holds much fluid; but sometimes ovarian tumors are solid and irregular in form; hard portions may project in such a manner as to simulate the sensation conveyed by foetal limbs, and this so closely that very skilled practitioners have been deceived. In the case of the pregnant uterus containing a living child, the movements of the foetus may often be felt, and, more certain still, one may feel the peristaltic movements of the uterus itself by extending the hands over its surface. But however clear may be the means of distinguishing between pregnancy, ovarian tumor, and ascites, when each exists alone, it is very different when pregnancy is complicated with ovarian tumor, or ovarian tumor with ascites. The signs may enable us to make out readily the presence of one element; the pregnancy, or the ovarian tumor, or the ascites, but the other may be so masked that it may be easily overlooked. Abnormal forms of pregnancy also are apt to lead astray. For information on this point reference is made to the articles *CÆSARIAN SECTION* and *OVARIOTOMY*.

It must not be hastily concluded, because an abdominal tumor has existed for more than nine months, that it is not due to pregnancy. It may



be a case of "missed labour," of which instances have been recorded by Dr. Oldham (*Pathological Transactions*, 1846) and Dr. McClintock (*Dublin Quarterly Journal of Medicine*, 1864). The fœtus may have perished, and be retained in utero; or the pregnancy may be extra-uterine, and there is no limit, except the duration of the woman's life, to the time during which she may carry an extra-uterine fœtus.

In order to appreciate rightly the relations of the state of pregnancy to the course of a surgical disease, and to the process of repair after accidental injury or surgical operations, some account must be given of the changes wrought in the blood by pregnancy and the puerperal state. Baillie and others looked on pregnancy as "a state analogous to inflammation;" the decidua he likens to false membrane, and the liquor amnii to serous effusion. This is no doubt an extreme view. Andral and Gavarret found that from the first to the sixth month the fibrin of the blood was below the physiological mean, and during the last three months above the mean; whilst throughout there was a diminution of globules. Becquerel and Rodier say the water, the fibrin, and the phosphorized fat are increased, whilst the globules and albumen are diminished.

Probably if organic chemistry were more advanced there would be also found various excrementitious matters. The general condition of the blood is most nearly that of hydræmia. A bruit de souffle is frequently heard in the heart of pregnant women. Some diseases of the circulation and respiration resulting from pregnancy have been elaborately described by Dr. de Cristoforis (*Annali Universali di Medicina, Milano*, 1863). He traces most of them to pressure. The gravid uterus, he says, presses upon the abdominal aorta and vena cava, causes an obstacle at the point of pressure, and hence there is accumulation of the arterial blood in the upper parts of the body. This produces a mechanical *superior arterial hyperæmia*, and the retarded blood in the lower limbs leads to *inferior venous œdema*. This mechanical difficulty, and, perhaps, in a still greater degree, the augmented physiological work thrown upon the circulating mass by the call to subserve the functions of nutrition and purification of two organisms, give rise to some degree of hypertrophy of the heart, a condition quite analogous to the muscular growth of the uterus, and like it subsiding after pregnancy. Thus it is observed that the pulse in pregnancy is accelerated. This state has been well described by Larcher (*Archives Générales de Médecine*, 1859), by Natalis, Guillot, and others. Now it is easy to believe that a heart thus acting at high pressure upon blood thus materially modified, may exert an important influence on the progress of tumors and the process of repair after extensive wounds. And in certain cases, the blood-changes are so exaggerated that the kidney or liver are quite overpowered, and albuminuria or jaundice follows. But the changes following upon delivery are often more striking still. Gassner (*Monatsschrift für Geburtskunde*, 1862) has shown that by the act of delivery a woman loses one-tenth part of her body-weight. This is probably a larger proportion than is lost by the patient who undergoes amputation at the thigh. And a further change goes on for two or three weeks after this sudden separation.

The superfluous tissue of the uterus is removed with marvellous rapidity. All this tissue is first converted into fat, then absorbed into the circulation, to be got rid of by the secreting and excreting organs. Unless these organs act energetically, the blood certainly undergoes deterioration. Indeed the excreting organs are so severely taxed in childbed that it must be very hazardous to throw upon them or the degraded blood the further task which the process of suppuration or repair attending an operation involves. The special condition of the breast deserves particular attention. The stimulus of secretion now draws a large afflux of blood to the organ; its tissues are increased in bulk, and not seldom the increased turgor runs into inflammation and abscess. It would be wise to postpone any operation upon the breast for at least three weeks if possible, and the question of weaning and arresting the secretion of milk altogether must first be seriously considered.

In many women, indeed, a condition of anæmia is induced or aggravated by lactation, which partly impairs the nutritive property of the blood, and predisposes to slow phlegmasia and suppuration. This is especially seen in the frequency of inflammations of the breast, of the cellular tissue of the pelvis, of the peritoneum, and of sub-acute metritis. The condition then of the system after delivery is not favourable to the success of surgical operations.

The influence of pregnancy upon various diseases may be supposed to throw some light upon the question under discussion. It has been affirmed that pregnancy retards the progress of some diseases, notably of phthisis. I much doubt whether this opinion is the result of accurate observation. It is not intelligible how blood which has lost somewhat of its purity, which is certainly poorer, and whose nutritious property is taxed to the utmost to supply the uterus and fœtus, can be fitted to suspend or to cure tubercular deposition. Apart from *à priori* reasoning, trusting to clinical observations alone, I am convinced that phthisis is actually accelerated by pregnancy. The same is true of heart disease, and of lung diseases generally. Cancer, certainly, if affecting the breast or cervix uteri, proceeds unchecked, if not stimulated to increased activity. Fibroid growths in the uterine walls, and polypi projecting into the uterine cavity, grow at an accelerated rate. Of course morbid processes falling within the immediate sphere of the developmental *nisus*, so active in the generative organs during pregnancy, may be expected to partake of that local activity. But since it is generally true that morbid growths and morbid processes flourish most in systems fed by impoverished and degraded blood, it is reasonable to anticipate that pregnancy will act prejudicially. Experience will probably show that pregnancy exasperates most or all morbid processes, whether they be contiguous to, or remote from, the uterus. The influence of pregnancy in exacerbating local or general diseases is also illustrated by the frequency with which abortion and premature labour ensue under these complications.

Dubois says gestation may become the cause of numerous pathological conditions; it aggravates most of those which arise during its existence, and it preserves from none.

One objection to the performance of severe surgical operations during pregnancy applies es-

pecially to operations upon the pelvic structures. It rests upon the great size of the blood-vessels and upon the great afflux of blood drawn to the generative organs under the stimulus of the developmental force of the ovum. The vessels of the uterus, vagina, and vulva are enormously increased in volume; they freely inosculate by large branches; the intermediate channels connecting arteries and veins are not so much capillaries, as is the case elsewhere, as large plexuses, in some cases associated with erectile organs, and these plexuses are connected with each other, and thus with the whole system of pelvic arteries and veins. Sometimes also the veins of the vagina and vulva become varicose. To wound a vessel in one part is, in effect, to tap the whole vascular system of the pelvis. The risk of profuse hæmorrhage and the difficulty of controlling it are therefore unusually great. Independently of this danger, however, it does not appear that any peculiar risk attends operations upon the pelvic structures owing to connexion with, or proximity to, the gravid uterus. A young woman several months pregnant was under Mr. Curling at the London Hospital, having an enormous growth of syphilitic condylomata around the vulva. The writer did not hesitate to recommend abscision, one reason that weighed being the obstacle the diseased mass would create to delivery, and the risk of inflammation and sloughing from the bruising and tearing almost certain to occur during the passage of the child. The hæmorrhage was controlled without much difficulty, and the pregnancy was undisturbed.

The inference, then, from all the above considerations, is that the period of pregnancy, of childbirth, and of lactation is one that the surgeon should avoid, if he can select a time for the performance of a severe operation. But this inference cannot justify an absolute prohibition.

The principle which should guide the surgeon when considering the propriety of performing a serious operation upon a pregnant woman appears to be this: If the surgical complication is in its nature progressive, and causing injury to the constitution, so that grave results may be expected to arise before the expiration of the term of pregnancy, it is wise to disregard the pregnancy and to be governed simply by the urgency of the particular case, as seen from a strictly surgical point of view. Reflection will indeed show that instant action may be the most promising course to adopt in the interest of the unborn child, which is bound up with that of the expectant mother.

Many examples might be added to that of M. Nicod to prove that pregnant women may bear severe injuries and operations. Mr. Napper, of Cranley, records a case of a woman seven months gone in her first pregnancy, whose arm he amputated on account of scrofulous disease of the elbow. The stump healed well, and she was delivered at term of a living child. (See *Obstetrical Transactions* for 1865, vol. vii.)

The matter may be thus stated in general terms: The healthy ovum adheres to the healthy uterus with wonderful tenacity. The ovum, the nidus, and the woman's constitution being sound, there is no kind or degree of severity of injury, from which recovery is possible, too great to be borne by a pregnant woman, without inducing abortion

or materially retarding repair and recovery. This rule even holds in the case of a constitution impaired by a chronic disease. The case is, however, very different when the constitutional disease is acute or comes on suddenly; then, the blood-change being great, sudden abortion is very likely to happen.

Mere physical injury not complicated with severe mental shock or emotion does not appear to endanger the continuance of gestation. Emotion, however, independently of injury, by causing a sudden diversion of blood to the pelvic organs, and perhaps by disturbing the healthy equilibrium and distribution of nerve-force is very apt to cause abortion.

Now the influence of emotion is greatly removed by inducing anæsthesia before operating, so that the risk is almost reduced to that attending upon the physical injury.

An important motive for removing a surgical complication may be found in the circumstance that some morbid conditions admitting of removal by surgical operations are liable to be much aggravated immediately after labour, under the influence of that momentous change in the constitution of the blood which follows upon this great and sudden physiological revolution. Tumors or other growths again may incur the risk of serious bruising or other injury from violent pressure during labour, or this pressure, bearing first upon a tumor, may cause stretching or laceration of the healthy structures to which it may be attached; or lastly a tumor may be of such a nature and so situated as to offer complete obstruction to delivery, and thus lead to rupture of the womb. In anyone of these cases, therefore, it will be prudent to operate as early in pregnancy as possible, provided operation can ensure the removal of the imperiling complication. This rule will especially apply to some tumors about the vulva, to fibroid polypi in the vagina, and to cancerous growths limited to the vaginal portion of the cervix uteri.

A most important question arises in some cases: Is it better to deal at once surgically with the complicating disease, or to reduce the case first of all to its simplest expression by terminating the pregnancy? Certainly it is sometimes more desirable to bring on premature labour than to defer an operation until after labour at term, or to operate during pregnancy. Is it possible to define these cases, or to lay down a general principle to guide in the choice of action? The cases in which this question arises are chiefly those of tumors in the pelvis or abdomen, and perhaps the most frequent one is that of ovarian cystic tumor. Supposing that pregnancy co-exist with such a tumor, and that the abdominal distension have become so great that relief must be given, shall the surgeon, or the obstetric practitioner intervene? It is clear that we may either tap the cyst or empty the uterus. I presume that the major operation of ovariectomy would not be contemplated. The observation of a considerable number of cases of severe constitutional or organic disease complicating pregnancy, and of ovarian tumors progressing simultaneously with pregnancy, has led me to the general conclusion that it is better to bring the pregnancy to an end in the first instance, and then to deal with the simple disease according to its particular indications. This conclusion is the result of three different orders of observations, all converging to the



same point: 1st. In a large proportion of cases nature solves the problem, takes the case into her own hands, and finds relief by the spontaneous induction of premature labour; 2nd. In another series of cases where labour has been induced artificially, immediate relief and safety have been obtained; 3rd. In another series of cases where labour has not occurred spontaneously or been induced by art, formidable catastrophes and even death have happened. Examples of all these issues have been observed in cases of ovarian dropsy complicating pregnancy. Nature can rarely tolerate the simultaneous growth of two tumors in the abdomen such as a cystic ovary, and the gravid womb. The power of adaptation of the abdominal and thoracic organs and the extensible capacity of the abdominal walls are alike apt to fail under the enormous and rapid eccentric pressure caused by the double growth within. "Haud bene convenient, nec in unâ sede morantur." One or the other must give way. If the tumor do not so press upon the uterus as to cause it to expel its contents, the growing uterus will act upon the cyst; it may displace this by pushing it upwards, stretching the pedicle. In one patient, the wife of a surgeon, distress having become urgent, I advised induction of labour. This was not acceded to; a fortnight later, shock and collapse set in, giving rise to labour at seven months. Death followed speedily. Dissection showed extensive peritonitis with effusion of blood in the abdomen; the ovarian cyst had ruptured, and the pedicle was not only greatly elongated, but twisted twice upon its axis, strangulating the vessels. The tumor had of course been rolled over, as well as pushed up under the diaphragm by the uterus advancing from below. In such a case it might fairly be contended that relief would equally be attained by puncturing the cyst without interfering with the womb, and it may be freely admitted that under some circumstances this proceeding will be preferable. But the following considerations must satisfy us that it is generally safer to empty the uterus first: 1. The displacement of the tumor by the gravid womb, the difficulty of defining exactly the line of contact of the two and to what extent the tumor is solid or fluid, must render paracentesis a hazardous step. 2. If the cyst be tapped, it may be only partially emptied, and no sufficient relief is then obtained. 3. The cyst may fill again rapidly, and then the distress and the necessity for further proceedings return. 4. A great portion of the cyst may be solid, and then the tapping will have done no good. 5. To empty the uterus is an easy, certain, and safe operation. 6. The uterus emptied, and the case brought to its simplest condition, immediate relief is obtained, and time is gained to watch indications for further action. 7. Opportunity is given to institute accurate examination of the tumor. In addition to these reasons, there is the fact that where tapping of the cyst is practised first, abortion is very likely to follow. Aran relates a case in illustration (*Leçons cliniques sur les Maladies de l'Utérus*, 1858-1860.)

Robert Barnes.

**PROBANG.** A long slender piece of whalebone, with a bit of sponge at its extremity, intended for the examination of the œsophagus, or the removal of obstructions in it.

**PROSTATE GLAND, DISEASES OF.** [The

diseased conditions to which the prostate is liable will be treated in the following order:—**PROSTATITIS**, acute and chronic; **SUPPURATION** of the **PROSTATE**, **DIFFUSE**, and **ABSCESS**; **ULCERATION**; **HYPERTROPHY** of the **PROSTATE**; **SIMPLE TUMORS**; **ATROPHY**; **CANCER**, **TUBERCLE**, and **CALCULI** of the **PROSTATE**.

*Acute Prostatitis* is by no means a common affection, if regarded as distinct and unassociated with inflammation of the urethra or bladder. When the latter organ is inflamed, the prostate appears sometimes to suffer, although in a secondary manner and degree. Sometimes, however, the prostate is inflamed apparently as a purely idiopathic occurrence, and not from continuity of tissue with adjacent parts. This, excepting the cases produced by violence, as by instruments, &c., is extremely rare.

*Causes.*—The pre-existence of acute inflammation of the urethra of any kind, but especially the gonorrhœal. Urethral stricture, in an aggravated form, tending as it does to the production of inflammation and disorganisation of all the parts posterior to it, especially those more immediately adjacent, as the prostate and bladder. The direct application of irritating agents in the shape of strong injections, cauterization, and mechanical violence of various kinds. Inflammation and calculi of the bladder. The application of cold and damp to the perinæum, as by sitting for a long period on moist ground, perhaps most frequently in gouty and rheumatic subjects. Horse exercise is said to be a cause, by means of the concussion occasioned, but evidence is wanting to establish this. That it may aid in producing it when some inflammation of the urethra already exists, is quite possible. Alcoholic drinks may induce prostatic inflammation, gonorrhœa already existing, but only on this condition. Inordinate sexual intercourse, under the last-named circumstances, may also act in a similar way.

The symptoms are, at first, a sensation of weight and fulness about the rectum and perinæum, with pain and uneasiness referred to the neck of the bladder. The patient requires to pass water more frequently than natural, and does so with an increase of the existing pain, especially at the close of the act. Subsequently the pain becomes more severe; the act of relieving the bowels at stool produces considerable distress; the stream of urine becomes small, much straining accompanies it, and the pain is exquisitely acute. At a later stage, if suppuration has taken place, the rectal swelling is softer, local throbbing is experienced, and should a catheter be passed, the patient will complain of excessive pain when the instrument reaches the prostatic part of the urethra. General fever, in a greater or less degree, manifests itself, and rigors mark the onset of suppuration.

The treatment should be at first moderately antiphlogistic, alkalies and small doses of antimony should be given frequently, while the bowels are to be freely opened at the outset, and a gentle action upon them maintained afterwards. Bleeding by leeches, 10 or 15 in number, round the anus and on the perinæum, often affords greater relief than any other single agent. Afterwards a hot hip-bath should be taken, a large poultice or hot flannel placed on the perinæum, and the patient be wrapped up warmly in bed. If retention of urine is urgent and distressing, and is not relieved by

these means, the catheter must be used. The practical observations, respecting the mode of introducing them in cases of enlarged prostate gland, will be more conveniently introduced when the chronic enlargement of this part is considered. (See also CATHETER, and URINE, RETENTION OF.)

I prefer, however, a well curved gum catheter of moderate size to any other, as a rule in these circumstances.

In the course of a few days, the severe pain and the frequent micturition gradually subside, although relapse may occur if exercise be too freely taken, or at a too early period. Care and moderation in diet, with total abstinence from alcoholic stimulants, should be enjoined for a time, as means must now be taken, not merely to restore the health by nutritive and tonic regimen, but to reduce the bulk of the organ, enlarged as it is from the effect of the inflammatory process.

*Chronic prostatitis* is by no means an uncommon affection. It is obstinate in duration and often the occasion of very troublesome symptoms. Its most fertile cause is gonorrhœal inflammation, which has extended backwards and affected, more or less acutely, the prostate. Local cold and damp, occasionally mechanical injury, more frequently long-continued indulgence in venereal excesses of any kind, are also undoubtedly causes. That form which results from long standing and severe stricture of the urethra, or chronic cystitis, or calculus, either vesical or prostatic, is common enough, and needs no separate consideration; it is the mere result of existing adjacent disease, upon which it altogether depends.

The patient complains of a little undue frequency in making water, of some muco-purulent discharge from the urethra, of dull pains in the perinæum and about the anus, sometimes occasional sometimes persistent, but almost always increased by exercise; often of pains in the thighs and legs, or in the sacral region; sometimes increased, but not invariably, by sexual intercourse. There is usually no pain in micturition until the end of the act, when it is occasionally, but by no means always, felt, and then it is never very acute like that of calculus. There is sometimes tenderness in the perinæum, and in the prostate itself, to rectal examination, but there is not necessarily any enlargement. The patient has frequently little or no sexual desire, and may or may not be the subject of frequent involuntary seminal emissions during sleep. The health is mostly impaired and general debility is complained of.

In the condition thus described I find no treatment, for the milder cases, so serviceable as counter-irritation at the surface of the perinæum. But it is necessary to continue it for a period of four to six, or even sometimes of eight weeks, and if thus persevered in, benefit is almost certain to follow. It may be accomplished by rubbing a moistened stick of nitrate of silver on the skin in front of the anus, over the bulb of the urethra, or by blistering a portion of about  $1\frac{1}{2}$  inch long by 1 inch wide, with strong "acetum cantharidis," the soreness to be kept up by the daily application of a piece of blistering-paper, or by occasional reapplications of the fluid originally used.

At the same time the state of the digestion must be improved, the vigour of the system be promoted by tonics and generous diet, and exercise is to be

permitted and increased by degrees as soon as the power of taking it without inducing pain is acquired.

The digestive organs being in tolerable condition, the use of iron is almost always attended with benefit. The sulphate, combined with sulphate of quinine, and made into pills with some extract of rhubarb, and a little extract of nux vomica, is an advantageous form of tonic for these cases, in which it is desirable to maintain regular action of the bowels, impaired as it usually is by inability to take much exercise. A little of the watery extract of aloes can be combined, if it is necessary to employ more decided aperient action. The tincture of the sesquichloride of iron is also a very efficient remedy, provided the bowels are not permitted to become unduly constipated. I prefer these forms of iron to any other, including the recently introduced hypophosphites, for the great majority of patients suffering from this affection. When the predominant symptom is frequent nocturnal emission, and there is much pain felt in passing an instrument through the prostatic urethra, nothing acts so beneficially as the application of a solution of nitrate of silver, commencing with about five grains to the ounce of water and increasing it to twenty grains if necessary, by means of a perforated catheter containing a piston by which the fluid can be set free at the proper spot, and its action mainly limited to it, a matter which it is important to accomplish pretty accurately. In performing this operation, the following course should be pursued:—The bladder should first be emptied; and the opportunity of doing so should be employed to determine the exact length of the urethra, in the usual manner, while the urine is flowing. The instrument containing the caustic solution should then be passed immediately, the solution being discharged as soon as the perforated extremity has arrived within the prostatic urethra, the situation of which may be correctly inferred from the known length of the urethra, as well as by the undue sensibility which the part possesses. The immediate results usually are, repeated wants to pass water, which are painful and sometimes attended with slight bleeding; these subside in 24 hours, and possibly are succeeded by a little purulent discharge for a day or two. During the first few days it is not uncommon that the symptoms originally complained of increase, but afterwards they gradually diminish. Should this, however, not be the case, no fresh application of the caustic should be made until three or four weeks have elapsed since the previous one, as it is impossible to ascertain the effect in a shorter period of time. If necessary, it may then be again applied after three or four weeks, and in a stronger solution. A third or fourth application may be necessary. I have, however, rarely continued to employ it if not successful on the fourth occasion. Its success mainly depends on applying it freely and accurately to the prostatic urethra, and when this is ensured it generally proves a very valuable remedy.

When chronic prostatitis consists mainly in induration and swelling, remaining as the results of an acute attack, those internal remedies which appear to possess a specific power to promote absorption of the effused matters should be employed, such as the iodide and bromide of potassium. They may be administered internally, by applica-



tion to the perinæum, and also by hip-baths. (See Treatment of HYPERTROPHY of the PROSTATE.)

*Suppuration* may take place in the prostate, and almost always in the form of abscess. In the diffuse form it is very rare, except in extravasation of urine from any cause. Acute prostatitis, not ending in resolution, not infrequently goes on to the formation of abscess. The symptoms are severe; and its presence may be suspected if after the first few days the acute symptoms do not subside, if the pain and difficulty of micturition and defæcation increase, if rigors occur, and the patient is very restless and feverish, complaining of great tension, and of a pulsating sensation in the perinæum and at the neck of the bladder. The fact is determined, if by rectal examination, the swelling there increases, and communicates to the tip of the finger a sensation of softness and elasticity, in place of the firmness and resistance which were noted before. The natural course of abscess in the substance of the prostate is generally spontaneous evacuation by the urethra. I have seen it occur immediately after the passing of a catheter, when the patient's condition, in consequence of the tumefaction caused by its presence, has rendered instrumental assistance necessary in order to empty the bladder. Occasionally the matter is evacuated by the rectum; and the result is perhaps as favourable, generally speaking, as through the urethra. It may be followed by a troublesome urethro-rectal fistula, but not necessarily, or even usually so. On the other hand, although the opening of the prostatic abscess into the urethra may soon close, yet if this does not readily take place, the sac will probably long remain open, and become a receptacle for urine, giving rise to fresh collections of matter around, from the inflammation so produced. Extravasation rarely, if ever, has to be feared, the parts exposed to urine being defined and thickened by exudation matter. Nevertheless, in many cases evacuation by the last-named course, that is, by urethra, is that on which we must rely. The only treatment we can adopt in order to prevent it, matter being already formed, is to make an artificial opening in the perinæum as early as possible, with some boldness, in the median line, in the direction of the prostate, which is perfectly ascertainable by rectal examination. The forefinger of the left hand having been introduced into the bowel, a long, straight, and narrow bistoury, the cutting-edge of which is upwards, should be thrust into the raphe, about three-quarters of an inch anterior to the anus in the known direction of the swelling, and the incision enlarged in a straight line upwards, to a slight extent, so as to give a fair patulous opening for the discharge of matter. The depth to which such an incision must be carried cannot be less than an inch and a half, it may be two inches; less than the former will be probably useless, and if so, unnecessary and injurious.

The discharge of matter from an acute abscess of the prostate is sometimes followed by long-continued suppuration. Chronic abscess may arise also by itself, though not very frequently; and it may occur as the result of confirmed or neglected stricture of the urethra.

It is by no means always easy or even possible to diagnose the existence of a chronic abscess of the prostate during life; in some instances, however, it may be recognised by rectal examination.

A part of the prostate may yield a sensation of fluctuation to the finger in the rectum; and if this is obvious in a case where the history and symptoms have been such as to render the occurrence of chronic abscess there probable, it is advisable to take means for evacuating it. This may be done by passing a grooved sound into the bladder, and making an incision into the spot detected, a proceeding which is rendered easy by the support which the sound affords to the parts; a rectal speculum may be used or not as the surgeon prefers. It by no means necessarily follows that we are to open the urethra in these cases, although it has been frequently done without producing any mischief in the shape of resulting fistula.

*Ulceration.*—The urethral mucous membrane of the prostate suffers ulceration as a consequence of previously-existing lesions. Pure idiopathic ulceration is probably extremely rare. Thus, when an abscess opens into the urethra, ulceration takes place, and this generally remains for some time. A like condition exists in the discharge of tubercle, or in the sprouting of malignant growth. It may be occasioned by aggravated stricture, and also during urinary retention and extravasation. After all, there is nothing special in these forms of ulceration as affecting the prostate; it is a morbid action affecting alike its tissues and those of all other soft parts in the organism when their vitality is impaired by certain morbid conditions, local or general.

*Hypertrophy of the prostate.*—Among men who have passed the fifty-fifth year, or thereabout, the prostate frequently enlarges by a slow and gradual process, and mostly produces more or less obstruction to the discharge of urine from the bladder. This enlargement is not a product of inflammation, nor of any of its results, but is due to an increased formation of the normal tissues of the prostate, and must therefore be classed as an hypertrophy of that organ.

It was believed by Sir Everard Home and Sir B. Brodie, that this hypertrophy was the necessary accompaniment of old age. (*Lectures on the Urinary Organs*, 4 ed. pp. 163-166, 186-187.) But the writer has shown, by a large number of dissections, that this is by no means the case (*Med. Chir. Trans.* vol. xl.); that, on the contrary, only one in three of male subjects after 60 years of age exhibits by dissection some sign of enlargement; that one in eight only exhibit symptoms during life; and that many reach the most advanced ages without manifesting the slightest trace of hypertrophy.

The first external character generally observable in a hypertrophied prostate is undue fulness, and an unnatural tendency to rotundity. Either lateral lobe may predominate, or the median portion may be largely developed. The term "median portion" is preferred to that of "third lobe," employed by Sir E. Home, and will be used in future as signifying the part hitherto so termed in this country. It is the term employed in France, where, as well as by many anatomists here, the title of *lobe* as signifying a normal division of the healthy prostate is denied. For a full discussion of the grounds on which the title of third lobe is rejected, see *Medico Chirurgical Transactions*, vol. xl., also "Diseases of the Prostate," by H. Thompson, p. 18, *et seq.*

The outline of the gland is often very irregular

in form, which may result from two conditions—first, either lobe may protrude greatly beyond the others, as just alluded to; or, independent tumors may be found embedded in it, or partially so, springing from the surface, and forming very salient projections in any direction, most commonly, however, towards the cavity of the bladder. From the examination of between 200 and 300 specimens, I find that the lateral lobes and the median portion are about equally liable to be affected; and that while the posterior part of the gland is commonly, the anterior part is only rarely, enlarged. In any of these conditions, the urethra, as it passes through the prostate, may be diverted a little to the right or left of the middle line, by pressure from the most enlarged part; the prostatic portion may be increased in length (necessarily with the increased length of the prostate itself), and the antero-posterior diameter of the canal is often much increased by reason of the enlargement of the lateral lobes, so that it is more capacious than natural, although effectually obstructed by the lateral pressure. And the result is, in almost all cases (there are a few exceptions), that the contents of the bladder are more or less retained.

In consistence, there is usually some change; the hypertrophied prostate is most commonly more firm and dense to the touch than the healthy; and to this rule there are but few exceptions.

When a prostate weighs about 7 drachms, it must be regarded as an example of hypertrophy, the average weight of a healthy prostate being about  $4\frac{1}{2}$  drachms. The most commonly-occurring weight, when the complaint may be presumed to have existed some ten or twelve years, appears to be between 9 and 12 drachms, or more than double the natural size. Nevertheless, many cases exceed this limit considerably. The largest example of hypertrophy known is 9 or 10 ounces, or about 75 drachms. The size of such a mass, forming a preparation now in the Museum of University College, is nearly that of a cocoa-nut; but such an example is extremely rare. In these varied circumstances the form and condition of the internal meatus are much altered. When the median portion is predominant, it acquires a crescentic form, the convexity of which is directed upwards. When the right lobe considerably exceeds in size the left, the crescent has its convexity to the left side, and so on; when an outgrowth from the median portion projects much, or has a narrow peduncle, which is not very common, it appears to be forced against the neck of the bladder by the effort of micturition, and the obstruction is rendered still more complete; and even when such an outgrowth is extremely small, the effect may be almost complete obstruction. As a result of this obstruction, if unrelieved by art, the bladder becomes distended, its walls thickened, often sacculated; and its mucous lining is the subject of chronic inflammation. The ureters may become dilated, the pelvis of the kidney also, and the renal organs themselves seriously injured by the pressure upon them, and by the irritation which it sooner or later sets up.

As regards the minute elements of the hypertrophied prostate, we find none present but those existing in the healthy organ. They are only arranged in different forms and proportions. In some cases the fibrous stroma of the organ is largely in excess over the glandular structures;

sometimes this is arranged in isolated masses forming independent tumors. Sometimes the glandular structures, although this is much less common, are developed beyond the fibrous stroma, and then the organ is soft and succulent; in the former condition it is close and firm in texture. In all cases the gland follicles are dilated, often loaded with inspissated secretion, and contain the well-known prostatic concretions. (For a detailed account of this subject see "Diseases of the Prostate," before referred to, chap. v.)

It is remarkable that in the great majority of hypertrophied prostates, the isolated tumors above referred to are present. They are simple fibrous structures and have no relation to cancerous formations. They may be found in any part of the organ, but are perhaps more numerous in the lateral lobes, especially at their posterior extremities, than elsewhere. Occasionally they are embedded in an enlarged median portion. It often happens that the small multiple eminences so frequently seen at the neck of the bladder in the site of the uvula are due to these small tumors there, situated under the mucous membrane and a few submucous fibres, there being no enlargement of the median portion. When the swelling is large and single, it is more commonly hypertrophy or outgrowth of that part. Occasionally they are separated by an interval from the prostate itself. A space of half an inch has been seen to intervene between such a tumor and the adjacent gland; a narrow line of duct, with other vessels, and a little tissue alone connecting them. Their size ranges between a tenth of an inch and about five-eighths of an inch in diameter. Their density is rather greater than that of the prostatic tissue proper; they are firmer to the touch, and more compact.

Examined by the naked eye, or under the microscope with powers of different degrees, we can discover no structural peculiarities as compared with the prostate itself; they possess all the elementary tissues common to the normal prostate, and they possess no tissue not belonging to it.

Very rarely, indeed, a polypous growth has been found attached to the verumontanum. A specimen is in the museum of St. Thomas's Hospital; one is mentioned by Rokitsky; and another occurred in the writer's own practice. (*Path. Trans.*, vol. vii. p. 250.)

On the subject of the causes of chronic enlargement of the prostate gland, it appears that little certain is known, excepting that it is seldom or never met with under the age of fifty-five.

After a careful study of all the alleged causes of this complaint, and their name is legion, I am satisfied that we are ignorant of any direct cause. I am confident we have no ground for believing that syphilis, gonorrhoea, sexual excess, sexual continence, gout, rheumatism, sedentary habits, congestion of pelvic vessels, or stricture of the urethra, all of which have been regarded as causes, have any such relation to it. As Mr. S. Cooper wrote in the last edition of this work, "it seems to me better to confess that the etiology of this complaint is unknown." It may be remarked in conclusion, that there seems to be some analogy between the simple fibrous tumors of the prostate, and those of the uterus, which opens a field for speculation respecting their origin. (*Med. Chir. Trans.*, vol. xl., a paper by the writer.)



One of the earliest symptoms generally observable is a manifest diminution in the force with which the urine is ejected. The desire to pass water becomes more frequent than natural, and the relief afforded by the act of micturition is less complete. In course of time, however, the act must be more repeatedly performed, and the period of night is no longer exempt from the calls to pass water. Pains in the groin, testicles, and thighs are sometimes, but by no means commonly, complained of, and a sense of weight and fulness about the perinæum, rectum, and hypogastrium is felt by the patient. An unpleasant odour appears in the urine, which is new to him, irritation of the rectum is experienced, the contents of the bowel are more frequently passed from inability on the part of the patient to prevent the act of defæcation accompanying that of micturition; and tenesmus, protrusion of the mucous membrane or prolapsus, and hæmorrhoidal swellings, are apt to result. Much stress has been laid by some writers, following J. L. Petit, who seems to have originated the idea, on the appearance of flattened stools as an indication of enlargement, but without sufficient grounds.

As the disease advances, symptoms of distended bladder or of chronic inflammation of that organ are experienced; and pain in the urethra, extending to the glans penis, becomes severe, often attended by some muco-purulent discharge. If unrelieved by art, the bladder yields to the constantly-augmenting demand upon it, becomes habitually filled, the surplus only flows off at each act of micturition, and at night when voluntary control is suspended by sleep, and even by day, urine drains away, to the great discomfort of the patient. This condition is generally described as incontinence, a misapplication of the term, as we shall hereafter see, which has been productive of fatal errors in practice.

The characters presented by the urine are important, being such as mainly depend on decomposition of some of its constituents from retention, mixed with the products of chronic inflammation of the bladder. At first it is a little cloudy, often pale, with a few shreds or flocculi suspended in it; more or less of mucous deposit slowly settles at the lower part of the vessel; it becomes alkaline, and a thin pellicle forms on the surface, more or less whitish and opaque, sometimes iridescent. In later stages the mucus increases in quantity, and appears as the slimy adhesive matter so often seen in chronic inflammation of the bladder; not miscible with the urine, it adheres to the side of the vessel, and follows the urine as it is poured out from one to another, in a mass which it is difficult to separate. In advanced cases this mucus is sometimes mixed with blood, and often exhibits traces of calculous, generally phosphatic, matter, in the form of small amorphous masses of soft consistence and whitish colour.

In such circumstances as those described, it is of the utmost importance to remember that the bladder becomes permanently distended, unless the catheter be employed; and the urine gradually increasing in quantity at length opens out the orifice, and flows off spontaneously. To designate this phenomenon the term incontinence was originally applied, and is still employed by many, although the condition so described is in reality the very reverse of *incontinence*, since the bladder

already contains too much, and the surplus only overflows, the viscus often retaining much more than its capacity in a state of health would admit of. The bladder is in fact *engorged*, and the urine *overflows*.

This phenomenon of involuntary micturition in elderly persons is very frequently accounted for, not on the ground of obstruction, but on that of paralysis affecting the bladder; and the term incontinence has been employed to designate this condition also, although it presents a state which is the exact reverse to that already so described. In this latter case it is rightly used; but to the former condition, it is a grave error thus to apply it. But the condition of paralysis, except when manifest hemiplegia or paraplegia are present, is very uncommon, and it follows then that real incontinence is a very rare occurrence in the adult male. That it is so is one of the most salutary and important lessons which the student can learn. It should be held as an axiom, the importance of which it is impossible to overrate, that an involuntary flow of urine indicates retention, not incontinence. How often has the overflow of surplus urine from an engorged bladder concealed the real evil from an inexperienced practitioner, and induced the patient to believe that his "water was too abundant, or passed too freely," and wanted repressing rather than withdrawing. And what has been his astonishment, when, the true state of matters being recognised by his attendant, the introduction of a catheter has given exit to some pints, it may be, of the retained urine!

The diagnosis of hypertrophied prostate depends on the following particulars. The age from fifty years upwards, rarely under sixty; symptoms of obstruction to the outflow of urine commencing to appear, or having only lately appeared; enlargement of prostate felt by examination in the rectum, and the catheter requiring to be passed to a greater distance, or to be more depressed between the patient's legs before urine appears, than in the natural state. When these conditions concur there is little doubt of the nature of the case, but error may arise from its similarity to other diseased conditions. The following distinctive signs it may therefore be useful to point out.

In stricture of the urethra, the stream of urine is invariably small, in a confirmed case extremely so; in the prostatic affection, though diminished in force, it is not necessarily much so in volume; the use of a full-sized sound, however, marks the distinction clearly. In stricture, obstruction is usually encountered before six inches of the instrument have disappeared, always before it arrives at the prostatic urethra. Lastly, stricture almost invariably makes its appearance before middle life, prostatic hypertrophy not until that period is passed.

In regard of calculus, the occurrence of sudden cessation of the stream of urine, of severe pain at the close of micturition, the exacerbation of symptoms, especially of pain, and the appearance of a little blood after exercise, may be looked upon as strongly indicating the presence of stone in the bladder. But it may exist in the absence of most of these symptoms, the two first-named especially, from the circumstance that the calculus is usually situated behind the enlarged prostate, and does not approach the more sensitive region of the internal meatus. The fact of small quantities of florid and unmixed

blood being occasionally passed after exercise, more closely approaches in value to a pathognomonic sign than any other. A persistent discharge of mucus, or of pus, in the urine, should also arouse suspicion of stone. The use of the sound, however, can alone clear up this case also satisfactorily.

The existence of tumor of the bladder is less easily affirmed; but there is generally much more pain; exquisite tenderness on the introduction of instruments; the urine is frequently or generally mingled with sanious discharge and flocculi, to which sabulous matter is often seen adhering. Exploration by rectum sometimes detects a firm irregular mass occupying some portion of the walls of the bladder, especially if malignant disease be present, of which other signs will also be ascertainable; but villous tumor is not appreciable by such, or by any other examination: its most characteristic symptom is almost constant admixture of blood with the urine.

Simple uncomplicated chronic cystitis, with catarrh, is by no means a common affection. The series of symptoms thus denoted is almost invariably due to the presence of a foreign body, to some form of obstruction, or to paralysis, depriving the patient of the power of expelling the contents of his bladder, a condition which is tantamount to obstruction. We may rely upon it that in most of the obscurer cases, there is a material cause, often calculus, the presence of which needs a more than ordinarily searching examination to verify. It may be encysted, or otherwise rendered difficult of detection by the sound.

Single or repeated acts of voluntary over-retention of urine are sometimes followed by atony or inertia of the muscular parietes of the bladder, and a state of chronic retention follows from their consequent inability to expel the vesical contents. This condition resembles much the retention produced by enlarged prostate, and requires frequent relief by the catheter in the same way, at least for a time. Here the absence of physical signs, the suddenness of attack, its connection with a cause recognised by the patient, and the diminished power of discharging the urine *after a catheter has been placed in the bladder*, are sufficient to distinguish this affection. Particular attention should be paid to the last-named point. In enlarged prostate, the urine often flows with considerable force when the influence of the obstruction is removed by the introduction of a catheter, and the current can be accelerated materially by the will of the patient, unless there be atony also, as there may be from undue distension; however, it is not generally considerable, except in long-neglected cases. But when the cause of engorgement and retention is atony of the bladder, the urine runs out of the catheter, and is not propelled, neither can the flow be much influenced by any efforts of the patient.

Lastly, there is paralysis of the bladder, a condition in which its nervous supply is either impaired or destroyed. It is almost always associated with a similar condition of the lower extremities, and this may result either from disease or injury of the encephalon or spinal cord. There is no evidence of the existence of true paralysis, that is, a removal or impairment of nervous influence, *limited to the bladder*; nevertheless, the term paralysis is constantly applied, but most inappropriately, to denote inability of the viscus to expel

its contents, whether the cause be obstruction at the neck, or over-stretching (atony) of its muscular walls.

*Treatment of Hypertrophied Prostate.*—If it be discovered, as it usually is when a patient applies for relief to his surgeon, that a certain quantity of urine is habitually retained, the first great principle is this;—that it is necessary to ensure the complete removal of the urine from the bladder at least once a day. It may be desirable to do this twice, or even three or more times daily, the necessity depending, in great measure, upon the degree of obstruction, and the consequent amount of residual urine. He may depend on his attendant for this relief, but in many cases he can learn to use the catheter for himself, after sufficient instruction and careful supervision.

It has been recommended for these cases by some that a catheter should be permitted to remain in the bladder for some days at a time. There are two hypotheses on which the advice is given. The first is, that by permitting the bladder to remain empty, or nearly so, during a considerable period of time, we encourage it to regain its contractility, assumed to be lost or impaired by over-stretching. This, however, is not the true pathological condition which causes retention in these cases. There may be some loss in the muscular power of the vesical coats, but it is not much except in old and unrelieved cases. The material obstruction at the neck caused by the enlarged prostate, and not any "local paralysis," as it is commonly termed, is the sole, or almost sole, occasion of the urinary difficulty, as has been before explained. Consequently, on this ground, the practice referred to gains little support. The second hypothesis is, that the constant pressure of the catheter promotes absorption of the substance of the tumor, and so tends to the material improvement of the patient's condition; but the fact is, that the tendency is much more to ulceration than absorption. It will of course be understood that there is no reference here to cases in which urgent urinary retention has existed, which has been relieved with difficulty by the catheter; or to those in which great pain is produced, or unusual obstacles are encountered in passing the instrument. In such circumstances we may be justified in permitting the catheter to remain in the canal for a considerable period.

As to the kind of instrument to be recommended, I have seen silver and flexible instruments used with equal facility by different patients, the nature of the case, and the result of trials with both, deciding the question in each particular instance. Perhaps flexible instruments are, in the majority of cases, the better and safer kind: and when they are employed, the curve is always required to be greater than they naturally possess as supplied fresh from the maker's hands. Hence they should be kept for some time before they are wanted, each mounted upon an over-curved stilet, so that when required it may retain as much of the curve as may be desired after the stilet is withdrawn.

Supposing, however, that the case is one in which, from neglect or otherwise, the urine has been long permitted to accumulate, and the residual amount after micturition has reached a pint, or even two. If we evacuate the bladder two or three times daily, great relief will undoubtedly be at once afforded to the patient, but the sudden



change will frequently act with prejudice to the constitution. If we persist, some febrile symptoms will probably soon show themselves, the patient will become low, and even finally sink, his end being accelerated if the injunction to empty the bladder two or three times daily be regarded as invariably binding. Sir B. Brodie was the first I believe to point out the consequence of such treatment in these cases (*Lect. on the Urinary Organs*. 4th ed. Pp. 203-5); and observation has demonstrated to me the justice and the value of his remarks. The surgeon should commence by removing only a portion of the urine, not exceeding half the contents of the over-distended bladder, and in the course of two or three weeks, perhaps, by gradually withdrawing a somewhat larger proportion, and slowly accustoming the atonied coats of the viscus to their new condition, he may venture to empty it entirely. But in this proceeding he must exercise great caution, watching for symptoms, and doing all he can to invigorate the patient, by improving his digestive organs, and by administering as much nutritious food as he can digest, with as much tonic and stimulant as he may require.

There are many complications which are prone to appear in connection with these cases. Atony of the bladder from over-distension in such a case as that just described may be first noticed. For this, cold affusion on the abdomen, cold injections into the bladder, after a time; electricity, with strychnia, steel and ergot, internally, may prove useful. Chronic-cystitis is one of the most common consequences of retained urine, of rude instrumental treatment, of external cold, or of internal irritation, to which the patient with hypertrophied prostate is liable. External counter-irritation above the pubes, in the form of sinapism or linseed meal poultices with mustard, and hot fomentations, is one of the best modes of treatment in cases which are somewhat acute in their character; while absolute rest, hot hip baths, and demulcent drinks, are of essential service. As the case becomes more chronic, a blister above the pubes is sometimes useful, made with nitrate of silver in preference to cantharides. Injections of warm water and subsequently of mild astringents, such as acetate of lead, from half a grain to a grain in the ounce of water; of nitric acid in the proportion of one or two drops of dilute acid to the ounce, in such circumstances, are often of admirable service in checking an abundant secretion of mucus and pus. Pain is allayed by opium in suppository and by the mouth, and in the former case is often well combined with extract of belladonna; two grains of extract of opium, one of belladonna, and five or six of simple cerate being a formula from which I have often derived good results. The decoctions of senega, pareira, buchu, and triticum repens, may be used in their turn, the first being most useful when muco-purulent discharge is free. In similar conditions, small doses of copaiba, cubebs, and of benzoic acid, are sometimes valuable. Alkaline salts, such as the sesquicarbonate of soda, and the citrate of potash, are useful in small doses, unless the urine is exceedingly ammoniacal. Lemon juice occasionally neutralises the alkalinity of the urine better than any other agent: the mineral acids do not correct this condition, but act as tonics and astringents. Tonic treatment, in medicine and in diet, is generally strongly indicated; stimulants

of an alcoholic kind are advisable only when the powers of life are rather low. If there is some hæmorrhage, it must be treated by rest, ice in bladders locally, and as little instrumental interference as possible. Opium is most valuable to allay the spasmodic straining which a bladder loaded with coagula is so liable to be affected with. Internal astringents should be administered also, and good support afforded in the way of nutriment, but no hot fluids should be permitted. Generally speaking, the clot will gradually dissolve in the urine, and come away safely if not interfered with; mechanical interference often provokes renewed bleeding. For the treatment of retention of urine see article on that subject.

In respect of general management, the functions of the stomach and liver, and those of the skin, should be always maintained in good order, and a cheerful tone with respect to the future encouraged. Numerous researches have shown that life is barely shortened by this complaint when the patient is well taken care of. The special treatment directed against the enlargement itself offers no great hope from its employment. Many remedies have been tried and found useless, but if any more than others offer a chance, they are iodine and bromine. These are useless in a case of simple fibrous tumor of the prostate, or in any case which is far advanced. In commencing hypertrophy it may be right to make trial of them. Small doses of the iodide of potassium and of the bromide combined, may be taken internally for a prolonged period of time, while suppositories may be used also, and hip-baths impregnated with the same salts, or in the form of the mineral waters of Kreuznach.

*Atrophy of the prostate* is met with in different forms. It may occur in exhausting disease such as phthisis; it may be caused by pressure from tumors, &c., the prostatic structure will disappear from the encroachment of malignant growth and tuberculous deposit, and it may be congenitally deficient, but there is also a senile atrophy which is peculiar to the organ. Among the examples of prostate from elderly persons, I could only regard eleven as the subjects of atrophy from all causes. There are no symptoms distinguishing atrophy, nor is there any treatment adapted to it.

*Malignant disease of the prostate* is almost invariably encephaloid, for not more than one instance of true schirrus is on record. It has at present been observed only in childhood, and at advancing age.

In the former the encephaloid deposit is generally limited to the single organ, or to it and to the adjacent lymphatics, and it runs a very rapid course. In the adult cases, the development of disease is slower, and other viscera are usually affected besides the prostate.

The conditions commonly found after death are as follows:—The prostatic mass is of irregular form, and the most projecting parts are often soft and sprouting. The colour varies; the recent portions of the growth are of a pale buff tint; others are yellowish, and some reddish up to deep blackish-red; generally a creamy juice exudes—from others sanious fluid, or fluid containing flaky masses of dead structure, and here and there are found small collections of purulent matter.

The symptoms of the malignant affection are those common to prostatic obstruction of any form, but generally declaring themselves with greater rapidity than in the cases of senile hypertrophy. These need not be repeated. But besides them, there are other characters, such as more severe pain, often very intense; occasional, often frequent, hæmorrhages; and more or less constitutional cachexia. The pain is felt in the rectum, or in the region of the sacrum, and shooting down the thighs, either the anterior or posterior aspect. Hæmorrhage is a common occurrence both at an early and late period in the course of the disease, being almost universally present at one time or another, and sometimes to an alarming extent. In regard to diagnosis, the irregularity in form and consistence of the tumor in the rectum, the severe pains felt, the hæmorrhage, the constitutional cachexia, and above all the presence of enlarged lymphatic glands in the iliac and sometimes in the inguinal region, will furnish a clue to the nature of the disease.

The treatment is palliative, and must be regulated according to the various necessities which arise in the progress of the case. Thus, accumulation of urine must be provided against, at the smallest possible risk of irritating, much less of injuring, the part. If catheterism can be dispensed with altogether, so much the better. In no circumstances is it of more importance to be extremely gentle in the manipulation of instruments. The pain must be relieved by anodynes administered both by mouth and rectum. The addition of conium to opium, by enema or suppository, is often particularly useful; and by mouth belladonna is sometimes a valuable auxiliary in mitigating pain, given in doses of from one-fourth to three-fourths of a grain twice or three times a day. Hæmorrhage must be treated on principles already spoken of, and the powers of life are to be supported by every means in our power. Nutritious food, both in the solid and fluid form, with a due proportion of alcoholic stimulant, must be supplied in accordance with the digestive powers of the patient.

No *cystic disease* of the prostate exists, although it is sometimes spoken of. The glandular follicles are often found dilated, especially in elderly persons, and these often contain the little bodies called "prostatic concretions." These formations have been much studied; they are extremely common at all adult ages, though much more numerous among the aged than others. They have little or no pathological interest, as they very rarely become large enough to give evidence of their existence during life.

*Tubercle of the Prostate* is very rare. When present, the organ is generally somewhat increased in size, until the later stages of the complaint are reached, when, after suppuration and discharge, its volume may become smaller than natural. At no period of the disease is the prostate affected alone, some other part of the genito-urinary tract being the primary seat of the affection. In most cases the deposit appears to take place first in the kidney, or, at all events, to be present there in an early stage. The organ next in order of liability to the disease, among the genito-urinary group, is the testicle.

The form which tubercle assumes in the prostate is, at first, that of minute yellowish points. These become larger, and numerous rounded collections of cheesy or curd-like consistence may be found, distributed throughout the substance of the organ. Deposition and aggregation continue until the mass may reach the size of a chestnut; commonly, not larger than that of a full-sized marble. It is then generally surrounded by a thin limiting fibrous membrane, being isolated by it from the surrounding prostatic tissue.

There are no symptoms which are, strictly speaking, proper to this affection. Undue frequency and pain in making water, occasionally blood in the urine, and at times the signs of cystitis, are commonly experienced. Pains in the back and pelvis, and in the region of the bladder and urethra, are complained of; while wasting and extreme debility slowly show themselves in the system at large. The local complaint is to be regarded but as a part of the development of tubercular disease existing in other portions of the genito-urinary organs, and generally in other regions of the body also. The presence of pus in the urine, of occasional hæmaturia, of pains in the loins, perinæum, and penis, gives rise to suspicion of calculus, to be resolved sometimes only by careful sounding. The state of nutrition of the patient, his history, and the condition of the lungs, are among the main points to be considered in connection with the urinary derangements in relation to diagnosis.

Nothing need be said of the constitutional treatment of tubercular disease, and little in relation to the local manifestation in the prostate. Mechanical interference is to be avoided, and every kind of irritating application. The improvement of the health, by all those numerous means which regulation of the diet, regimen, exercise, climate, and medicine enable us commonly to achieve in tubercular patients, constitutes almost the whole of the treatment to be employed in the affection, when involving the urinary or genital organs. The diagnosis once established, it is of great importance that the patient should be kept free from all instrumental treatment, which, in such cases, provokes irritation, and aggravates the disease, without conferring upon him any benefit whatever.

*Prostatic calculi* exist in very various sizes and forms. The smaller examples, which are most frequently met with, are rounded or ovoid; the larger are irregular, often elongated, sometimes branched, and commonly consist of several fragments uniting to form a mass. These fragments fit almost accurately one to the other at their adjacent surfaces, but, nevertheless, appear to be separate and distinct calculi which have become adapted in form one to another by close proximity. The small isolated formations are about the size of grains of pearl barley, rarely as large as peas; and these form the purest specimens of prostatic calculus. The masses formed by coalescence are of all sizes, but have been seen reaching the length of four or five inches in very rare instances. In the latter case they extend into and along the urethra, and even into the bladder. Still in these circumstances, chemical analysis shows them to be mainly composed of phosphate of lime, and to have but a small admixture of the ordinary vesical or



urinary product, the triple phosphate of ammonia and magnesia. They are in consistence hard, and so close in texture as to bear some resemblance to porcelain. They are white, fawn, or pale brown in colour, the surface being usually of a darker tint than the interior.

The operative proceeding by which large prostatic calculi have been removed is usually an incision in the perinæum carried into the urethra upon a grooved staff, in the manner and situation of lateral lithotomy. Occasionally, the opening has been made in the median line, *i.e.* in the raphé of the perinæum. Undoubtedly this situation is the best and safest for the incision, inasmuch as the median opening gives a more complete command of the position occupied by the stone, and is also a nearer and less hazardous route to the neck of the bladder under these circumstances. The operation is far less dangerous than that of ordinary lithotomy, as the bladder remains untouched, supposing there is no vesical calculus also, a point which must be carefully investigated beforehand. Especial care must be taken at the time of operation to remove all the fragments which are lodged in the prostate so as not to leave nuclei for fresh deposit.

Sir B. Brodie relates a case in which he removed small prostatic calculi with the long urethral forceps; but some of these escaped also into the bladder, and had subsequently to be removed from that situation.

Calculi are not infrequently found in the bladders of patients with hypertrophied prostate; and it is worthy of remark that the latter complaint sometimes, but by no means always, masks the existence of the calculus, which is prevented from rolling to the sensitive neck of the bladder by the tumor there. The calculus usually occupies the deep bas-fond of this organ, and is not easily discovered by sounding unless the pelvis of the patient is raised high above the level of his shoulders, and a sound having a small short curve be employed, the beak of which can be turned downwards behind the enlarged prostate, so as to search thoroughly the depression there. Indeed, such, in my opinion, is the only form of sound calculated to ensure the discovery of a stone in any bladder.

The existence of enlarged prostate is not an absolute objection to lithotomy: it increases the difficulty of reaching the bladder and of seizing the stone. It is not an insuperable difficulty to lithotritry, but it renders the introduction of instruments often more difficult and the removal of detritus less easy. Each case must be judged on its own merits.] Henry Thompson.

See *J. Hunter*, on the Venereal Disease, p. 169, &c. 2d edit. 4to. Lond. 1783. *Baillie's Morbid Anatomy*, P. *J. Desault*, Œuvres, Chir. t. iii. p. 220, &c. 8vo. Paris, 1803. *Sir Everard Home*, On Diseases of the Prostate Gland, 2 vols. 8vo. Lond. 1811—1818. Also on Strictures, 3 vols. 8vo. 3d. ed. 1805—1821. *Sir C. Bell*, On the Muscles of the Ureters, in *Med. Chir. Trans.* vol. iii. *J. Shaw*, On the Structure of the Prostate Gland, in *C. Bell's Surgical Obs.* vol. i. 8vo. 1816. *E. A. Lloyd*, On Scrofula, p. 107, &c. 8vo. Lond. 1821. *J. Howship*, Obs. on Dis. of the Urinary Organs, &c. 8vo. Lond. 1816.; also, On Complaints affecting the secretion and Excretion of Urine, Lond. 1823. *Sir B. C. Brodie*, On the Diseases of the Urinary Organs, ed. 2. 8vo. Lond. 1835. *Cruveilhier*, Anat. Pathol. t. i. liv. xviii. fol. Paris, 1832—1835, and t. ii. liv. xxvi. *J. Wilson*, On the Male Urinary and Genital Organs, 8vo. Lond. 1821. *Meyer*, Aug. Recherches sur les Maladies de la Prostate, Paris,

1836; [*Recherches Anat. & Path.* Paris, 1841. *Civiale*, Maladies des Organes Urinaires, last edition, Paris, 1858. *Stafford*, On the Prostate, 2nd ed. Lond. 1845. *Jno. Adams*, Anat. and Diseases of the Prostate Gland, 2d. ed. Lond. 1853. *Dec. Hodgson*, The Prostate Gland and its enlargement in old age, Lond. 1856. *Henry Thompson*, Diseases of the Prostate (Jacksonian Prize), Lond. 1861.]

**PSEUDO SYPHILIS** (from *ψευδής*, false, and Syphilis, the venereal disease.) Disease resembling the venereal, but not really of this nature. (See **VENEREAL DISEASE**.)

**PSOAS ABSCESS.** [This form of abscess, which is classed among those of a chronic character, is particularly distinguished by the course it follows from above downwards, originating in most instances from a carious condition of the two last dorsal, or the proximate vertebræ in the lumbar region. It mostly enters the sheath of the psoas muscle, and either accompanies it in its direction downwards toward the hip joint, or presents itself in the shape of a small tumor in the inguinal region, a short distance above Poupart's ligament, or else by its gravitation at almost any point in the femoral region. In its early stage the symptoms are obscure, and often pass unnoticed until a small tumor is observed, or a tenderness in the spine is felt in the act of walking, or on pressure being made. Psoas abscess, which is common at the age of childhood, becomes much rarer as we advance towards manhood, for in the latter period we often see the chronic abscess in this region in the form of pelvic abscess, originating from acute cellulitis, with or without any disease in the iliac bones, and presenting many of the characters of psoas abscess. It is often extremely difficult to form a correct diagnosis of these two forms, until a later stage of the psoas abscess appears to indicate its real character. This abscess is unquestionably of a strumous nature, possessing all the characters and properties of that disease, terminating either by ankylosis of the bodies of the vertebræ, or fatally from constitutional exhaustion. In its treatment, counter-irritation by issues is most advisable at an early stage; indeed, issues are preferable in most instances to the cantharides blister, from the uncertainty and irregularity of its action; perfect quietude, and a strict attention to the secretions of the bowels should be enjoined; at the same time a diet of a light and nutritious nature should be allowed. We must be cautious in opening a psoas abscess, unless some urgent reason points out its necessity, as, for instance, the pressure of the matter upon important organs, or a threatened ulceration of the cyst, when an outlet for the matter should be made in a valvular form, in order to allow a gradual escape of its contents, without the admission of air into the cyst. Linseed meal poultices should now be resorted to, or an india-rubber drainage tube may be used; wine should be allowed, and a liberal diet. Tonics, such as iron and quinine, are now especially indicated, and particularly the Syr. Ferri Iodid. or the Ferri Ammon. Citras, from which frequently great benefit may be derived. Dr. Pidduck has suggested an admirable combination of the osteo-phosphate of lime with the saccharine carbonate of iron, which, when mixed with the various ingredients, and converted into gingerbread nuts, are readily taken by children with much benefit to their general health, and to the osseous system.]

(See *Proceed. Med. Chir. Soc.*, 1857.)] See LUMBAR ABSCESS. George Lewis Cooper.

PSORIASIS. A scaly disease of the skin. (See SKIN, diseases of.)

PSOROPHTHALMY. (See TINEA TARSI.)

PTERYGIUM. (Dim. of πτερυξ, a wing.) As Scarpa remarks, surgeons usually apply the term "*pterygium*" to that preternatural, reddish, ash-coloured, triangular little membrane, which most frequently grows from the internal angle of the eye, near the caruncula lachrymalis, and gradually extends over the cornea, so as to cause considerable impediment to vision. The disease, however, presents itself sometimes in the form of a semi-transparent thin greyish membrane, not furnished with many visible vessels, and sometimes as a thick red fibrous mass, very like muscle, being very prominent even on the cornea, where it seems to terminate in a substance-like tendon, and it is observed to be pervaded by numerous blood-vessels. The first is the *pterygium tenue* of Beer; the second, the *pterygium crassum* (*Lehre von den Augenkr.* b. ii. p. 636), or the membranous and fleshy pterygia of other writers.

Though pterygium most commonly proceeds from the internal angle (also Beer, b. ii. p. 637), sometimes it arises from the external, and, in rare instances, from the superior or inferior hemisphere of the eyeball. But, whatever be its origin, its figure is almost invariably that of a triangle, with its base on the white of the eye, and its apex more or less advanced over the cornea, towards its centre, and that of the pupil. Indeed, there are a few cases in which two or three pterygia of different sizes occur on the same eye, and are arranged round its circumference at interspaces of various breadths. Their points are directed towards the centre of the cornea, where, if they unfortunately conjoin, the whole of that transparent membrane becomes covered with an opaque veil. The occurrence of more than one pterygium on the same eye is very rare. Beer, in all his practice, met with but two cases of double pterygium, and with only one of three pterygia on the eye. (Beer, b. ii. p. 638.)

According to Scarpa (whose observations apply chiefly to the membranous form of the disease) chronic ophthalmia with relaxation and thickening of the conjunctiva, opacity of the cornea, and pterygium, only differ in degree. All the three complaints seem to him to consist of a more or less extensive varicose state of the vessels of the conjunctiva, combined with a degree of preternatural relaxation, and thickening of that membrane. On the contrary, Mr. Guthrie does not agree with Scarpa, that chronic varicose ophthalmia with relaxation and thickening of the conjunctiva, nebula of the cornea, and pterygium, are diseases differing only in degree. On the contrary, he asserts that a true pterygium is very rarely the consequence of chronic inflammation. The nebula, he observes, is never of the spear-formed shape of the pterygium, but always irregular, its progress rather from than towards the cornea, and the width of its base not equal to that of the latter disease. (See *Operative Surgery of the Eye*, p. 128.)

Pterygium is observed by Mr. Travers to be most prevalent in warm climates. (*Synopsis*, &c. p. 101.) It is also said to be most frequent in old people, though Mr. Wardrop and Dr. Monteith have seen it in very young infants. (Wel-

ler's *Manual of the Dis. of the Eye*, vol. i. p. 218.)

The triangular figure of the pterygium, with its basis on the white of the eye, and its apex on the cornea, is one of its principal diagnostic characters, by which the true disease may be discriminated from every other soft, fungous, reddish excrescence obscuring the cornea.

Another distinguishing character of pterygium, as Scarpa has observed, is the facility with which the whole of it may be taken hold of with a pair of forceps, and raised into a fold on the cornea. Every other kind of excrescence attached to this membrane continues firmly adherent to it, and cannot be folded, and raised from the surface of the cornea, in any manner whatever. This particularity is of the highest importance in the treatment; for the genuine pterygium may be cured by simple means, while fungous excrescences of the cornea can only be radically removed, and perfectly cicatrised with the utmost difficulty.

Scarpa's belief in the reality of a malignant or cancerous pterygium must appear a doctrine requiring confirmation, when it is considered that Mr. Travers makes no mention of such form of the disease, and Beer distinctly states that, in a practice of thirty-two years, he had cured 376 pterygia, of various sizes and thickness, without one bad symptom, or consequence. And hence, he concludes, that the disease is strictly local. (Beer, b. ii. p. 641.)

The true benign pterygium, says Scarpa, which has a triangular figure, and is ash-coloured, or pale red, is free from pain, and admits of being raised in the form of a fold on the surface of the cornea, may be cured by cutting the opaque triangular little membrane accurately from the surface of the cornea, which is in part covered by it. But, as the pterygium is nothing but a portion of the delicate transparent layer of the conjunctiva, converted into a thick, opaque tunic, it follows that the pterygium cannot be removed in any way without the spot which it occupies on the cornea being bereft of its natural external covering, and this part of the membrane rendered more or less opaque. Scarpa's experience enables him to state, however, that the superficial, indelible speck, remaining on the cornea, after the removal of the pterygium, is always less extensive than the space previously occupied by the disease.

In the treatment of pterygia with bases extending far in the white of the eye, Scarpa prefers detaching them at their apex, as far as the junction of the cornea with the sclerótica, and then to separate them at their base by a semicircular incision, comprehending one line in breadth of the substance of the conjunctiva, and made in a direction concentric with the edge of the cornea. Scarpa has observed that, in this mode of operating, the subsequent cure takes place sooner than when the common method is adopted; the cicatrix occasions no sort of frænum, and the conjunctiva, circularly stretched by the cicatrix, lies smoothly over the white of the eye, and loses that relaxation, and varicose state, which he considers as the groundwork of the pterygium. Such attention, however, is not requisite when the pterygium is small, and its base does not extend far in the white of the eye.

The operator, after desiring the patient to move his eyeball towards the part corresponding to the



base of the pterygium, is to take hold of the membrane with a pair of forceps held in his left hand, and pinch it into a fold, at about one line from its apex. The duplication is now to be raised, and drawn out gently until a sensation of something giving way is felt, which indicates the detachment of the pterygium from the delicate cellular texture, by which it is connected with the subjacent cornea. Next, by means of a pair of scissors, the surgeon must dissect this fold as closely as possible from the cornea, proceeding from the apex towards the base of the pterygium. The section being completed to where the cornea and sclerotica meet, the fold is to be again elevated still more, and, with one stroke of the scissors, the pterygium, and the relaxed portion of the conjunctiva, forming its base, are to be detached as concentrically and closely to the cornea as possible. This second incision will have a semilunar shape, the horns of which ought to extend two lines beyond the relaxed part of the conjunctiva, and follow the curvature of the eyeball.

When the operation is finished, the surgeon must promote the hæmorrhage by washing the part with warm water, and then cover the eye with dry lint, or lint moistened in the liquor plumbi acet. dilutus.

Unless pain, tension of the eye, and considerable tumefaction of the eyelids, follow, it is sufficient to wash the eye and inside of the eyelids three or four times a day with warm water, and carefully keep the parts from being exposed to the air without compressing them. If the symptoms just mentioned should occur, antiphlogistic treatment must be adopted. On the fifth or sixth day, at latest, after the operation, all the surface, from which the pterygium has been cut, appears yellowish, and covered with a fluid like mucus. The edges of the wound, and the adjoining part of the conjunctiva, assume a reddish colour. Afterwards, the wound contracts daily, and at length completely closes. All local stimulants are to be avoided.

In the early stage of pterygium, while the membrane is as thin as a cobweb, Scarpa considers it unnecessary to deprive the cornea of its natural covering; and that it is quite enough to cut off a portion of it, in order to intercept all communication between the dilated venous ramifications of the pterygium and the varicose trunks in the white of the eye. This is accomplished by cutting out, with a pair of forceps and scissors, a semilunar piece of the conjunctiva, at the point where the cornea and sclerotica conjoin, and exactly at the base of the incipient pterygium, just as is practised for opacity of the cornea. The recent pterygium is observed to disappear gradually after the operation, or to change into a slight dimness of the cornea, extending over a part of the space previously occupied by the disease. This opacity is commonly much more trivial than what follows a cicatrix. Acrel, in his *Surgical Observations*, mentions having successfully treated an incipient pterygium in this manner. Scarpa has also tried the plan several times with success. Such treatment must be better than merely making two or three deep cuts, or scarifications, in the membrane, near the edge of the cornea, as advised by Beer (b. ii. p. 641). And, in proof of the uncertainty of the latter method, we find Beer himself speaking of the necessity of using stimulating ap-

plications, like powdered sugar, alum, the vinous tincture of opium, &c. if the operation is not of itself sufficient. In the *pterygium crassum*, Beer recommends the knife as the best means of cure; but he differs essentially from Scarpa, not merely in preferring a knife to the scissors, but in beginning the operation by making a deep cut through the base of the pterygium in the white of the eye, from which point he continues the dissection of the pterygium, till this is all removed as far as its apex on the cornea, when he uses either the knife or scissors, as most convenient. (Beer, b. i. p. 643.)

Mr. Guthrie, who acknowledges the correctness of Scarpa's objections to removing a large pterygium to a great extent towards the caruncula lachrymalis, adopts a middle course, between the methods of Beer and Scarpa, and removes half of the pterygium from the apex, towards the base. (Vol. cit. p. 130.)

Beer mentions, that it sometimes happens, especially in cases of thin pterygia, that the disease stops at the edge of the cornea, and spreads no further, as long as the patient lives. (Beer, b. ii. p. 641.) Under such circumstances, of course, the complaint will give no trouble, and may be left to itself, as particularly advised by Mr. Travers. (*Synopsis*, &c. p. 274.) When, however, it encroaches upon the sight, this gentleman says, that "it should be raised by dissection, as close as possible to the margin of the cornea, and the relaxed portion of the membrane removed by an incision, midway between the base of the pterygium and the cornea, and concentric to that membrane."

[Desmarres dissects the pterygium from before backwards (from its apex towards its base); and its apex, then movable, is attached by sutures to an incision in the conjunctiva near the upper and inner edge of the cornea, where it may undergo a new adhesion without intruding upon the cornea.

Mr. Bowman leaves its corneal portion and removes that covering the sclerotica. The conjunctiva above and below is then made more movable by lateral incisions and brought together with sutures, so as to cover the space formerly occupied by the pterygium.] C. Bader.

For further information, consult *J. Wardrop*, *Essays on the Morbid Anatomy of the Human Eye*, vol. i. p. 22, &c. 8vo. Edinb. 1808. Scarpa, *Sulle Malattie degli Occhi*, cap. xi. Richter's *Anfangsgr. der Wundarzneikunst*, b. iii. p. 141, &c. Göttingen, 1795. Beer's *Lehre von den Augenkr.* b. ii. p. 636, &c. 8vo. Wien, 1817. B. Travers, *Synopsis of the Diseases of the Eye*, 8vo. Lond. 1820. Weller's *Manual*, vol. i. 8vo. Glasgow, 1821. G. J. Guthrie, *On the Operative Surgery of the Eye*, p. 124, &c. 8vo. Lond. 1823. R. Middlemore, in *Trans. of Prov. Med. and Surgical Association*, vol. iii. p. 236. [Mackenzie, *On the Diseases of the Eye*, 4th ed. 1854. Desmarres, *Traité Théorique*, &c. 2nd ed. 1855. Paris. Ophthalmic Hospital Reports, October, 1857, 1858.]

PTOSIS or BLEPHAROPTOSIS (from πῑπτω, to fall down), a drooping of the upper eyelid with inability of voluntarily raising it. [Ptosis may be caused by paralysis or paresis of the branch of the third nerve, which supplies the levator palpebræ muscle, before it reaches that muscle, or by alterations of nutrition of that muscle itself, or of the entire eyelid. In the first case it is generally complicated with paralysis of the sphincter of the pupil, and of one or several of those recti muscles, which are also supplied by

branches of the third nerve, when on raising the drooping lid with the finger we find divergent strabismus, and the pupil somewhat enlarged and fixed. A slight impairment of the power of raising the upper lid, through changes affecting the branch of the third nerve, is termed paresis of the levator palpebræ muscle. The skin of the forehead in such cases is thrown into folds when making an effort to raise the lid, while the skin of the lid hardly changes its appearance.

*Treatment.*—Here we have to consider the cause of the ptosis. It may be the result (1) of severe or repeated inflammation, leading to hypertrophy and to an increase in the weight of the upper lid; (2) of protracted intolerance of light with spasmodic closure of the eyelids, producing hypertrophy of the orbicularis muscle, and thus destroying the antagonism between it and the levator palpebræ muscle; (3) of increase of weight of the lid not in aged persons from an abundance of skin, together with weakness of the levator palpebræ muscle. In these cases the action of the levator palpebræ muscle is often still further impeded through narrowing of the palpebral aperture.

In 1, after all inflammation has ceased; in 2, after the intolerance of light has subsided; and in 3, we can, by the removal with scissors and forceps of some skin and orbicularis muscle, along the margin of the anterior surface of the tarsus, improve the condition of the patient, who for reasons of personal appearance, or to improve the sight, may be desirous to undergo the operation.

To ascertain how much of the skin should be removed we pinch up a fold with the fingers or with a broad forceps along and parallel with the margin of the lid, so as to raise that margin above the upper edge of the patient's pupil, while the eye is directed straight out. The patient, while the fold of skin is raised, must be able to close the lids readily without effort. The fold is removed best with scissors. Then a strip of the orbicularis muscle, its width varying from one-fifth to one-quarter of an inch, is dissected away from the tarsus, taking particular care to remove the thick portion attached to the edge of the tarsus. One suture inserted midway between the outer and inner canthus suffices. It is carried through the outer edge of the margin of the eyelid (tarsus) and through the nearest portion of skin. The wound usually heals within a few days. Cold water dressing may be applied. The suture often comes off spontaneously.

Acute alterations of nutrition during œdema or inflammation of the eyelids, *e.g.* in the course of purulent ophthalmia, erysipelas, ophthalmitis, &c., cause the swollen and often immovable upper lid to overlap the lower one, the patient having but slight or no power of raising it. In such cases, no treatment need be adopted as long as its cause (the purulent ophthalmia, &c.) has not subsided.

Ptosis from paralysis of the third nerve through tumor, syphilitic or rheumatic changes, or abscesses, in other parts, or occurring during congestion or hæmorrhage into the brain, as a rule, appears suddenly.

The general medical treatment of ptosis, if it is the result of paralysis, must be directed against the morbid changes which caused the paralysis,—tumors, syphilitic and rheumatic changes, abscess, intra-cranial congestion or hæmorrhage.

Raising the eyelid during the day by means of strapping, or with a metal suture, is of some use if the movements of the eyeball are free.

An operation, to raise the lid by removal of some of its skin and muscular structure, is not advisable.

An operation (Mr. Bowman's), the object of which is to raise the orbicularis muscle and tarsus beneath the skin of the eyelid which previously is separated from the muscle, and thus to diminish the width of the drooping lid, through the medium of a cicatrix, formed between the displaced portions of the orbicularis muscle and tarsus and the skin, has in few cases proved successful. At first, an incision is made parallel with, and about one-eighth of an inch from, the outer edge of the margin of the eyelid, through the skin, down upon the orbicularis muscle. The bleeding and the thinness of the skin make dissection difficult. The difficulty is much less if during this part of the operation the compressorium forceps is applied. The skin is dissected away from the orbicularis muscle to the extent of the tarsus, and a little beyond its upper margin. A loop of silk is then passed round some of the bundles of the orbicularis muscle, near the margin of the eyelid, at an equal distance from the outer and inner canthus, and the silk thread carried beneath the skin, and out at the eyebrow, and fixed there. One or two more silk threads may be applied in the same way along the margin of the lid. The effect is, that the tarsus and orbicularis muscle are raised behind the skin, which is thrown in folds, and overlaps the margin of the lid.

Cold water dressing is applied frequently, and the patient kept in bed for about a week, the swelling, &c. of the lid has been considerable in several cases.

The silk threads are removed about the eighth day, when the displaced muscle and tarsus are supposed to have undergone the necessary adhesion with the skin.

For alteration in the position of the cornea by dividing the superior rectus muscle, if the patient has only one useful and freely movable eye; or by dividing the external and shortening and advancing the sclerotic insertion of the internal rectus muscle if other branches of the third nerve are paralysed, see *Strabismus*.] *C. Bader.*

See *Richter's Anfangsgr. der Wundarzn.* b. iv. p. 488. 8vo. 3rd edit. Güt. 1802. *J. A. Schmidt*, in *Abhandl. der Königl. Med. Chir. Jos. Acad. zu Wien.* b. ii. p. 365. 1801. *Weller's Manual*, Transl. by Monteath, vol. i. p. 97, &c. 8vo. Glasgow, 1821. *G. J. Beer*, *Lehre von den Augenkr.* b. ii. p. 109, &c. 8vo. Wien, 1817. *G. J. Guthrie*, *Operative Surgery of the Eye*, p. 41, &c. 8vo. Lond. 1823. [*Desmarres*, *Traité Théorique et Pratique des Maladies des Yeux.* éd. 2. Paris, 1855.]

#### PUNCTURED WOUNDS. (See WOUNDS.)

**PUPIL.** [Most of the natural and morbid changes of the eye reflect themselves in the state of the pupil; alterations of its size, shape, and colour, are guides in assisting us to form a correct diagnosis and devise a plan of treatment, not only of changes in the iris, but of numerous other ocular and cerebral anomalies. Light thrown upon the healthy retina causes contraction of the pupil by reflex action of the optic nerve in the brain (*corpora quadrigemina*) upon the third nerve.

Certain terms are in use in reference to the mobility of the pupil. Its movements are normal, or "the pupil acts well," if it responds to all the



requirements of health, as regards its contraction, dilatation, and its accommodative movements.

In an eye (at twenty) in which the diameter (medium dilatation) of the pupil is  $\frac{1}{2}$  of an inch, we find that the pupil can become contracted to a diameter of  $\frac{1}{4}$  of an inch, and can be dilated to a diameter of  $\frac{3}{4}$  of an inch. The distance of the margin of the pupil (medium dilatation) from the apex of the cornea amounts to about  $\frac{1}{4}$  of an inch.

The centre of the pupil is situated a little inwards from the axis of the cornea, and is carried still a little more inwards when approaching the cornea during accommodation. The margin of the pupil during all its movements glides upon the capsule of the crystalline lens, and either advances towards or recedes from the cornea, according to the changes which take place in the curvature of the crystalline lens.

Contraction of the pupil is either direct—*i.e.* the result of some kind of stimulus applied to the same eye—or it is indirect or consensual, *i.e.* the result of some kind of stimulus applied to the fellow eye.

*The pupil becomes contracted*.—1. When looking at (accommodated for) near objects, or when looking through a “weak” concave lens. The relations between the size of the pupil and the state of accommodation may, however, be disturbed through anomalies in the optic nerve; as also in those nerves which supply the iris, or through changes in the structure of the iris itself. 2. During the action of the muscles attached to the eyeball, more especially of “the internal recti.” 3. On the stimulus of light. 4. On direct irritation of the fifth nerve, or of its ophthalmic branch, or after division of the Gasserian ganglion. The contraction produced by division of the third and of the sympathetic nerve is attributed to a reflex action in the ciliary ganglion from the irritation of these nerves being conveyed to the fifth. If the influence of the spinal nerves upon the iris is removed, the parts supplied by the cerebral nerves remain unrestrained, and as a consequence of this uncontrolled action, contraction of the pupil follows. It is contracted during sleep from decrease (?) of sensibility of the fifth nerve. 5. On the local application of medical agents, such as aconitum napellus, ruta graveolens, opium, physostigma venenosum (Calabar bean). 6. After escape of aqueous humour, of vitreous substance, or of the lens.

The mobility diminishes with the advance of age. A mobile pupil is no certain proof of the eye possessing sight, since the pupil of a blind eye may “contract” when the eye is moved quickly. The pupil of a blind eye moves in concert with that of the “healthy” fellow eye.

We test the mobility of the pupil by making the patient face the light, keeping the light thoroughly excluded from the eye which is not under examination. The eye under examination being directed to the light, is shaded by holding our hand before the pupil, which being quickly withdrawn, it is again exposed to the light.

Atropia should be applied if adhesions or other structural changes exist or are suspected. The dilatation of the pupil is the result of contraction of the “radiating” fibres of the iris.

*The pupil becomes dilated*.—1. When looking at (“relaxing the power of accommodation”) distant objects. 2. On diminishing the stimulus of

light. 3. On the application of medical agents, as belladonna, &c.

In describing morbid changes, use is frequently made of such terms as, the pupil is of “medium size,” “it is contracted,” “it is dilated,” “it acts in concert, it is sluggish, fixed,” &c. &c., thus comparing it with the size and mobility of the pupil in health when tested with the same degrees of light; *e.g.* “the pupil is dilated” indicates that it remains dilated when a healthy pupil, exposed to the same degree of light, assumes a medium size, or becomes contracted. It may be dilated to such an extent as to cause its margin to disappear behind the cornea, or on the other hand, contracted to the size of a small pin’s-head.

“It acts in concert,” or “its consensual movements are undisturbed,” if, while the mobility of the fellow pupil is examined, its movements are similar to those of the pupil under examination, while its mobility may, however, be deranged if tested by itself, the fellow eye being at the time kept closed.

“Its movements are sluggish” if the rapidity of its contraction or dilatation, or of both, are below par. The cause of this may be found in changes of the texture of the iris, or in intra- or extra-ocular, or more especially in cerebral changes, all of which causes act by altering the function of the nerves that supply the iris; or this may arise from anomalies of the retina, demanding a less active reflex-action of the pupil. A combination of these causes often occurs.

The “pupil is fixed,” when it remains immovable on being exposed to the stimulus of light. This may be from adhesions only, or from anomalies of innervation. For anomalies of mobility see MYDRIASIS and MYOSIS. The size of the pupil bears no relation to the vascularity of the iris, for it may be wide or narrow, with but little blood in the iris.

*Hippus* or *Nystagmus* of the iris designates a rapid succession of contraction and dilatation of the pupil, independent of the stimulus of light, as is occasionally observed in hyperæsthesia of the retina, and in hydrocephalus.

*Iridodonesis* (tremulous iris) is observed if the iris loses the support of the crystalline lens, whether from dislocation or removal of the latter, or from paralysis or from enlargement of the “posterior chamber,” and some portions only of the iris may be tremulous, others not.

The pupil in health is round. It is “irregular” if portions of its margin advance more into its area than others. Irregularities are produced through adhesions, or as a result of paralysis or paresis of only some of the fibres forming the iris.

The former are always caused by an attack of iritis, and the latter are observed in presbyopic or hypermetropic persons when attempting to look at objects held close.

The colour of the area of the pupil varies with the time of life, and chiefly depends upon alterations in the colour of the lens and vitreous substance, and also of the surrounding tunics. Its area is “clear” or black in healthy eyes, if the pupil is contracted and examined with the unaided eye, though in old persons it becomes slightly greyish. Its colour should however be ascertained by lateral illumination, when even in the young eye it appears somewhat greyish, provided the lens which reflects some of the light thrown into

it occupies the area. It appears "greenish" or "yellowish" according to the amount of saturation of the crystalline lens, and vitreous with yellow colouring matter; and there are also varieties of colour produced from cataract, by exudation and pigment from the iris.

The "cat's eye pupil," or a yellow or golden reflection from behind the pupil, is produced by lymph or cancer, or pus in the vitreous chamber, and may appear as a consequence of displaced retina.

In fair persons, and especially in albinos with widely dilated pupils, the natural red reflection from the choroid may be perceived in certain positions of the eye. All these anomalies of size, shape, colour, and mobility are frequently combined with each other. In the examination by lateral illumination and in the local application of atropia, we have two means of recognising these anomalies when they result from iritis and adhesions; as also with the ophthalmoscope we may ascertain those connected with intra-ocular and cerebral changes.

The descriptions of the morbid changes of the iris were in many instances derived from microscopic examination of the living eye.]

When the opening in the centre of the iris is preternaturally large, and this organ more or less deprived of its power of motion, the disease is technically named *mydriasis*, which is either *symptomatic* or *idiopathic*. The first form of the complaint is exemplified in hydrocephalus, hydrophthalmia, pressure on the brain from various causes, worms, amaurosis, &c. The second often presents itself as a paralytic affection of the iris; it is frequently induced by the application of certain narcotics, like belladonna, and hyoscyamus. Congenital cases of mydriasis are also met with, as well as instances brought on by a long residence in darkness. A dilatation of the pupil may likewise be the consequence of an adhesion of the uvea to the anterior capsule of the lens. When the retina continues sensible, the inconveniences, produced by mydriasis, are intolerance of light, complete blindness in the daytime, and in the end amaurotic mischief, occasioned by the irritation of the immoderate quantity of the rays of light admitted within the eye. The kind of prognosis, and the mode of treatment, must often depend entirely upon the primary affection, of which many cases of mydriasis are only symptomatic. Of course the original disorder must always be cured if possible. When mydriasis appears to arise from paralysis of the iris, blisters may be applied over the eyebrows, and the same remedies tried, which are usually employed in other local paralytic disorders. The entrance of too much light into the eye may be moderated with shades and tubulated spectacles.

The case, which is the reverse of the preceding, is a preternaturally contracted, more or less immovable state of the pupil, termed *myosis*. According to Weller, it is sometimes congenital. It is often met with as a symptom of other disorders, especially ophthalmia, inflammation of the dura mater, phrenitis, concussion of the brain, &c. Persons whose business is to be looking at small shining objects, as watchmakers, often acquire a myosis from habit, and they cannot be cured of it, unless they avoid the causes which brought it on, keep themselves in a darkish room, and use a green shade or tubulated spectacles. (See *Weller's Manual*, &c., transl. by Monteath, vol. ii. p. 54.)

It is noticed by Beer, that myosis, when a sequel of ophthalmia, is less obvious than most other consequences of ocular inflammation; for though the iris is motionless, and the pupil considerably diminished, this opening is perfectly clear and black, and not drawn out of its usual position, nor is its pupillary edge in the slightest degree angular. The patient, though he is continually complaining of weakness of sight, is able to distinguish (with some trouble indeed) even the smallest objects in the daytime, and in very light situations; but his sight is evidently worse in the evening, and in darkish places in the daytime; for when both his eyes are affected, he is in the dusk nearly blind, and can scarcely find his way. Beer remarks, that almost every considerable internal ophthalmia, or iritis, however favourably the disorder may be cured, and the eyesight restored, always leaves after it more or less contraction of the pupil, which affection, though not the least portion of coagulating lymph can be perceived in the posterior chamber, is combined with a partial or complete immobility of the iris. Beer assures us that every expedient, which he has yet tried for the permanent removal of this complaint, has failed; the dilatation of the pupil thus produced being but temporary. And with respect to the most powerful narcotics, he states, that in two cases, they were worse than useless, as they caused a still greater contraction of the pupil, which however, after a few hours, resumed its former diameter. Hence, Beer is disposed to set down the myosis, following internal ophthalmia, as an incurable complaint. (See *Lehre von den Augenkr.* b. ii. p. 261, &c.)

The next case demanding some notice in this work, is a *closure of the pupil (atresia pupillæ)*. According to Beer's observations, there is only one exception, in which in the adult patient a closure of the pupil is not the consequence of ophthalmia, and the case here signified is termed a *collapse of the pupil*, or *synchysis pupillæ*, the causes of which are said to be, either a very considerable loss of the vitreous humour from a wound of the eye, or else a dissolved, or rather disorganised state of the same humour, known under the name of *synchysis*. (*Lehre*, &c. b. ii. p. 190.) Every internal ophthalmia, extending to the retina and choroid, when in its highest degree, is apt to produce a complete closure of the pupil. However, the obliteration of this opening is not the only cause of blindness; for long before this state of the iris happens, the sight is destroyed by considerable and frequently irremediable injury of the retina and neighbouring textures, in which the inflammation is directly situated. An incomplete closure of the pupil, Beer says, is still more disposed to take place at the period when iritis passes from its first into its second stage; and syphilitic iritis is said to be particularly apt to leave after it this disagreeable consequence. (Vol. cit. p. 191.) In cases of the latter description, vision is not always quite prevented, but only more or less diminished, the coagulating lymph, effused in the posterior chamber, having formed only a delicate semitransparent web. However, if, in the second stage of the inflammation, such lymph should be converted into a dense membrane, with opacity of the lens and its capsule, the eye then only retains more or less perfectly the faculty of just distinguishing the light. But when, in such a case, the patient is completely insensible of the difference between light and



darkness, the blindness, as in the examples mentioned above, is not owing to the closure of the pupil, or to the cataract, but to other morbid changes, resulting from the same inflammation, which caused the defect in the pupil itself, and capable of being ascertained by peculiar appearances in the eye. Passing over obstructions of the pupil by the unabsorbed matter of hypopium, and by the continuance of effused blood in the chambers of the eye, I come to the case next noticed by Beer, in which a closure of the pupil arises from a partial adhesion of the iris to the cornea (*synechia anterior*), and will inevitably happen, when a considerable portion of the iris, or a great part, or the whole, of its pupillary edge protrudes through an opening in the cornea, and becomes adherent to it. However, sometimes, in these cases, the pupil becomes completely obstructed, though the protrusion of the iris is inconsiderable, and its pupillary edge not engaged in the cicatrix, a circumstance exemplified, when the cicatrix over the adherent part of the iris expands very much, and has an extensive leucomatous surface, so that, though the pupil may be of considerable size, it is concealed, and vision impeded. And, even when there is no adhesion of the iris to the cornea, no *synechia anterior*, as it is termed, and no distortion of the pupil, a large dense cicatrix of the cornea may obstruct vision by lying exactly over that aperture. Lastly, as Beer has explained, the greater part of the cornea may be in an opaque, spoiled condition, so that the healthy iris can be discerned only at certain points behind its circumference, no vestige of the pupil itself being distinguishable; and such concealment of this opening may be either combined, or not, with a partial adhesion of the iris to the cornea. In such cases the patient can frequently perceive the light very well. (Beer, b. ii. p. 194, 195.)

From what has been stated, it is manifest to Beer, that, in many cases of atresia iridis, the prognosis must be highly unfavourable, and that no attempt to form an artificial pupil should ever be made, when the patient's blindness proceeds from other causes besides the imperforate state of the iris. Such an operation, Beer observes, can only be proper when the blindness is entirely owing to the closed, or concealed state of the pupil; when the different degrees of light can be plainly distinguished; when the case is uncomplicated with any disease of other important textures of the eye, capable of rendering the manual proceedings difficult, or impracticable; when the eye has been for a long time perfectly free from inflammation; is healthy. (Beer, b. ii. p. 196.)

When vision is totally lost in one eye, and materially impaired in the other, Mr. Guthrie judiciously observes, that the question, whether an operation ought to be performed or not, is important; for, if the patient still enjoys sufficient power of vision to guide himself, the surgeon must be more than hardy who would put that portion of the faculty of sight in jeopardy by attempting an operation: which may fail, however skilfully done. Yet, Mr. Guthrie does not absolutely denounce the operation: he adds, "In such circumstances the operation should not be attempted upon any grounds, unless the case is so simple as to require only an opening in the cornea, and the removal of a portion of the iris,

for the purpose of enlarging the natural pupil. If the patient cannot see sufficiently well to guide himself, the conditions are very essentially altered, since an unsuccessful operation involves the loss of very little, whereas much is to be gained by the successful issue of it. Where opacities in the centre of the cornea occasion the impediment to vision, it is prudent to dilate the pupil beyond the edge of the opacity by the daily application of belladonna, which may possibly enlarge the sphere of vision so as to supersede, in a doubtful or dangerous case, the necessity of an operation." (See *Operative Surgery of the Eye*, p. 444.)

Beer represents the event of the operation as being very uncertain, when the patient cannot plainly discern the various degrees of light; when the cornea is affected with leucoma, or scarred and spoiled nearly to its very circumference; when there is only a partial staphyloma of it; or the constitution is unhealthy, or impaired by the effects of former attacks of scrofula, syphilis, or gout. Lastly, Beer sets down the operation as certainly useless, or even as likely to cause an entire destruction of the eye, when the patient is quite insensible of light; when the iris and neighbouring textures, such as the *corpus ciliare*, *corona ciliaris*, the membrane of the vitreous humour, this humour itself, and the blood-vessels of the organ, are in a morbid state, or the whole eyeball manifestly in a preternatural condition. However, an opacity of the lens and its capsule, even when the latter is completely adherent to the uvea, forms no prohibition to the formation of an artificial pupil, though it is a circumstance that has great weight in the selection of the method of operating. (Beer, b. ii. p. 197.)

The morbid states of the whole eyeball, which may complicate the atresia iridis, and render the operation not only useless, but hazardous to the preservation of the eye, are its dropsical enlargement (see *HYDROPTHALMIA*); its atrophy; its preternatural firmness, from a general varicose affection of its blood-vessels; and its morbid softness, from a disorganisation of the vitreous humour. (Beer, vol. cit. p. 198.)

Numerous are the plans of making an artificial pupil, if we except the occasional practice of forming a kind of artificial prolapsus of the iris, in order to change the position or shape of the imperfectly closed pupil, they may all be classed into three principal methods. 1. The simple transverse, perpendicular, or otherwise-directed incision in the iris, now termed *corotomia*, performed either through the sclerotica, or the cornea. 2. The excision of a piece of the iris, technically named *corectomia*. 3. The separation of a part of its circumference from the ciliary ligament, called in the language of oculists *corodialysis*, with which the last method, or the operation of *corectomia*, is combined in the plans suggested by Assalini and Reisinger. The excision of a portion of sclerotica, close to the cornea, with the view of forming an inlet for the rays of light to the retina, as proposed by Autenrieth, when the cornea is entirely opaque, may be considered a hopeless proceeding. With respect also to the three other methods, it is now well understood by all impartial surgeons, that the choice of them must depend upon the particular circumstances of the case, and that here it would

be as absurd to think of employing in all instances only one plan, as to have the idea of extending the same principle to all the forms and varieties of cataract.

When the thing is possible, it is considered by Beer most advantageous to make the artificial pupil rather towards the inner canthus; though others express a preference to the centre of the iris. But, as he truly remarks, since the new opening must be where the cornea is transparent, the operator is frequently obliged to form it either below, towards the temple, or quite above; for there is often only just room enough left at one point for conducting the necessary manœuvres, with any degree of precision.

According to Mr. Guthrie, "When an artificial pupil cannot be made in the centre of the iris (from whatever cause), the other parts of it are eligible in the following order: 1. The inferior part of the iris inclining inwards; 2. The internal, a little below the transverse diameter of the eye; 3. The inferior and external; the upper part being least eligible, from the eyelid covering that portion of the cornea in the natural state of the eye." (*Operative Surgery of the Eye*, p. 442.)

Mr. Guthrie agrees with Beer, that the place, in which the iris is to be perforated, generally depends more on the transparency of the cornea, than the choice of the operator. It is also remarked, that a small artificial pupil, at the lower part of the iris, is infinitely more valuable than a large one at any other, which, in the natural state of the eye, is covered by the eyelid, or much out of the axis of vision. If the state of the cornea will permit it, Mr. Guthrie says a sound part of the iris should be selected. (p. 443.) He considers the external and internal margins of the iris, immediately on a line with the central transverse diameter, particularly unfavourable for the method in which the iris is separated from the ciliary ligament, because there the long ciliary arteries enter, and the attachment of the iris is firmer than at other points.

Cheselden first devised a section of the iris, for the purpose of forming an artificial pupil. He proposed the introduction of a couching needle, with a sharp edge only on one side, through the sclerotica, about half a line from the cornea, into the posterior chamber. After the iris had been perforated towards the external angle, and the point of the needle then pushed through the anterior chamber, as far as that side of the iris which is nearest the nose, the edge was turned backward, and the instrument withdrawn, so as to make a transverse division of that membrane.

The account of the proposal, given by Cheselden himself in the *Philosophical Trans.* for 1728, is very incomplete; and, according to Mr. Guthrie, he did not actually perform the operation on the person, whose history he there relates, but only annexed to it an account of a particular operation which he considered worthy of record: a circumstance which, from not being attended to, has been the source of considerable errors. (*Operative Surgery of the Eye*, p. 395.) Morand, when he was in London, saw Cheselden form an artificial pupil; but the process, as described by Morand, differs from the above, inasmuch as the needle passed as far across the posterior chamber as

two-thirds of the iris, when its edge was turned towards this membrane, which was thus cut, and as much of it divided in withdrawing the instrument horizontally, as left an artificial pupil of an oblong form.

Janin performed Cheselden's method as described by Morand, on two subjects with the utmost care possible, but not the smallest benefit followed; for, after the subsidence of the symptoms produced by the operation, the transverse section, made in the iris by the edge of the needle, reunited. (*Mém. sur l'Œil.*) Mr. S. Sharp also saw a failure from the same cause. (*On Operations*, chap. 29.)

An accident occurred to Janin, in the act of extracting a cataract; viz. he included the iris together with the cornea, in Daviel's scissors, and cut it perpendicularly, and the division remained permanent. This led him to propose a perpendicular incision as the best expedient for making an artificial pupil. His plan consisted in opening the cornea, as is practised for the extraction of the cataract, and in dividing the iris perpendicularly with scissors, near that part of the pupil which is next to the nose; for he affirms, that he has seen strabismus result from making the section towards the external side, on account of the too great divarication of the optical axes.

Although the practice of making an incision in the iris, or corotomia, is severely disapproved of by Beer, who states that it admits of being practised only in very few cases, and is rendered quite unnecessary by, what he denominates, the two other better plans (*Beer* b. ii. p. 199), it is still considered by some men of experience as having recommendations, and they have therefore endeavoured to improve it. However, it will only be in my power to notice in this work a few of its modifications.

That Cheselden's method ought not to be entirely rejected, there can now be no doubt. Like all other modes of forming an artificial pupil, it certainly does not merit exclusive preference. In addition to the testimony of Sir W. Adams, we have that of Mr. Ware, to prove, that Cheselden's operation frequently succeeds. When the pupil had become closed, after an unsuccessful extraction of the cataract, Mr. Ware in several instances made a new pupil, agreeably to Cheselden's mode, with the most perfect success. "The fibres of the iris retracted as soon as they were divided, and left the pupil very nearly of its natural size. Its shape was not quite round; but the sight was immediately restored, and to so great a degree, as to enable the patient, by the help of suitable convex glasses, to see distinctly both near and distant objects, neither pain nor inflammation being consequent to the operation."

Where there is a prolapsus of the iris, through a breach of the cornea, involving more or less of the pupillary margin, Mr. Travers considers Cheselden's method the most applicable, viz. "the transverse division of the stretched fibres of the iris, and which, if the section be made in front of the membrane, i.e. from before backwards, admits of no improvement. The edges of the section instantly recede and form an excellent pupil." However, he afterwards adds, "that a partial adhesion of the pupillary margin may be combined with a healthy lens. In this case, the removal of the free border of the pupil, drawn by means of



forceps, through an incision in the cornea, will be preferable, on account of preserving the transparency of the lens." (*Synopsis of the Dis. of the Eye*, p. 343.)

Professor Maunoir, of Geneva, published a successful case, in which an artificial pupil was formed, and a caseous cataract extracted. "I opened (says he) on the right eye in the following manner. The patient being seated on a chair, and having the head inclined upon a cushion, I placed myself behind him, and with the forefinger of the left hand confining the upper eyelid, whilst an assistant depressed the lower, I made with the right hand a semicircular incision in the lower and external part of the cornea. This incision occupied a full third of the circumference of the membrane. On re-opening the eye, the iris was seen projecting a little from the wound in the cornea. I replaced it with the blunt point of my scissors. Introducing the two blades closed into the anterior chamber, and then opening them, I caused the pointed blade to penetrate the iris, leaving the blunt blade between that membrane and the cornea; then closing the scissors, a perpendicular incision of the iris resulted, describing a little more than half the chord of an arc of two-fifths of the circumference of the iris, traced on the side of the temple. The first incision not having occasioned the formation of a pupil of the necessary size, I introduced the scissors into the iris, a second time a little obliquely, and immediately the pupil appeared of a satisfactory form and size, but exhibiting the crystalline entirely opaque. The second stroke of the scissors had divided the capsula; I therefore introduced the small curette, in order to endeavour to destroy what adhered of the crystalline to the shrunk and contracted circumference of the old pupil. This attempt did not succeed. Lastly, I effected a passage of a portion of the opaque lens, by means of a slight pressure with a large scoop, exercised on the lower part of the globe of the eye. The crystalline, which was of a cheesy consistence, came out with the greatest ease, and though it was not entirely removed, yet a sufficient quantity was discharged to leave the artificial pupil of a most perfect black. This new pupil was on the side of the temple; and at the exterior and lower part of the iris." (See *Med. Chir. Trans.* vol. vii. p. 305, et seq.) In this communication are also two other cases, in which Maunoir operated with success, though they were complicated with cataracts, and adhesions of the lens to the iris. In some remarks, annexed by Scarpa to the preceding account, the latter expresses his opinion, that it is not necessary to be scrupulous, whether the crystalline be partly, or entirely opaque, whenever the capsule is opaque, and adheres to the iris, behind the edge of the interior and inclosed pupil.

Amongst other late opinions, professed by Scarpa, we find the following: that no instrument is so proper as the scissors for making an incision in the iris; that, when the case is not complicated by cataract, a very small wound in the cornea is sufficient; that the formation of a triangular edge in the iris, by means of a double incision with the scissors, is the most easy and least painful of all the methods hitherto proposed for obtaining a permanent artificial pupil; and lastly, that specks of the cornea present no obstacle, because the artificial pupil may be made opposite the transparent

part of that membrane. (*Med. Chir. Trans.* vol. vii. p. 320, 321.)

As I have already noticed, the contraction of the natural pupil is sometimes occasioned by the iris being stretched towards some point of the cornea, to which it is adherent. This state, as Scarpa observes, is most frequently accompanied with partial opacity of the cornea, around the adhesion, or prolapsus of the iris, as well as with opacity of the lens and its capsule. At other times, however, these internal parts preserve their natural transparency, notwithstanding the deviation of the natural pupil. In the latter case, the pupil, though removed from its situation, is not in reality obliterated, but merely very much contracted, and incapable of admitting the quantity of light necessary for vision, especially if the opposite part of the cornea be slightly opaque. In such an example Scarpa recommends making a small incision in the cornea at the most commodious part, when with Maunoir's scissors closed, and constructed with little buttons at the ends of both the blades, an endeavour is to be made to break the adhesion existing between the iris and the cornea. If this can be effected, the natural pupil generally recovers its former situation and size; but, if the adhesion be very firm, Scarpa introduces one of the blades within the contracted pupil, behind the posterior surface of the iris, until the other blade has reached the confines of the cornea with the scleroticæ. The iris is then to be divided in the form of the letter V, without at all injuring the capsule or lens, both of which are transparent. (*On Diseases of the Eyes*, p. 384, ed. 2, transl. by Briggs.) When, after extraction of the cataract, the pupil has been dragged down in this manner by adhesion to the lower third of the cornea, the upper two-thirds of which are transparent, Dr. Monteath, of Glasgow, has succeeded five times in forming an artificial pupil, and restoring vision by making a small opening in the upper and outer part of the edge of the cornea, capable of admitting Maunoir's eye-scissors, with which the over-stretched fibres of the iris are to be cut across by one simple incision, three lines in length. The cut edges instantly recede, and leave an oval pupil of sufficient size. (See *Weller's Manual*, vol. ii. p. 70.) In the cases above specified by Scarpa, Sir Wm. Adams, instead of performing corotomia, endeavours to separate the iris from the cornea, and then to alter the position of the pupil by drawing it towards that part of the cornea which has remained transparent. For this purpose, he punctures the cornea about one line in front of the iris, separates the adhesion, and then makes the disengaged portion of the iris protrude through the puncture, and leaves it there, even using the forceps, if necessary, for drawing it out as far as is deemed necessary for its being securely fixed. This method is disapproved of by Scarpa, because a second prolapsus of the iris in the same eye appears to him a very serious disease, and rather calculated to increase the opacity of the cornea, and augment the contraction of the pupil, than afford relief.

According to Beer, the excision of a portion of the iris, *corectomia*, is particularly indicated in all cases in which there is a sound transparent lens, as in many examples of synechia anterior, concealment of the natural pupil by a central opacity of the cornea, &c. Beer admits, however, as an exception, the instances in which the transparent

portion of the cornea is so small that no opening can be made in it with the knife, large enough to permit the iris to be taken hold of with a small hook or forceps, and a piece of it cut out above the ciliary processes. (Beer, b. ii. p. 200.) The reason here given does not appear to me very strong, because it may be asked, why not acquire more room by cutting a portion of the opaque part of the cornea? Weller assigns a better reason against corectomia, viz. when he refers to the risk of a sufficient piece of the cornea not being left transparent, opposite the new pupil, after the cicatrization of that membrane. (Vol. ii. p. 65.) Beer further states that corectomia may be performed, in cases of atresia iridis consequent to the operation of extracting the cataract, when the surgeon is certain that no coagulating lymph, effused during the previous inflammation in the posterior chamber, reaches above the lesser circle of the uvea, or is conjoined with opacity of the remaining capsule of the lens. The first state may be learned from the singular colour and form of the greater ring of the iris; the second, from the very indistinct manner in which the patient is sensible of the different degrees of light. (Beer, b. ii. p. 200.)

The excision of a piece of the iris, says Beer, requires the preliminary formation of a flap in the cornea, one line in length, with the cataract-knife, and as close as possible to the sclerotica, so that no subsequent opaque cicatrix may interfere with the success of the operation. The second part of the business, viz. the excision of a piece of the iris, must be done in three ways, according to circumstances: 1. The iris may not be anywhere adherent to the cornea, in which case, after an opening has been made in the latter membrane, the iris is propelled out between the edges of the wound by the aqueous humour, yet left in the posterior chamber, which opportunity the surgeon must immediately avail himself of for taking hold of the projecting piece of the iris with a very fine hook, and cutting it off with Daviel's scissors; the remainder of the iris is instantly retracted behind the cornea, and a well-formed pupil is immediately seen. 2. Only the part of the edge of the pupil may remain not adherent to and drawn towards the cornea, where it is intended to form the artificial pupil; a state best ascertained by a lateral inspection of the eye. In this case, after opening the cornea, Beer says, the operator is directly to introduce a small hook between the iris and cornea, so as not to injure either of these parts with its point, and he is then, with the instrument directed obliquely, to get hold of the pupillary edge of the iris, and, while the iris is drawn out between the edges of the incision, the projecting piece is to be cut off with Daviel's scissors. Thus, the natural pupil is to be extended behind the transparent part of the cornea, towards the edge of this membrane. 3. The pupillary edge of the iris may be adherent to the cornea exactly in the situation where the artificial pupil is to be formed: in this case, Beer directs the iris to be taken hold of at its greater circle with the hook, or (if this should tear its way out) with a pair of fine-pointed forceps with teeth, drawn out between the edges of the wound, and the point of the cone, thus produced, cut off somewhat within the edges of the wound, as drawing the iris further out might tear it, and have a prejudicial effect. In all these cases, says Beer, the undiseased lens and its capsule will not be injured, if the patient keep

tolerably steady, and the operator have already acquired dexterity in the extraction of the cataract. When corectomia is to be performed for a closure of the pupil, consequent to extraction of the cataract, Beer particularly recommends the forceps to be used, though he adds that such operation is applicable only when the remaining capsule has not been spoiled by inflammation, and the quantity of lymph in the posterior chamber is not so great as to reach above the lesser circle of the uvea.

The only other species of corectomia which I deem it necessary to notice, is what was proposed in the year 1811, by the late Mr. Gibson, of Manchester. It is described as follows: "The first step of the operation is to secure the eyelids, as in the operation for extracting a cataract. A puncture is then to be made in the cornea, with a broad cornea knife, within a line of the sclerotica, to the extent of about three lines. All pressure is now to be removed from the eye-ball, and the cornea knife gently withdrawn. The consequence of this is, that a portion of the aqueous humour escapes, and the iris falls into contact with the opening in the cornea, and closes it like a valve. A slight pressure must now be made upon the superior and nasal part of the eyeball, with the fore and middle finger of the left hand, till at length by an occasional and gentle increase of the pressure, or by varying its direction, the iris gradually protrudes, so as to present a bag of the size of a large pin's head. This protruded portion must be cut off with a pair of fine curved scissors, and all pressure at the same time removed; the iris will then recede within the eye, and the portion which has been removed will leave an artificial pupil more or less circular." (Gibson on Artificial Pupil, &c. Lond. 1811.) Such was this surgeon's mode of operating, when the closure of the pupil was attended with central opacity of the cornea, uncombined with adhesions. The effect of a slight adhesion of the inner border of the iris to the cornea, will be to prevent the protrusion of the first of these membranes through the puncture in the cornea, which protrusion so much facilitates the operation. In this case, a portion which does not adhere, must be drawn out with a small hook, and then removed. Sometimes the adhesion may be separated at the time of making the puncture, and then the iris will protrude. When the whole, or greater part of the inner border of the iris, is involved in adhesions to the cornea, these must be separated with the cornea-knife, after making the puncture, and the iris may then either be drawn out with the hook, or a portion of it be removed by means of very minute scissors. In every case, however, the removal of a portion is essential to success.

*Corectialysis*, or the mode of forming an artificial pupil by detaching a portion of the iris from the ciliary ligament is said to have been devised by Ad. Schmidt and Scarpa about the same time, and has been variously modified by Reisinger, Langenbeck, Himly, Graefe, and others. (Weller on Diseases of the Eye, vol. ii. p. 65.) According to Beer, this plan of operating is indicated when the cornea is everywhere incurably opaque, excepting so small a part of it that it could not well be opened for the excision of a portion of the iris. (Beer, b. ii. p. 203.)

The feeble union of the iris with the ciliary ligament, and, consequently, the greater facility



of detaching its edge from that ligament, with which it is connected, than of lacerating its body, induced Scarpa to try a new method of forming an artificial pupil when the natural one had become too much contracted, or quite obliterated after the extraction, or depression of the cataract. His method of operating consists in detaching, by means of a couching-needle, a certain extent of the circumference of the iris from the ciliary ligament, without dividing the cornea. The attempt met with success.

This separation of the iris from the ciliary ligament invariably occasions an extravasation of blood which always renders the aqueous humour more or less turbid; but the turbidness is afterwards absorbed, and the eye recovers its original transparency.

The celebrated Ad. Schmidt performed core-dialysis with a lancet-pointed curved needle, which was introduced, through the sclerotica, into the posterior chamber, with its concavity towards the uvea.

With the view of removing all risk of the new opening becoming closed again, Reisinger forms an artificial pupil by making a small incision in the cornea, and introducing a minute double hook, which opens and shuts like a pair of forceps. After passing the hook closed into the anterior chamber, as far as the greater circle of the iris, he turns the points of both the small hooks towards this membrane, then opens the instrument a little, and hooks hold of the iris, which is to be separated from the ciliary ligament, when the instrument is to be shut again, and the part of the iris, taken hold of, drawn a little through the opening of the cornea, where it adheres, and cannot recede again towards the ciliary ligament. (See *Darstellung eines neuen Verfahrens die Mastdarmfistel zu unterbinden, und einer leichten und sichern Methode Künstliche Pupillen zu bilden*. 12mo. Augsburg, 1816.)

Langenbeck is the inventor of an instrument for the formation of an artificial pupil; it is a silver tube, to one end of which is attached a very small gold one, containing a minute hook, capable of being moved backwards and forwards, to the extent of only two lines, by means of a spring in the silver tube. (See *G. F. Guthrie on Artificial Pupil*, p. 63, &c. 8vo. Lond. 1819; also *Langenbeck's Neue Bibl.* b. i. pp. 1, 454, and 676, 8vo. Hanover, 1817—19, and b. ii. pp. 13 and 106, where he answers some objections made to his instrument by Schlagintweit.) Doubtless, one cause of the failure of many operations for artificial pupil is one, to which Mr. Guthrie has adverted, viz. the omission to keep down the subsequent inflammation of the iris and adjacent textures by the timely employment of the lancet, and other antiphlogistic measures. On this subject, however, I need not here dwell, as the proper treatment is already described in that part of the article IRIS, which refers to iritis. For literature on Pupil, see also article IRIS.

PUS (from πύον, matter). The fluid formed by the process of suppuration. (See SUPPURATION.)

[PYÆMIA. Several diseases have been grouped together and described under the name of Pyæmia, which although different in their origin, have a common tendency sooner or later to produce abscesses in different parts of the body. These dis-

eases must always have existed, but it is only of late years that their true pathology has been understood. Formerly they were described under the names of Irritative, Sympathetic, Hectic, Typhoid, or Surgical Fever. Even in the present day it is probable that some of these affections, differing materially in their origin, but producing the same kind of symptoms, are described as identical, and that they will only be distinguished as separate diseases when the labours of pathologists have added the finishing touches to the work that has been commenced and continued with so much promise during the present century. The common symptom which unites all these diseases together is the tendency to form multiple abscesses in different parts of the body. These abscesses are formed generally by the same series of actions which produce ordinary abscesses, but sometimes the pus is deposited so quickly, and with so little local elaboration, that it would appear to have been almost ready formed in the blood. In some cases no local abscesses are formed, but the secondary actions are of such a nature that they evidently would have formed had the patient lived long enough. In such instances the mass of blood is contaminated to that degree that death ensues before there is time for the abscesses to develop.

When any morbid matter passes into the veins there is but one means by which it can be prevented from entering the general circulation, and that is by the obstruction of the vessels in which it is contained. The means adopted by nature in order to produce this obstruction is, under ordinary circumstances, the coagulation of the blood. In the absorbent system of vessels, morbid matters are arrested in their course towards the circulation in a different way. Every absorbent vessel conveys its contents in the first instance to a lymphatic gland, where the fluid undergoes a kind of digestion, which fits it for being received into the blood, or when such a conversion is found impossible, the morbid matter is expelled from the system by suppuration. When inflammation of a lymphatic vessel has arisen—be it a simple or a specific inflammation—the diseased action always pursues a course towards the gland, or towards the group of glands “first in order,” and there it generally terminates; those “second in order” very rarely indeed being affected. When symptoms of pyæmia ensue in such cases, it seems probable, that some of the same morbid materials that caused the disease of the lymphatics have gained an entrance into the veins directly, and not through the intermediate channel of the lymphatics. It is only in very rare instances indeed that the infection of the blood arises from a diseased gland by the passage of matters along the efferent lymph tubes.

The number of vitiated fluids which may traverse the veins without leaving any trace of their course, is probably great; but there are some which leave evident indications of their passage towards the general circulation. With the latter class we are principally concerned in relation to pyæmia. The blood may become poisoned by its exposure to the action of any of the products generated by decomposing or putrid animal substances; and many of the serious and grave results described in this essay, are produced in consequence of the introduction of septic and ichorous matter from the raw surfaces of wounds. Now, whatever may be the exact nature of this septic matter, its production

holds a very frequent, although by no means a necessary, connection with the suppurative process. The nature and composition of pus, and the chemical changes to which it is liable, have, therefore, naturally attracted a good deal of attention. The composition of pus seems to vary with the locality in which, and with the circumstances under which, it is formed. Thus, the pus of a chronic abscess appears to decompose more rapidly, and to generate sulphuretted hydrogen much more quickly, after exposure to air, than that of an acute abscess. Pus is not a simple fluid, but the reverse. It contains a large amount of organic matter of different kinds, and it is, therefore, unstable in composition, and liable to undergo putrefactive and other changes. When it decomposes, very various and diffusible bodies may be generated, such as ammonia, gas products, leucine and tyrosine, with acids of the butyric group, &c. Pus may also undergo an acid or alkaline fermentation. The former is rare, but when it does occur, volatile and fatty acids are developed. Vide Aitken's *Science and Practice of Medicine*, vol. ii. p. 862, 2nd Edition.

The author has ascertained from some experiments that butyric acid will readily induce a coagulation of the blood; but the cause of the local clotting in veins about wounds cannot be the same in all cases. It will be shown hereafter that very different degrees of severity and danger exist in different cases. It may with reason be suspected that the cause of pyæmia and septic diseases are due to the generation and absorption of some one or more peculiar organic poisons, rather than to the introduction into the blood of some product arising out of the ordinary decomposition of pus or other animal fluids; and that, when the poison is introduced into the system, the subsequent phenomena may then depend upon the presence or absence of a fit nidus or pabulum in the blood. And the experiments of Professor Panum on putrid infection would indicate that there exists a fixed, non-volatile, putrid poison, of a peculiarly indestructible character, which resembles, in the intensity of its action, the poison of serpents, curare, and vegetable alkaloids, and differs from all ferments by retaining its power after boiling and treatment with alcohol.

The results obtained by experimental investigation have been very contradictory however. This has probably arisen from several distinct but allied diseases having been embraced within the term pyæmia, and attempts have been therefore made to seek out a cause common to them all, in the way of isolating a special agent. It does not come within the scope of the present article to enumerate all the results of recent investigations, even were this possible; but we must refer the reader to the labours of Professor Weber, of Bonn, and to those of Dr. Polli, of Milan. The former, in order to study the effects of putrid animal matters introduced into the blood, endeavoured to eliminate, by filtration of the corrupted blood, all the solid matters that it might contain, so as not to confound the effects of a septicæmia with those of embolism and obstructed vessels. He was enabled to produce fever with rigors, sopor, &c., by the injection of filtered putrid blood, and he recognised the signs of gastro-enteritis, hæmorrhagic effusions into the mucous membranes, &c., upon *post-mortem* examination. By this plan he has demonstrated that, without any mechanical causes

produced by embolism, the introduction of septic materials produced characteristic affections.

The effect of injected solution of sulphuretted hydrogen was quite the same as that of the putrid fluids themselves, viz., profuse diarrhoeal evacuations, croupy inflammations of the bowels, congestions of the lungs, liver, spleen, and kidneys, fever, irritation of the spine, and opisthotonos. In some cases the symptoms were quite choleraic, with decided lowering of the temperature of the body. The blood corpuscles were much contracted and wrinkled; the blood became dark, and coagulated slowly.

Sulphide of ammonium acted in the same way, but less powerfully. On the other hand, butyric acid produced nervous phenomena, viz., somnolence, convulsions, paralysis, tetanus, and death. Dr. Polli, as the result of his laborious investigations of the subject of septicæmia and its allies, has constructed a theory, by which he holds that we must regard a true fermentation of the blood in the living animal, produced by the action of special ferments or catalytic agents, including such living organisms as bacteria and vibriones, as alike the exponent of this class of diseases and the source from which all our indications of treatment should be drawn.

*Pathology.*—The morbid agents which leave distinct traces of their passage or presence in the blood-vessels may be practically divided into three classes. 1. Those which on admixture with the blood determine its coagulation either in an injured part or in some distant capillaries. 2. Those which have a tendency to cause the fibrin (in combination with albumen) to separate from the other elements of the blood, and to deposit itself in some part of the circulating system. 3. Those which upon admixture with the blood produce its decomposition.

1. Coagulation of the blood in a vein may be either a primary or secondary affection; it may be either the cause or effect of the inflammation of the coats of the vein. In the one case the coagulation is determined by a diseased condition of the blood, quite independent of the vessels in which it is contained; in the other, it is produced by some impression conveyed through the coats of the vessels. Practically, however, these two classes of cases are not easily distinguished, for it is impossible in any individual case to say how far the blood in a vein may have become directly influenced by the contents of the *vasa vasorum* which are poured into it. The blood from the inflamed cellular coat may in this way be directly conveyed to the interior of the vein, and thus be a means by which the impression is produced which causes the coagulation of the blood in the interior of the affected vessel; or, on the other hand, should the coagulum be first formed, the obstruction of these minute vessels may be the means of producing the characteristic congestion of the venous coats. It is evident, then, that the vein and its contents may act and react upon each other. A description of the diseased actions in one will, therefore, necessarily involve a consideration of the morbid conditions of the other; and although for convenience these may be described separately, yet must they be considered as often occurring simultaneously in practice. The gravity of the symptoms will depend upon the nature of the matters conveyed from the diseased part, into the circula-



tion. The local symptoms need therefore bear no direct proportion to the constitutional affection.

The purely mechanical view of accounting for all secondary obstructions appears most imperfect. In the skin we may, indeed, observe the process by which these secondary congestions are formed. A circular patch will assume a livid hue, and every point will be equally affected. The blood in each capillary branch will become stagnant, while the surrounding skin will retain its natural appearance. It is quite unreasonable to suppose that all the vessels in the affected portions of skin should be obstructed by minute portions of the original clot, and that none of these should have passed into the unaffected parts of the skin. Such an action can only be accounted for by the coagulation of the blood in the part.

All the changes which take place in inflammation of one of the larger veins may take place in the secondary affections. The coagulum may be dissolved in the smaller as in the larger veins, and (together with any extraneous matter that it may contain) may be removed to some other part of the body, or, the coagulum remaining, it may lose its colouring matter, undergo a fatty or pigmental degeneration, or it may shrink and acquire the character of a fibrillated tissue, and become part of the organised structure of the body. Should the coagulum consist of irritating fluids in conjunction with the blood, inflammation will be set up in the immediate neighbourhood of the obstructed vessels. Lymph will be deposited, and will add to the induration which previously existed, and the circulation through the part will be still further obstructed. At this stage of the disease it is not at all uncommon for portions of the affected part to mortify; when the skin is affected this is probably the most frequent termination. In the lungs, which are supplied with blood from both sides of the heart, mortification is seldom observed, and in the spleen and liver it scarcely ever takes place, but the structure of these organs becomes broken down in a manner which much more resembles the effects of decomposition or softening than of inflammation.

Should the part not pass into a state of mortification, then, the following changes generally occur: the centre of the indurated mass becomes softened, and converted into puriform fluid. This fluid is often of a dirty-brown colour, as though some blood or small portion of the organ had decomposed in it. It is not contained, like an abscess, in a distinct cyst, but is surrounded by the purple induration, caused by the effused lymph mixed with the stagnant blood. By degrees all the affected portions lose their consistency and become broken down. The softening takes place from the centre towards the circumference of each discoloured spot, till they become converted into so many distinct abscesses.

2. The admixture of diseased secretions with the blood, instead of inducing coagulations, may give to the blood a tendency to separate into its different elements. Fibrin in combination with albumen will then be deposited in some part of the vascular system, where it may become united to adjacent parts, or the portions of fibrin so deposited may undergo further changes which bear some resemblance to ordinary suppuration.

3. Decomposition of blood in living vessels.

There can be no doubt that the blood is veritably poisoned by the introduction of putrid matters, and that death in pyæmia more often results from this condition than from any local effects. The symptoms, which follow the injection of putrid fluids are altogether more severe, rapid, and diffused than those which follow the injection of fluids containing solid particles. The phenomena of coagulation and embolism may be present or not; but the blood is so vitiated that it is no longer fitted for the nutrition of the tissues, and the interchanges which should take place between these no longer occur, and the circulation through the capillaries may consequently become arrested.

Decomposition may take place while the blood is yet in the living body. If once commenced it may rapidly be communicated either by contact or by the removal of the decomposing blood, either in a fluid or semi-coagulated state, to a distant part of the circulation. If a very small piece of cotton wadding, for instance, be soaked in a putrid fluid, and introduced into a vein, in twenty-four hours the blood, for many inches up the vein, will have formed a dark gelatinous clot, which if left will soon pass through the various stages of putrefaction. This action will be generally accompanied by inflammation of the vessel in which the decomposing blood is contained. The surrounding parts will then become involved, and the whole will form, if the action be sufficiently long continued, a putrid abscess. The following experiments of M. Gaspard indicate how readily the results of decomposition may be conveyed from one part of the body to another.

*Experiment.*—"Two ounces and a half of thick fetid fluid, derived from the maceration of cabbage leaves in an equal quantity of water for two days, at a temperature of 77° Fah., were injected into the right jugular vein of a moderate sized dog. During the operation the animal became faint, and vomited several times. Some hours afterwards there was a great uneasiness and oppression, with recurrence of the vomiting, and continued faintness during the day. After nine hours a most copious and very fetid evacuation took place. The discharge was as black as soot, and composed of mucus, with a little fecal matter, and a large quantity of what appeared to be corrupted blood. Some time afterwards there was a second evacuation of bloody mucus, exactly resembling the first. On the following day there was much loss of strength—the animal lay upon its side, or staggered as it walked. There was great and insatiable thirst, with a small, feverish pulse; but the most remarkable symptom was the occurrence, at intervals, of palpitation of the heart, accompanied by great increase of impulse and sound. On the third and fourth days the animal was better, but there was still great thirst, fever, and occasional rejection of fluids from the stomach. On the fifth day the symptoms became aggravated. There was extreme weakness, a tottering gait, excessive thirst, the eyes red, and filled with gum, the nostrils were stuffed, swollen, and obstructed with mucus, and the lining membrane of the mouth was tumid, and of a violet red colour. In the middle of the day there was a liquid greyish-white evacuation, resembling pus in its odour, consistence, and appearance, mixed with some clots of putrified blood. Death occurred during the following night.

*Post-mortem appearances.*—The mucous membrane of the eyes, nose, and mouth was red or violet, and covered by a very abundant thick mucus. The lungs were of a dark colour, with some black patches, but still crepitant. The left ventricle of the heart presented several brown stains, resembling ecchymoses, which penetrated into its tissue. Its internal surface was of the colour of lees of wine, offering a singular contrast to that of the right side, which contained a hard fibrinous concretion, two drachms and a half in weight, of a light yellow colour, and resembling grease in appearance. This was of the same consistence throughout, and everywhere free, with the exception of a portion of the size of a finger nail, which adhered to the inner surface of the ventricle. No appearance of the injected fluid could be recognised in this clot. It was continued, of the same colour and consistence, into the pulmonary artery, and into the vena cava, the vena azygos, the axillary, and even the right jugular vein.

The intestinal mucous membrane, especially of the rectum, the duodenum, and a small portion of the small intestines, was of a violet-red colour. It was inflamed in longitudinal stripes, and in patches, which gave a mottled appearance, even to the outer surface of the intestines before they were opened. This discolouration was not accompanied by any thickening of the tissues, nor by ulceration, and appeared rather the result of ecchymosis or hæmorrhage. The lining membrane of the rectum was principally affected, and its mucous glands were swollen and very prominent. This intestine contained matters resembling those evacuated before death. The other intestines contained a very thick greyish-white mucus. The mesenteric glands were enlarged. The gall-bladder contained black, thick, ropy bile, resembling melted tar.

*Experiment.*—"An ounce of putrid water, in which some beef had been macerated, was injected into the crural artery of a middling-sized dog. The artery having been tied, the pulse ceased below the tendo Achillis. A considerable degree of fever and restlessness followed the operation. This continued the whole day and the following night, without any vomiting or evacuations which so commonly followed similar operations upon the veins. The next day the limb was very painful, but not swollen. There was thirst, with the ordinary secretion of feces and urine. On the third day the animal was evidently better; the appetite had become almost natural, and he could walk more easily, although the limb still appeared very painful. In the night there were some soft, almost liquid evacuations. The fourth day the animal was evidently recovering, when an ounce and a half of very fetid and very concentrated fluid (derived from the maceration of beef) was injected into the crural artery of the opposite limb. The animal immediately evinced pain, accompanied by very violent and remarkable palpitation of the heart. It walked lame, keeping the leg raised, and soon became feverish and uneasy. The symptoms were exactly the same as after the first experiment. The leg became gradually more and more painful, and extremely sensitive, but not infiltrated with serum. During the night there was much expression of pain, and the animal was in continued motion. Death occurred nineteen

hours after the second injection. The limb had become swollen only within five or six hours previous to death. *Post-mortem appearances:* The limb presented a very large quantity of bloody fluid infiltrated in all the tissues. The superficial muscles were black, and presented more or less the appearances of gangrene. The deep muscles were entirely disorganised, and converted into a putrid pulp, resembling masses of the red lees of wine, extremely fetid, and disengaging a quantity of gas. The limb first injected was still swollen, and presented, in the interior of the adductor muscles, two or three cavities filled with a putrid bloody serum. In the chest, the lungs were healthy, as were also the right cavities of the heart, but the left cavities presented several reddish-black spots, scattered over their external surface. In the left auricle was a firm, yellowish-white coagulum, adhering to an inflamed spot on its inner surface. The intestinal canal was filled with a brownish-red fluid, resembling altered blood, which in the stomach and duodenum was of the colour of soot. The mucous membrane of these organs, as well as of the jejunum and rectum, were gorged with blood of the colour of the lees of red wine, but without any inflammatory thickening of their coats."

Another experiment performed by Gaspard sufficiently illustrates the fact that the blood is really poisoned by the introduction of putrid matters. He extracted some blood from the jugular vein of a dog, which had died from the effects of a putrid injection. Although this fluid was defibrinated and filtered, and was without any sign of putridity, its introduction into the jugular vein of a healthy vigorous dog gave rise to symptoms of blood-poisoning; the animal was attacked with vomiting and purging, but eventually recovered.

An important and very suggestive monograph, before alluded to, has recently been published by Dr. G. Polli, of Milan.

Under the head of *Morbific Fermentations of the Blood*, he describes the changes produced by the introduction of putrescible substances into the circulation. From his experiments upon animals he has arrived at the following:—

1. That the injection of a certain quantity of pus into the circulation produces pyæmia, and such diseases as are characterised by multiple abscesses.

2. That the injection of putrid matter produces septicæmia, or those diseases recognised by the name of putrid infections, and characterised by a typhoid gastro-enteritis.

3. That the injection of matter obtained from contagious diseases—glanders, for instance—will reproduce the same affections.

Dr. Polli gives many experiments illustrating the effects of the injection of putrescent materials into the veins of dogs. He relates particularly the effects of the injection of corrupted human pus, in quantities varying from two to four grammes: It appears that the animal recovers after injection of the smaller quantity, but generally dies between the fifth and seventh days after the operation for injection of the larger (four grammes). The symptoms correspond with those which have been narrated. At the post-mortem examination, the gastro-enteric mucous membrane was found in a state of inflammation, of dark red colour, and dotted with puriform exudation, and the lungs



presented numerous ecchymotic spots and blood-clots.

The injection of from one to three grammes of putrid blood into the veins of a dog was followed by symptoms similar to the above, but the disorder was of a much more serious character. As before, a dog would recover after the injection of the smaller quantity, but death generally took place after injection of three grammes. A similarly ecchymosed, bloody, and dark-red spotting, and congestion of the muco-enteric tract was present, particularly about the vicinity of the stomach, duodenum, and rectum.

The injection of the discharge from the nares of a glandered horse into the veins of a dog, even where the small quantity of half a gramme was used, gave rise to some of the phenomena observed in the above experiments, with numerous unhealthy abscesses in the skin, areolar tissue, and between the muscles. After death, the clots in the lungs were both more numerous and better marked than in the cases where pus was injected. These clots were oftentimes softened in their centres and converted into purulent-looking cavities.

From these experiments it appears that the action of decomposition commenced in one portion of the blood, may be propagated to any part, or to the whole system, and unless the action were checked, this would be the usual result. The blood is in a peculiar manner open to the influence of portions of liquefied fibrin or decomposing blood, after every lesion either from accident or disease. The evolution of ammonia is one of the first products of incipient decomposition. This also is said to be one of the essential conditions of coagulation of the blood. The same influence, therefore, that tends to set up a diseased action in the blood, would appear at the same time to have a tendency to limit the disease by producing coagulation of that fluid. It is true that the coagula thus formed may, in their turn, undergo disintegration or decomposition, and portions of the clot may be carried to and arrested in other vessels, or the products of its decomposition may be the means of infecting other parts. But, in other instances, the coagula remain firm, and prevent the extension of disease to the remainder of the blood, or along the blood-vessels.

The union of separated parts by a thin layer of blood, indicates what Hunter called the "intention" as much when such a union is temporary only as when it is permanent; and so the object of the coagulation of the blood in the veins, in cases where the process of decomposition is commenced, appears evident, although the remedial effect is not always attained.

When, through the introduction of a septic agent, the stagnant blood begins to decompose, and the action is not limited by its coagulation, the whole of the constituents of the blood are together involved in the changes which take place. An interval, however, even in the most strongly-marked cases of natural disease, usually elapses between the development of the infecting cause, and the manifestation of constitutional symptoms. This is especially the case where diseased secretions enter the circulation through the nutritious vessels of bone.

The cancellous structure of bone may be compared to the cellular tissue of soft parts. When inflamed, its interstices become filled up by the

effused products, and an abscess may be as accurately circumscribed in the hard as in the soft structures of the body. In a healthy constitution, the adhesive inflammation will, in this way, always precede the suppurative; but where the inflammation is not circumscribed by adhesion, the secretions may permeate from cell to cell in non-adhering parts. In soft structures, a remedy is at hand for allowing the escape of matter by a free division of the parts, but in bone, where the same process takes place, the hard unyielding sides offer an effectual obstruction to the escape of any effused fluid. An unhealthy inflammation is propagated along the endosteal membrane; the cells of the bone may then become infiltrated with inflammatory products, the sinuses and small veins become closed with coagula, and, if these coagula break up, there is nothing to prevent the diseased secretions and pieces of decomposing fibrin from finding their way into the general circulation. The morbid matter is detained for a certain time, during which the process of decomposition is established. The first infected portions of blood, together with the morbid matters which they contain, then pass on to infect the blood in adjacent vessels. The dissolved and putrifying fibrin from these, proceed further towards the centre of the circulation; in its course it will loosely coagulate fresh portions of blood, and then determine their decomposition. Every additional quantity of blood that is infected will add to the amount of putrid fluid in the vessels, and thus the disease will propagate itself, quite independent of the original source whence the morbid matter was derived. Each portion of blood which is attacked loses its vitality, passes into a state of decomposition, and becomes itself the means of infecting other portions. The contaminated blood may then be found in the vessels in every stage of decomposition, or it may have passed out of the vessels in which these changes have taken place, having first stained them of a deep livid colour. Long tracks of purple veins will occasionally be found, some being blocked up with viscid blood in various stages of putrescence, and some having discharged their contents, and being comparatively empty.

The frequency with which symptoms of pyæmia follow injuries to, or operations upon, bone is well known. The organisation of bone, and the comparative slowness with which remedial actions are carried on in it, render it peculiarly liable to interruptions in the process of repair, especially when, as not unfrequently happens, the vitality of some portions of bone with their peri and endosteal membranes has been threatened. The offensive smell of the bone, as well as the appearance of its cancellous structure infiltrated with unhealthy lymph and puriform matter, will frequently show, in such cases, that the processes above named have not followed their natural course.

The general result of putrid fluids in the system, whether introduced directly into the circulation, or injected into a serous cavity is, to produce a remarkable affection, characterised by a peculiar congestion of the mucous membrane of the stomach and intestines. The vitiated material or animal poison is determined to the muco-enteric tract, much in the same way that a mineral poison is when inserted through a wound. The evacuations that accompany this condition are evidently an effort of nature to relieve the system from the

vitiated fluids which have entered the circulation, and it is not a little remarkable that the mucous membrane, and none of the other coats of the intestines, should be affected in these cases. The appearances produced may be distinguished from the results of common inflammation, in that no thickening or shrinking of the tissues is produced, but they are swollen, congested, and blood-stained, either in petechial spots, in larger patches, or over a continuous surface. The discharge from the intestines in such cases consists chiefly of mucus, but this may sometimes be accompanied by a kind of passive hæmorrhage, and occasionally the secretion may assume a puriform character, without any abrasion of the mucous lining of the canal.

It may now readily be understood that the appearances and symptoms, which a few years ago were so often observed and described as forming a separate disease, under the name of *gastro-enteritis*, may frequently have been only secondary results produced by an unhealthy condition of the blood.

When the actions produced by the introduction of putrid fluids into the body are fully developed, all the indications of putrefaction may take place, even in the living body. Not only the fluids, but the so-called solids pass rapidly into decomposition, and the former would appear, in addition to being extremely liable to decompose themselves, to have the property of infecting other parts, and even other healthy bodies. Thus we read, that during the plague of Marseilles, the bile taken from those who had died of the disease, uniformly produced death when injected into the veins of dogs.

After a putrid element has been introduced into the system the blood is evidently altered in composition. It becomes black, viscid, and in a great measure deprived of its coagulating power. After death it is found fluid, of a very dark colour, and not unfrequently mixed with gas.

The long-continued congestion of the mucous membrane, as of other parts, has a tendency to terminate in the softening of the tissues involved. This is the case whether the congestion is of healthy or diseased blood, but the tendency is much more marked, and occurs much more rapidly, in the latter case than in the former. The congestion of comparatively healthy blood in the legs of old people, affords a common instance of consequent softening and breaking down of the tissues. A molecular necrosis occurs unattended with any great amount of inflammation.

In the treatment of affections arising from the presence of a septic poison in the system, it is important to remember that the alimentary secretions afford a natural method of relief. The determination of this class of poisons is evidently to the mucous membrane of the intestines, and every facility should be given for its elimination in that way.

In cases where the blood is more or less decomposed in the living vessels, it sometimes, as has been shown, does not coagulate at all, or any coagulum that may have formed becomes rapidly dissolved. In the latter case the colouring matter of the blood will stain any part with which it may lie in contact, and leave an appearance on the lining membrane of the blood-vessels which has often been mistaken for inflammation.

The *post-mortem* appearances in the more solid structures of the body, in those who die in conse-

quence of the introduction of vitiated fluids into the blood, often cannot be distinguished from similar changes produced by other causes, yet there are some effects which are peculiar, and may be directly associated with the reception of foreign matter into the circulation. The most characteristic circumstance, attending the extension of disease to different organs of the body, through the medium of the blood, is that several parts of these organs, or even different organs, will be simultaneously attacked. The disease will appear at once, in various spots, which will become rapidly disorganised, while the surrounding textures will remain unaltered, either in structure or colour. The appearances observed upon dissection will vary according to the part attacked, and the stage of development in which the disease is found. *The lungs* are the organs in which the successive changes may best be observed. The morbid processes affecting these organs are, perhaps, the most important and interesting, not only on account of their frequency and gravity, but because we can trace in them the type and pattern of those diseased conditions elsewhere seated. When portions of a disintegrating or decomposing blood-clot, or when puriform fluid has entered the circulation, the first appearance produced in the structure of the lungs, is that of one or more congested or dilated veins of very small diameter. If these be laid open, minute clots will be commonly found in their interior. This will be followed by a well-defined spot, of much darker colour than the surrounding texture. Several of these spots will probably appear at the same time, and each one of them will soon become surrounded by a spherical patch of purple congestion. Effusion of lymph will now take place, commencing in the centre of each affected portion, and gradually extending towards its circumference. If the disease continue, each spot will suppurate, and the different parts will become softened and broken down, in the same order in which they were previously solidified.

The morbid changes in the lungs will conform to one or other of the following descriptions:—

In the slightest degree of the affection, as we view the surface of the organ through the pleura, particularly about the edges of the lobes, it is found to be variously mottled and blood-stained. Numerous spots of congestion, blotches, or purpuric-looking dottings are discovered, forming separate foci, as it were, of disease. These appear dark and well-defined at the centre, with a congested-looking periphery, which passes into the healthy textures by a gradual diminution of the depth of colour. On cutting into these parts, the quantity of air is found to be diminished: a sero-sanguinolent fluid exudes, and we may perhaps discover the blood coagulated in one or more twigs of the pulmonary vessels.

In another and more advanced stage, these distinct centres of diseased action have become the seats of effused products, so that different lobules of the organ are hepatised, and no longer crepitate on pressure. There will generally be a softening or abscess in the central part of these lobules, where the action has first commenced, and where the effused products are remotely placed for vascular supply. In this last variety the organ becomes the seat of multiple abscesses, like small vomice, and with or without surrounding induration.



The serous covering may or may not be implicated. The surface over such diseased spot of lung may be covered with a freshly effused, soft lymph, which may conceal the lobular disease beneath. The marks of pleuritis are sometimes much more extensive and general, consisting of diffuent lymph and sero-purulent effusion. This inflammation is occasionally excited by the close proximity of pulmonary abscesses, or by their rupture and communication with the pleural sac.

The initial step in these morbid changes has to be sought for in the altered condition of the blood contained in the vessels, and not in the existence of a phlebitis. It is manifestly impossible, in every instance, to trace the presence of coagula in vessels so minute as those of the lungs, yet it can be done with sufficient frequency to justify the conclusion that they are commonly present at the onset. It is not until the healthy nutrition of the part has been affected, and inflammatory action induced, that the coats of the vessels participate in the disease. A coagulation of the blood may doubtless be the effect of inflammation, and not its antecedent, since we generally find the blood coagulated in the vessels of a pneumonic lung. But when the lung is no more affected than in the first variety, fortunately the condition of the blood in the vessels can be more easily traced than in the subsequent stages, and coagula or emboli are generally present.

Turning to the *heart*, which is, however, far more rarely affected, we discover that the morbid processes are essentially the same. In pyæmic carditis, small secondary abscesses may sometimes be found affecting the cardiac structures immediately beneath its investing membrane. The surface of the organ also presents numerous ecchymotic or purpuric-looking spots and blotches. Although the lymph may be general over the pericardium, as in the pleura, yet the cardiac muscle will generally be found diseased in isolated spots, with intervening portions of healthy structure. If the lymph be scraped off the pericardium, these will appear as small elevated opacities, which, when cut into, are found to be minute cavities with softened edges, and filled with a puriform fluid, or a pulaceous material.

The *liver* frequently becomes the seat of secondary inflammation. In the early stage, brownish spots may be observed scattered through its substance. These, as they extend, assume a bluish or slate-colour, and the structure of the liver thus affected is found to have lost its consistence, and to be very easily broken down by pressure. Every part affected here, as in the lungs, proceeds rapidly to softening and suppuration; and the usual appearance presented after death is that of several small circumscribed abscesses, around which the structure of the liver has been condensed only to a very small extent. It sometimes happens that the larger veins in the liver become affected. These vessels being held open by the firm structure of the part, are not so readily obliterated as in other situations; and it happens that the fibrin of the blood being more or less perfectly separated from its other constituents, is found in detached masses mixed with fresh portions of blood, which have not undergone the same change: a very peculiar mottled appearance, resembling granite, is thus occasionally produced.

Affections of the *spleen*, produced by the introduction of foreign matters into the blood, are pro-

bably not so readily recognised as similar affections in the lungs and liver. For although the spleen is often found to be diseased in those who die from infection of the blood, yet it is comparatively seldom that secondary abscesses have been found in it.

When the general mass of the blood has undergone a septic change, the pathological changes induced in the spleen are, sometimes, very marked.

Not only is the organ enlarged, but it is very irregular in point of consistence. Numerous conical, rounded, or oblong masses of induration are present in it; white, yellowish white, or chocolate in colour. The masses correspond to veins obstructed with fibrin and blood-clot, bounded by an irregular zone of vascular tissue.

The remaining part of the gland tissue may be so friable and softened, that it is very easily ruptured, and the diffuent contents exude through the rents like a thick treacle, leaving the indurated masses behind.

In the person of a previously strong and healthy man, who died very rapidly after being admitted into hospital with symptoms of delirium tremens, intestinal diseases and low fever, the spleen was found of a dark slaty hue upon the exterior; the trabeculae and interior of the gland were completely disorganised, and filled with a dark brownish mud-pulp, which drained off so completely as to leave the gland a loose bag of one-third of its original size, and containing, here and there, irregular indurations of altered fibrin and blood-clot. The heart had dark fluid blood in its left, and loose dark clots in its right cavities. The lungs were full of small abscesses and indurations (lobular pneumonia.) The intestinal mucous membrane was much congested, mottled with large ecchymotic-looking spots, and softened in places. In this case no injuries or external wounds (save a few bruises) could be discovered.

Deposits of lymph are sometimes met with in the *kidneys*. These are of small extent and of a light colour. The patches of congestion so characteristic of this disease in other organs, are not here observed. This may depend upon the peculiar disposition of the capillary system of the kidney. The blood has to pass through the malpighian tufts, and may be altered in character before it reaches the proper venous system of the organ.

In cases where purulent infection of the blood has been purposely produced, portions of the kidney will not unfrequently be found inflamed and firmer than natural; but if the origin of the disease were not known, these appearances could not always be distinguished from those produced by inflammation of the kidney from other causes. In a case where a fibrinous concretion had formed in the left side of the heart, and had afterwards become disintegrated, the kidneys were found, when examined by the author, to contain numerous masses of white deposit in various stages of softening.

The *skin* is liable to be affected in three different forms. The first of these occurs very rarely, and consists of small deposits of matter in the structure, or upon the surface of the skin, resembling in many respects the pustules of small pox. The second form is also of rare occurrence, and consists of small congested spots on the surface of the skin. These are generally of a dark purple hue, but sometimes they assume a bright red colour. In one case observed by the author a bright red eruption ex-

tended over the trunk and limbs, not unlike the eruption of scarlet fever. The third form presents itself much more frequently than either of the others, although it has not hitherto much attracted the attention of pathologists in connection with purulent or other infection of the blood. It commences very suddenly, and frequently without any particular attention being directed to the part. A large circular patch of congestion, livid or purple in the centre, but becoming of a lighter colour towards the circumference, will form, usually upon some part of the lower extremities. The skin of the calf of the leg is, perhaps, more frequently attacked than that of any other part. In the centre of the congested portion, mortification very rapidly takes place, and is indicated by the part assuming a black or dull leaden colour. In some cases, it would be difficult to say where the mortification ceases and the congestion begins, but in other instances, there is a distinct line of demarcation formed; a zone of bright red congestion will then occasionally surround the mortified part.

Some modifications of this third form of affection of the skin may be met with occasionally in the course of the disease. Blotches, assuming a livid or dusky-red appearance (which gradually fade into the colour of the surrounding skin), will present themselves in different parts, and terminate in thick exfoliation of the cuticle, or in small sloughs of the skin. In some instances the superficial portions only of the skin are destroyed, and the parts beneath appear comparatively unaffected; small circumscribed portions of the outer layer of the skin will exfoliate, and the subjacent parts will heal without suppuration, by a process similar to that of scabbing.

In the *cellular membrane*, serum, lymph, and pus may be deposited, mixed with each other in various proportions. The surrounding vascularity in these cases is usually small, and the lymph effused not properly organised; there is, consequently, no natural boundary to the disorganising process, and the fluid secreted becomes infiltrated in the surrounding parts.

When the *muscular structure* is affected, suppuration takes place with great rapidity; portions of muscles may be found quite soft, and sometimes pultaceous, in circumscribed patches, around which the fibre is perfectly healthy. Pus is occasionally deposited on the exterior of muscles, and it will be then smeared over the surface, and rather infiltrated in the cellular tissue, than contained in a cyst. In the interior of muscles there is the same absence of the natural limit to the inflammation; but owing to the more compact structure of the part, the deposits of matter generally remain circumscribed.

The *serous membranes* are peculiarly liable to be attacked by secondary inflammation, and when affected, suppurate with the greatest readiness. They generally exhibit but a slight degree of vascularity, and sometimes scarcely appear more injected than in their natural condition. In the peritoneal cavity, large quantities of unorganised lymph are frequently poured out, mixed with turbid serum or pus. The synovial membranes of joints, when affected, often appear to run directly into suppuration, and will become distended with pus in a very short space of time. The pleura on the other hand will seldom suppurate at first, but lymph will be deposited upon

its surface, and its cavity will contain turbid serum, occasionally mixed with blood.

The morbid actions which generally result in a contamination of the blood of the whole system may be confined in great part, if not entirely, to a particular set of vessels. This is illustrated by the following very interesting post-mortem examination, made thirty-six hours after death, and recorded by Dr. Marston, R.A.

Sergeant W., æt. 33, died on the 12th of February, 1867, having been subject for several weeks to great irritation of the stomach and intestines, accompanied by jaundice, and loose dark-coloured stools.

*External Marks.*—On the front of the chest and extremities there were numerous red, ineffaceable, petechial spots. On the back, these spots were of a dark livid hue. The skin of the neck presented a diffused redness, closely resembling scarlatinal rash.

*Abdomen.*—The cæcum, about the situation of its appendix, with the right extremity of the omentum, were found to be closely adherent to the abdominal parietes, and the adherent portions of a very dark colour. On opening the intestines at this part, it was found to be ulcerated and thickened, and the appendix was traced with difficulty from its being embedded in a mass of tissue in a semi-gangrenous condition. A small clot of half putrid blood, with some decomposing and highly fetid fæces were discovered on slitting up what appeared to be the vermiform appendage. Upon opening the *superior mesenteric vein*, it was found to contain some blood clots. In some places, these clots were so intimately adherent to the coats of the vein, and had been so hollowed out into a tunnelled form by the blood circulating through their interior, that the adhering fibrin looked like the lining membrane, but it was easily peeled off, and the epithelial coat below was found to be unaltered. As the epithelium presented the usual microscopical appearances, it was evident that the vein itself was not the cause of the coagula. The fibrin was a deposit from the blood in the part, and not the product from a diseased lining membrane. In some places where the tunnelling was less complete, portions of decomposing blood clot still remained, with a fluid exactly resembling pus. *The liver*, which was large and discoloured, was next examined, and found to be full of small abscesses, from the size of a millet seed to that of a walnut. These metastatic abscesses, which must have been some hundreds in number, were in most intimate connection with the various branches of the portal veins, spreading out from them like leaves from the twigs of a tree. The portal veins were laid open, and the main divisions to the right and left lobes contained decomposing clots with a quantity of pus, or a fluid like it to all appearance. The blood in the smaller branches was in a similar state, and, here and there, one of these small vessels appeared as a long white streak lying parallel to the section. The lobules, at the least affected parts, were surrounded by a dark ring of congestion which contrasted with the white interior of the lobule. These abscesses had no limiting membrane, but were, in fact, composed of the disintegrated elements of the necrosed hepatic tissue. *No abscesses* existed in the *lungs* or *other organs* (except in a few mesenteric glands), the



liver apparently having acted as an effective filter in preventing the passage of the decomposed elements into the general circulation.

*Symptoms.*—Sometimes, after an injury to a vein has been followed by the formation of coagula, symptoms of exhaustion, almost amounting to collapse, set in with all suddenness. The patient struggles and gasps for breath, while his features become remarkably anxious and pallid, without any appearance of venous discoloration. The pulse is small and intermitting; the skin cold, and covered with a clammy perspiration, and the muscular strength gone. The heart's action is loud, ringing, and irregular. These are symptoms of venous embolism; they denote that some coagula have reached the right side of the heart and even passed into its large vessels. This cardiac form of apœcia, as Dr. Richardson has so well remarked, is due to the non-transmission of blood to the air, and not to any impediment to the ingress of air to the blood. In Mr. Freer's case, recorded by Mr. Hodgson, these occurrences followed four hours after the saphena major vein had been tied for varices; and, in another case, described by Dr. Druitt (*Medical Times and Gazette*, July 19, 1862), similar symptoms followed the translation of a thrombus from a vein in the thigh to the right side of the heart. Several other cases have been recorded at different times.

The commencement of constitutional disease, after direct infection of the blood, is marked by the sudden change in the manner and appearance of the patient. A severe rigor is usually the most prominent symptom, and is followed by much febrile excitement, or by extreme depression. A very peculiar heat of skin will sometimes be present, while at other times the surface will be covered by a profuse clammy perspiration. The fever is irregularly intermittent or remittent in type, in the cases characterised by numerous blood clots and metastatic abscesses. Evening exacerbations are also commonly present. In cases of septicæmia, where a general infection of the blood exists without any necessary connection with blood-clotting embolism, and multiple abscesses, the range of the pulse and temperature is very much higher, and the fever more continuous in type.

Great depression frequently accompanies even the first stages of this disease, indicated by a want of tone in the pulse, by an extremely listless manner, and sometimes by a tendency to syncope. The countenance becomes anxious, the tongue dry and brown in the centre, and red at the edges; or, in other instances, it presents a coating of a pasty, yellowish-white colour; a dusky yellow hue frequently pervades the skin, and sometimes the conjunctivæ of the eyes. The pulse varies much in frequency in different cases, and at different times in the same case; generally, it is very rapid, especially when accompanied with much heat of skin. Sometimes there is severe pain, which may be referred exactly to the spot, that subsequent examination shows to have been the seat of secondary inflammation; at other times it is not confined to any particular situation, but consists of general ill-defined feelings of short duration, and recurring at irregular intervals. The peculiarity of such sensations is best expressed by the terms applied to them by the patients themselves—"catching pains all over," "soreness of the stomach," and "thrilling in the blood."

Vomiting may occur, either as a symptom of constitutional disturbance, or as indicative of inflammation of an abdominal organ. In the latter case it is extremely obstinate, and the fluid ejected is generally of a green colour. Diarrhœa is a symptom of frequent occurrence. Its appearance will not unfrequently be accompanied by relief of the other symptoms. When it occurs it is generally profuse, and little under the control of medicine. The intellect is seldom affected during the first stages of the complaint, but subsequently, in severe cases, restlessness, delirium, and coma, seldom fail to succeed each other. Death is commonly due to exhaustion in the cases of pyæmial fever attended with extensive exhaustion; but in other instances, it may be a direct result of the poisoned blood—a necræmia.

These symptoms are all peculiar, both in regard to the rapidity with which they make their appearance, and also the sudden manner in which they occasionally disappear. When this infection of the blood arises in surgical practice, the accession of these constitutional phenomena is often manifested from two to six days after surgical operations or injuries. When one of the large veins has been originally affected, the interval which elapses is comparatively short. In cases occurring after childbirth, it is usually longer, extending to the end of the second week. After surgical operations or accidents involving some portion of bone, the access of the disease may be marked by a rigor during the third or fourth week. The local phenomena which precede and accompany the constitutional malady are sometimes very indicative of a septic change. A wound, for example, ceases to appear healthy; the surrounding tissues become inflamed, the healthy secretions of pus and lymph cease—the part dries up, and this is succeeded by an ichorous discharge. Sometimes the areolar tissue becomes boggy and œdematous, or even emphysematous, from the development of gases arising out of a septic decomposition of the fluids. At this stage the decomposition, originating at a local region, may infect the general mass of the blood and rapidly kill the patient, without the occurrence of any blood clotting; or coagula may form in the vessels, disintegrate, and decompose, and become conveyed to other parts. In the last instance, the phenomena of thrombosis and embolism become superadded to the original septicæmia.

*Treatment.*—In the preceding pages the writer has endeavoured to indicate the true pathology of pyæmia, and has shewn that many and essentially different processes have been included within this term. Phenomena which *may* follow a phlebitis, properly so called, may equally ensue where there has been no such inflammatory affection. Those morbid conditions of the blood in which there is a tendency to the production of lesions of many and distant parts, with multiple centres of inflammation, commonly however take their origin from a coagulation of the blood at some definite point, or from the introduction of some septic or decomposing agent into the circulation.

When we examine into the phenomena which follow the injection of a purulent or decomposing organic substance into a vein, we perceive that these are capable of being arranged into two different series:—1. Those mechanical changes

which arise from the coagulation of the blood at the part, the breaking up of such coagulum, and the transference of portions thereof to distant parts, producing what is termed by Virchow thrombosis and embolism. 2. Those general alterations in the characters of the blood-fluid, which, whatever may be their exact nature, are highly suggestive of some molecular disturbances and morbid alterations of its constituents, such as unfit it for the nutrition of the tissues. It will be obvious that these need not be conjoined or concomitant effects. The first may be alone observed; but in the majority of instances perhaps, where the second has an existence, it is preceded and accompanied by the first condition. In injecting any substance into the blood capable of causing its coagulation, we have that substance included in such coagulum, and, if it be not discharged by a local process, portions of it may be transferred to other parts; and this is more likely to occur if the poison be one capable of generating its like out of the materials with which it is in contact.

The treatment naturally, then, divides itself into local and constitutional, both as regards the primary lesion and the subsequent affections. Whatever tends to favour the healthy healing of a wounded vein may be regarded as affording security against any subsequent disease; and the chief point in the local treatment is to prevent any accidental circumstances from interfering with the natural process of repair. When the powers of the constitution are enfeebled, even the natural motions of a part may interfere with recovery, and rest sometimes becomes an important object in the treatment. How necessary this is after childbirth, when the divided veins are being closed, every one who has attended such cases practically knows. Again, after bleeding, the arm will inflame in a much greater proportion of cases when the patient is obliged to follow his usual occupation, or when, from accidental circumstances, the arms are kept in motion. It has occurred to the author to see the symptoms of purulent deposits set in on the day following prolonged attempts to bring fractured portions of bone into position. In all such cases any external violence, or even the motion of the body, may loosen the coagula formed either between the wounded surfaces or in the cavities of veins.

If the description now given of the morbid phenomena in veins be the correct one, the distinction between the process by which fibrin or fibrinous coagula are deposited from the blood and that by which lymph is secreted from the lining membrane of a vessel is of primary importance, not only in regard to the pathology of this class of diseases, but also with regard to their surgical treatment. No surgical interference could arrest a morbid process which extends by continuity of action along the lining membrane of a vein; but such interference is both indicated and warranted if the occasional and severer symptoms of phlebitis depend upon the contents of some particular veins being transmitted, often in a more or less coagulated state, to the general vascular system. Such attempts have not been entirely wanting.

Hunter remarks that when inflammation takes place beyond the orifice of a vein so as to alarm the surgeon, he should immediately place a compress upon the vein at the inflamed part, to make

the two sides adhere together; or if suppuration has taken place, then the compress should be put upon that part of the vein just above the suppuration. Now, as lymph is not effused in the early stages of phlebitis as a secretion from the lining membrane of the veins, the adhesion produced by Mr. Hunter's method of treatment would be by coagulum of blood only. This would not, under ordinary circumstances, become organised. It would adhere only to the sides of the vessel, and it would be constantly liable to become displaced. Such an obstruction, although it might prevent, for a time, the morbid contents of a vein from entering the general circulation, could scarcely be looked upon as a permanent union of the sides of the vessel.

In cases where the affected vein is seated superficially, a much more certain and effectual way of closing its canal, and of barring the entrance of its contents from the general circulation, may be used. This method, which, when properly performed, I believe to be free from danger, has been recently adopted in several instances. It consists in making acupressure in a sound part of the vein above the disease in two places and dividing the vein subcutaneously between these two points. The result of this plan of treatment as far as it has hitherto been tried has appeared very successful.

As the process of reparation in veins has been variously described by authors, so the different theories propounded has led to different kinds of treatment. At the Veterinary College, even within the last few years, it was publicly taught that a coagulum in a vein was a foreign substance, and ought to be removed; and the jugular vein in horses which had been bled was sometimes slit up for several inches, in order to remove the coagula which formed in successive portions of its course.

That a coagulum in a vein may be an irritating substance has been fully proved, but the irritation then depends upon the accidental admixture of foreign matter.

To remove coagula in ordinary cases, is to remove the very means prepared by nature for the restoration and safety of the parts. Position, topical applications, bandages, and temperature may all have their influence in producing healthy actions. As the wounds which precede purulent deposits are generally characterised by feeble powers, those conditions which most tend to invigorate the parts are principally indicated. The irritability of a wound frequently appears to be nothing else than a series of attempts to bring about an action, which it has not the power to accomplish; as soon as that is fulfilled, which the necessity of the parts demands for their healthy condition, irritation will cease. In such cases everything that will confer strength to carry out the intended action will prevent inflammation. But no local applications are likely to accomplish this object, unless the powers of the constitution are supported at the same time. It is evident, observes M. Cruveilhier, that the treatment of phlebitis ought to be concentrated on the first period of the disease, viz., that of the coagulation of the blood. So soon as portions of a disintegrating or decomposing clot, or the septic products of a wound, have become mixed with the circulating blood, medicine is generally of little avail. Unfortunately, in a large number of cases, the contamination of



the blood takes place through minute vessels of a wound hidden from our sight; and the occurrence of severe constitutional symptoms is the first signal of a malady to which, only too often, there is but one end. When there are indications of the extension of inflammation along a vein, the mode of treatment formerly adopted in this country was the administration of calomel and opium; and in France, general bleeding, but especially the application of large numbers of leeches.

Such treatment was based upon false pathological views. The use of calomel and bleeding has now been generally abandoned, and a stimulating plan of treatment substituted for it.

Although a careful comparative experience be still wanting, the numerical evidence which we have in some diseases tends to indicate the plan of treatment which is most in accordance with the views now held and taught.

At a period when puerperal fever was rife, forty cases attacked with some form of the disease, says Dr. Ferguson, "were treated without any bleeding or leeching, or without any attempt to induce the constitutional effects of mercury, and of these only two died." So long as there are the local phenomena of venous obstruction from the presence of blood-clots, mercury is not only useless but injurious; and when the constitutional symptoms would indicate a general infection of the blood, the case can certainly no longer be termed one of inflammation at all, but it comes within the category, and requires the treatment of a blood disease of typhoid type.

The cases in which purulent deposits usually form, indicate a debilitated state of constitution. They are of much more frequent occurrence in large towns than in the country, and in hospital than in private practice. The depressing influences which give rise to erysipelas, and puerperal fever, will also predispose to the formation of these abscesses, and as scanty diet, loss of blood, debilitating surgical operations, and overcrowded rooms, have been found among the causes of the former, so may they be looked upon as favouring the production of the latter.

There are several very important points connected with the etiology and causation of these diseases, which have not yet been at all satisfactorily worked out.

There appears, for example, to be some intimate etiological connection between such diseases as phlebitis, inflamed lymphatics, the different forms of erysipelas, pyæmia, and putrid infection. They all seem to depend, to a very great extent, upon the presence of specific morbid materials in the blood, which are either introduced from without, or generated within the animal economy. The diseases we have named frequently occur simultaneously, and their prevalence and spread—if not their generation—would often seem to depend upon peculiar conditions of the atmosphere, particularly the atmosphere of hospital wards. What is the exact determining cause or causes of these disorders is beyond our knowledge, for we have not yet ascertained what the changes in the secretions of a wound are, which precede the general blood contamination. Of one thing the author feels quite certain, that when one of them, as for example erysipelas, has once originated, it is communicable.

It is not an essential character of such commu-

nication that the disease which follows should be exactly the same, for it has happened in the author's experience (in common with that of others), to have observed the appearance of cases of pyæmial disorder, after exposure to the erysipelalous poison. The two disorders are frequently combined in the same patient: a wound exhibiting the local characters of erysipelas, and the constitution exhibiting the symptoms of pyæmia.

Professor Simpson, in some suggestive papers upon surgical fever, has advanced some very cogent evidence upon the spread and communicability of these disorders. The most important practical lesson to be learnt is, that this group of diseases is preventible to a great extent. Whatever ministers to a defective hygiene, the presence of decomposing animal matter in the atmosphere—in one word, dirt—supplies the *external* conditions most favourable to their occurrence, and whatever ministers to the accumulation of those effete and waste products which produce an unstable condition of the blood and tissues, supplies the most favourable *internal* conditions. It is too much to hope that we shall be enabled to prevent these accidents to surgery by the most rigorous application of the most sagacious rules; but no one can doubt that much may yet be done. When we take the lowest rate of the recorded mortalities in some English hospitals, and contrast them with the highest rate of the continental hospitals, we cannot avoid perceiving the existence of external causes which are within our control, and remediable.

It becomes an interesting subject for inquiry, whether the application of acupressure, instead of ligature, for the arrest of hæmorrhage, will at all lessen the mortality in surgical practice.

In many cases the disease which gives rise to pyæmia has its origin in the interior of a bone. The veins are here held open by their solid walls and are placed under circumstances most favourable for the extension of disease after it has once commenced in their cavities. M. Jules Roux read a memoir before the Imperial Academy of Medicine at Paris, in 1860, in which he showed the great liability of what he termed osteo-myelitis to extend throughout the cancellous structure of any bone that has become affected by it, and he consequently recommends that where amputation is performed it should be done through the joint above the affected bone. This is the only mode we have in cases where absorption of morbid matter is taking place from the diseased cancellous structure of a long bone of preventing the further contamination of the general system.

An abundant supply of food, fresh air, a nutritious and stimulating diet, and the most scrupulous attention in preserving a cleanly state of all wounds are the main prophylactic measures.

The treatment of inflammation of the veins, in which purulent deposits so frequently originate, is thus spoken of by Sir B. Brodie, after matured observation: "All the experience that I have had on this subject would lead me to believe that, like erysipelas, it has its origin in a low asthenic state of the system, and that those persons are especially liable to it who have been much lowered by hæmorrhage at the time of an operation, or by too scanty a diet afterwards. An operation is a shock upon the nervous system, making a great demand upon the vital powers. The effects of this shock

are often much aggravated by loss of blood, and a very scanty diet actually makes the patient more liable to some kinds of inflammation. Our mode of practice ought to be rather to sustain his powers by allowing him wholesome nourishment, and not to add to the influence of the other depressing causes, the still worse one of starvation."

The general management of this disease after the formation of purulent deposits has commenced, is probably as little satisfactory as any that come under the notice of the surgeon. The whole course of the disease is characterised by what has been aptly designated "action without power." The excitement of the system will imitate all the acts of genuine inflammation, without any of its healthy results, and loss of energy will appear immediately after, or even arise in conjunction with, the first symptoms of increased action.

"What treatment," says Cruveilhier, "shall we oppose to purulent infection? To this question experience is as yet dumb, while the various remedies to which theory would seem to point have failed as signally in my hands as in those of others; yet, when the injection of putrid matters into the veins of living animals has been followed by abundant and very foetid evacuations, they have frequently got well." Cruveilhier conceived "that diseases resulting from purulent infection would not be stamped with the seal of incurability, and that nature, seconded by art, would triumph in the majority of cases if the pus, which is incessantly renewed, did not incessantly renew the sources of infection." In accordance with this remark, M. Gaspard found that animals which recovered after the injection of a certain quantity of pus into their veins, often died when the experiment was repeated. The recovery was usually preceded by black, liquid, and extremely fetid evacuations, which often seemed to afford immediate relief.

Dr. Polli, of Milan, has very recently published a monograph upon the diseases arising from purulent or putrid absorption and their treatment. Having shown by various quotations and observations (some of which were original) that many maladies have for their cause a fermentation of the constituents of the blood—sometimes determined by putrescible materials, or by ferments introduced from without, sometimes by spontaneous alterations of the materials of the blood itself, originated by the particular influences to which the organism was subject—he proceeds to take a narrower and more precise position, and to identify the supposed causes with the given species of disease, by producing artificially those maladies by the introduction into the blood of certain morbid ferments.

The summary conclusion of his experiments is, that with the injection into the circulation of the morbid materials indicated, we can artificially produce certain grave and well pronounced maladies, which shall exactly possess the general characters of diseases due to morbid ferments.

From this synthetical study of disease, he asks whether, if it be granted that the starting point of the morbid phenomena be due to the action of a specific ferment in the blood, it is possible to impede its effects, render it inactive, or neutralize it in the living organism?

It is well known that the eminent French physiologist Bernard, while he establishes the fact

that such fermentations can take place in the blood, holds that "the neutralisation of ferments is impossible, because, to do this, the properties of the blood would be changed to such a degree that life would be no longer possible."

Dr. Polli's efforts are directed to establish the doctrine that the neutralisation of morbid ferments in the blood of living animals can be effected without altering it in a manner incompatible with life.

Many substances possessed of anti-fermentative or anti-catalytic properties are known, but these possess such poisonous or caustic qualities as to render them inapplicable. Dr. Polli shows that sulphurous acid, in combination with the bases of alkalis or alkaline earths, possesses these powers in a marked degree, and can be used to almost any extent. Herein, then, lies the gist of Dr. Polli's discovery, and it rests upon the results obtained from 70 experiments, of which he cites 16 of the more important, in an appendix to his memoir.

His observations go to show that, by the addition of sulphites to the substances used for injection, we may prevent their injurious action; that if we inject a morbid agent, we may neutralise its effects by the administration beforehand of the sulphites as prophylactics; and that by their use, when the morbid ferment is already present in the blood, we may anticipate similar results.

Dr. Polli's experiments seem to have been well designed and carefully performed, and they are oftentimes crucial in their nature. Some of the results are conflicting, as might be anticipated, when we consider the great difficulties attending the subject; indeed, it is scarcely possible to keep the effects of a thrombosis and embolism separate from those of the blood poisoning, and in some of the cases described, the amount of the sulphites used was insufficient for attaining their full therapeutic action.

There seems to be great unanimity of opinion among the Italian physicians and surgeons, as to the therapeutic properties of these agents, both as local applications to unhealthy sores, in which they arrest the fœtor, diminish the pain, and promote healthy action, and as internal remedies.

The results obtained by the ordinary treatment of diseases of the type under consideration are so lamentable, that we cannot avoid hailing any aid with gladness which is put forward upon plausible reasoning, and attested by a fair amount of evidence. But clinical experience alone must test the value of this as compared with other plans of treatment.

In one of his pamphlets, Dr. Polli has recorded the experiments made upon himself, and another individual, with the view of defining the doses tolerated by the system, and of indicating their physiological action.

In the period of four days each of them consumed 50 grammes of sulphite of magnesia without inconvenience. Dr. Polli states that so large a dose as 4 grammes could be taken with so little inconvenience that he has no doubt that it might have been augmented to 5 or 6 grammes, if required.

From chemical observations made upon the excretions, he found that the sulphites are absorbed as such, and pass out by the kidneys. While some of these salts pass out of the system unchanged, the remainder are excreted as sulphates,



becoming oxidised at the expense of the oxygen in the blood and tissues. The observations indicate further that the salts are present in the urine at first as sulphites, then that these are mixed with sulphates, and that finally the sulphates only can be detected.

In a severe case of purulent absorption, according to Dr. Polli, it will be necessary to saturate the system, as it were, with the remedy, by giving it in doses as large as can be tolerated. With this view, these salts may be introduced by the mouth, by enemata, and through any wounds that may be present.

In cases of a more chronic or less urgent nature, we may give 15 or more grains of the sulphite of soda or magnesia as a dose, three or four times daily. As a lotion, injection, or gargle, the sulphite of soda may be used, from the strength of 2 or 4 drachms to the 8 ounces, or a saturated solution may be employed.] *Henry Lee.*

[*Abernethy*, Surgical Essays (Ill consequences succeeding Venesection), Edin. 1793. *Andral*, Précis d'Anatom. Pathol. Paris, 1828. *Arnot*, Med. Chir. Trans. Lond. 1829. *Balling*, Zur Vesentzündung, Wurzb. 1829. *Bouilland*, Recherches pour servir à l'Histoire de la Phlébite, Rev. Méd. à Paris, 1825. *Breschet*, De l'Inflammation des Veines, Journ. Complément, Paris, 1819; et Phlébite, Dic. de Méd. Paris, 1826. *Carmichael*, Obs. on Varix, &c.; Irish Coll. Trans. Dublin, 1818. *Cruveilhier*, Phlébite, Dic. de Méd. Prac. Paris, 1834. *Dance*, De la Phlébite, &c. Archives de Méd. Paris, 1828. *Davis*, Med. Chir. Trans. Lond. 1823. *Frank*, De Phlebitide, Prac. Med. Univ. Taurin, 1825. *Hasse*, Pathological Anatomy, Syd. Soc. Translation, Lond. 1846. *Heressé*, Sur la Phlébite, Journ. de Méd. Paris, 1806. *Hodgson*, Treatise on Dis. of Arteries and Veins, Lond. 1845. *Hunter*, On the Inflammation of Veins, ed. Med. Comment. Edin. 1775; and Obs. on the Inflammation of the Internal Coats of Veins, Med. Chir. Trans. Lond. 1793. *Langstert*, Theoria de Arter. et Ven. Affect. Prag. 1764. See Diseases of the Veins; Cyc. of Med. Lond. 1834. *Lee* (*Henry*), On Phlebitis and Purulent Deposits, Lond. 1850. *Longuet*, Sur l'Inflammation des Veines, Paris, 1815. *Neisfeld*, Ratio Medendi Morbos Circuli Sang. Bres. 1773. *Phæbus*, De Concrementis Venarum Osseis et Calculosis. Berd. 1832. *Puchelt*, Des Veneusystems, &c. Lips. 1818. *Ribes*, Exposé des Rech. sur la Phlébite, Rev. Méd. Paris, 1825. *Sasse*, Dissertatio de Vas. Sang. Inf. Hal. 1797. *Schmuck*, Dissert. Sistens Observ. De Vas. Sang. Inf. Heidelb. 1794.]

**QUININE, SULPHATE OF.** This valuable preparation of bark, which is prescribed in a large number of surgical cases, may be exhibited in doses of from one to five grains, three or four times a day, according to circumstances. As its solubility in water is increased by an excess of acid, one drop of diluted sulphuric acid is frequently added for every grain of quinine. When, however, circumstances render it advisable to dispense with the acid, the sulphate of quinine may be prescribed without it, dissolved in the Tinct. Aurantii, or in the form of pill, either by itself or combined with opium, blue pill, squills, Extractum Conii, &c. It may also be given to children mixed with syrup.

**RACHITIS.** (From *ράχis*, the spine of the back, because the disease was once supposed to depend on disease of the spinal marrow.) The rickets. See **RICHETS**.

**RANULA.** (Dim. of *rana*, a frog.) A tumor under the tongue, usually believed to arise from an accumulation of saliva in the duct of the submaxillary, and occasionally in that of the sublingual gland. The term is derived, either from an imaginary resemblance of the swelling to a frog,

or from the disease making the patient, as it were, croak when he attempts to articulate. Such writers as have treated of this disease before it was known that the parts affected by it were destined for the secretion of the saliva, could have no accurate notions of its true nature. Celsus is supposed to have alluded to ranula, in the fifth section of his seventh book, where, after treating of the diseases of the tongue, he introduces the following passage: *sub lingua quoque interdum aliquid abcedit, quod fere consistit in tunica, doloresque magnos movet.* The latter circumstance, however, renders it probable, that some other affection was signified, as a ranula is rather attended with a sense of restraint, than of pain. Fabricius ab Aquapendente and Dionis considered a ranula as an encysted tumor of the meliceris kind. Munick expressly says, that the affection originates from a thick saliva, which, not being able to pass out of the salivary ducts, accumulates under the tongue, so as to cause a swelling in that situation. De La Faye, in his notes on Dionis, adopted Munick's view: he says, "There are two sorts of ranulae; some, which are round, and situated beneath the tongue, seem only to be produced by a dilatation of the excretory duct of the sublingual gland; the others are longer than they are round, are situated at the side of the tongue, and are formed by a dilatation of the excretory duct of the inferior maxillary gland. The fluid which fills such tumors is the saliva, which gradually accumulates in them, in consequence of its viscosity and the atony of the duct." Now and then the contents are purulent, and very often calculi are met with. (*Dupuytren*, Clin. Chir. t. iii. p. 302.)

[Mr. Holmes Coote mentions an anomalous encysted tumor with unusual contents in the position of a ranula but more solid and firmer. The patient was under the care of Mr. Lawrence, who made an incision into it, and removed from its interior a quantity of thick matter of the consistency of putty. The cyst, which was not very adherent, was dissected out, and the patient did well.]

The fluid which escapes from an ordinary ranula does not chemically resemble inspissated saliva. The examination of the fluid of a ranula from a boy twelve years old, gave the following results:—Water 94·6; soluble albumen with a very small quantity of stearine, osmazome, salivary matter? and carbonate, nitrate, and acetate of potash 5·1 in 100 parts; but no sulpho-cyanite of potash, and only a trace of salivary matter. A small concretion, however, removed from Wharton's duct according to Dr. L. Possell, contained 7·8 of salivary matter soluble in water, 13·3 of salivary mucus insoluble in water, 68·87 of sulphate of lime, 9·93 of carbonate of lime. In another specimen of salivary calculus Poggiolo found neutral carbonate of lime 94 $\frac{3}{4}$ , animal matter 4, water 2, in 100 parts. Translation of *Chelius* by South, pp. 405–6, vol. ii.]

The excretory ducts of the submaxillary and sublingual glands appear to be the only ones liable to this change; for the texture of the parotid duct is too dense to yield and constitute a swelling of the above description. Baron Dupuytren, who has made the foregoing reflection, adds, that the seat of ranula has not yet been anatomically demonstrated, and that it is very desirable that there

should be an elucidation of the questions by dissection, whether this disease is situated in the salivary ducts beneath the tongue? or whether it consists merely in a serous cyst? or else in one of a mucous, or sero-mucous texture, formed of the dilated follicles? The same distinguished surgeon then expresses his own suspicion, that tumors of different natures, belonging in turn to one of these three kinds, have been, on account of their situation, indiscriminately confounded together under the name of ranulæ. (*Clin. Chir.* t. iii. p. 297.) Malgaigne believes, that ranulæ are most frequently only serous or sero-mucous cysts, developed under the mucous membrane of the mouth. (*Man. de Méd. Opér.* p. 463. ed. 2.) Dupuytren notices the observation of certain writers, that children are sometimes born with ranulæ; but suspects, that such tumors are only serous cysts situated under the tongue, and which occasionally become so large as to reach down to the sternum. M. Breschet dissected five of these pretended ranulæ, and found them to be of the latter description. (*Répertoire d'Anatomie.*)

Leaving out of consideration mucous cysts with opaque pultaceous contents and large bursal and other cysts, which occasionally are found to extend from the mouth into the neck, not perhaps correctly described as ranulæ, still there remain the more common transparent tumors under the tongue, the pathological anatomy of which is not yet sufficiently determined. They are evidently not all formed in the principal duct of the sub-maxillary or sublingual glands, though many of them are. But I am inclined to believe that all cases of true ranulæ are in obstructed salivary ducts either in the principal ducts or in some of their ramifications.

The closure of the orifice of the duct of the sub-maxillary gland may be the result of inflammation of the sublingual mucous membrane, or of the tongue itself. Aphthæ and ulceration may obliterate the duct. Sometimes, when the frænum of the tongue is divided, some of the excretory ducts opening on each side of it are cut, and may become obliterated. (See *Dupuytren, Clin. Chir.* t. iii. p. 301.)

If the tumor acquires a certain size, it pushes the tongue backwards, displaces or injures the teeth, affects the voice, obstructs speech, mastication, and deglutition, and in infants interferes with the action of sucking. Lastly, the tumor may project out of the mouth, or beneath the jaw.

[Mr. South relates that the elder Cline used to mention in his lectures that he was one morning alarmed by the noise of a person breathing with great difficulty in the next room to his consulting room, and, on hastening in, he found a man stretched on a chair and almost suffocated. On being inquired of as to what was the matter, he pointed to his mouth, upon looking into which Cline observed a large ranula, which he instantly punctured with a lancet, and relieved the patient from the threatening suffocation.]

Persons who move their tongues a great deal, and those who sing, have been set down as very liable to the present complaint; but this opinion, I believe, rests on no good foundation. The fluid in the tumor is precisely like white of egg; but it is thicker, after having remained a long while in the swelling; and it is occasionally of a calcareous, and even stony nature. Ranula does

not proceed from an inspissation of the saliva, as De la Faye supposed, but from an obstruction of the duct or orifices of this tube. The collection may produce a tumor of large size; but the swelling generally bursts when it has attained the dimensions of a walnut.

Mr. B. Bell met with a case, where an ulcerated opening had formed, and been treated in vain with various detergent and corrosive applications, and even a mercurial course. At length, the true cause of the disease having been ascertained, a cure was accomplished in a few days, by removing a piece of calcareous matter, which, by obstructing the duct, had first caused the swelling, and then ulceration.

With the intention of easing a ranula an opening is frequently made into it with a lancet, but the incision closes up again, and the swelling reappears. J. L. Petit relates a case, in which the puncture was repeated ten times, and yet the cure was not accomplished. The ancients made the same remark; and hence, Paré preferred the actual cautery to the lancet. Dionis had also seen ranulæ recur, after they had been simply opened with a lancet; and he recommends, for the prevention of this inconvenience, the application of a mixture of honey of roses and sulphuric acid to the inside of the cyst, so as to destroy it. By the introduction of a piece of lint into the cavity, or by freely opening it, and removing the edges of the incision, the chances of success are increased; but even these methods may fail, as I know from experience.

M. Louis having observed that the radical cure depended on a fistulous aperture, through which the saliva continued to flow, recommended such an opening for the saliva to be made, as would not close.

Le Clerc recorded a case in which the root of the swelling extended under the tongue; the tumor filled the whole mouth; the prominence which it formed outwardly was as large as a duck's egg; and the disease, in its progress, had made the teeth of both jaws project outward. At some parts of its surface, a fluctuation was perceptible; other places were exceedingly hard. The patient, who could scarcely breathe, demanded assistance; and a puncture was made in the softest part of the swelling below the chin. A thick yellowish fluid issued out of the ranula. The opening was enlarged with a knife, and about a pint of gritty inodorous matter was extracted. There was no hæmorrhage from the cut; and no sooner had the contents of the swelling been let out, than the patient began to articulate, which he had not been able to do for a long while. The sides of the tumor being so prodigiously distended, Le Clerc thought proper to destroy the inside of the cavity with a tent, dipped in a mercurial solution. The cure was completed in a month, and the tongue gradually regained its original size, a part of which it had lost.

But, as M. Louis observes, fortunate as the termination of this case was, it must not be indiscriminately set down, that destroying the cyst or even opening the tumor, is always requisite. A more simple method will sometimes succeed. In a particular case, which this gentleman has related, a sinusity, which divided the swelling into a right and left portion, made him suspect that it consisted of two sacs, in contact with each



other. On each side, in front, and in the same line, there was a point, which was the orifice of the salivary duct, somewhat dilated, and blocked up with a viscid matter. Having very easily passed a small probe into the orifices, a matter similar to white of egg made its escape. A small leaden probe was passed into each opening, and, two days afterwards, the sacs were emptied again, and two pieces of lead, somewhat larger, introduced. The patient was advised to take out the pieces of lead every morning, empty the swellings, and then replace them. In a fortnight, the openings, having been kept continually dilated, had no tendency to close; the saliva did not accumulate, and the ranulæ never appeared again. Sabatier also employed a tent, or piece of bougie, with success.

I attended a young lady who had a ranula, in which the plans of freely opening the cavity, of transfixing it with setons, of removing portions of the cyst, and of introducing into it lint wetted with a strong solution of nitrate of silver, all failed. The latter experiment caused a great deal of pain, and some swelling of the glands of the neck. I therefore decided to try the effect of making a small puncture in the tumor, and keeping in it a very small silver canula, constructed with a little circular rim at its outer end, to prevent it from slipping into the sac. In about three weeks a cure was thus accomplished. The tube gave no inconvenience, and kept in its place remarkably well. Instead of a tube, Dupuytren preferred a little contrivance, termed *bouton à demeure*, consisting of two thin elliptical metallic plates or buttons, five or six lines broad in the greatest diameter, and joined together by a pedicle two or three lines in length, and the external surface of which plates was convex, the internal concave. A puncture two lines long having been made in the tumor about an inch from the point of the tongue, and its contents discharged, one button is introduced with the aid of a pair of forceps into the cyst, and the other remains in the mouth. This little instrument may be worn without inconvenience as long as necessary, the fluid of the cyst regularly escaping between the connecting pedicle of the instrument and the sides of the opening. (See *Clin. Chir.* t. iii. p. 316.)

Boinet related, to the French Academy, a case, in which the swelling not only filled the whole mouth, but one half of the tumor projected out, and a cure could only be accomplished by excision. The two upper incisor teeth, on the left side, were lodged in a depression observable there: and the canine tooth, of the same side, forced outward by the mass of the disease, had pierced the lip near its commissure. A fluid resembling mucus flowed from a narrow aperture at the lower part of the swelling. The tongue could not be seen, so much was it pushed backward, and for some time, the patient had only subsisted on liquid food, which he was first obliged to convey to the back of the throat with some mechanical contrivance. The four incisor teeth, two canine, and first grinders of the lower jaw, had been pushed out of their sockets, by the pressure of the swelling. The patient's aspect was alarming, and he was threatened with suffocation. Extirpation was deemed necessary, and performed with caution. The large cavity thus occasioned was filled with lint. The lower jaw being diseased,

Boinet scraped some of its surface off, and covered the places with lint, either dry, or dipped in spirit of wine. Some exfoliations followed, and the fungous granulations which grew were repressed by proper applications. In three months the parts were healed in so regular a manner that the motion of the tongue was not in the least obstructed, and no defect continued, except the alteration of the voice, occasioned by the loss of teeth.

*Louis*, in *Méd. de l'Acad. de Chir.* t. iii. *Sabatier*, *Méd. Opératoire*, t. ii. p. 19, &c. ed. 2. *Callisen*, *Systema Chirurgiæ Hodiernæ*, vol. ii. p. 108, &c. *Hafniae*, 1800. *Lassus*, *Pathologie Chir.* t. i. p. 402, &c. 8vo. *Paris*, 1809. *Richter*, *Anfangsgr. der Wundarzn.* b. iv. cap. 1. Gøtt. 1800. *J. J. Stahl et J. F. E. de Schoenbergen*, *De Ranulâ*, sub *Linguâ speciali cum Casu*, Erford, 1734. *Breschet*, in *Répertoire d'Anatomie* and in *Journ. Univ. des Sciences Méd.* Décembre, 1817. *J. P. Malgaigne*, *Man. de Méd. Opér.* p. 463. 12mo. *Paris*, 1837. ed. 2. *Baron Dupuytren*, in *Léçon's Orales de Clin. Chir.* t. iii. 8vo. *Paris*, 1833, art. 11.

**RECLINATION.** A term employed in Germany to denote the operation of turning a cataract, so as to change the position of its anterior and posterior surfaces. (See CATARACT.)

[RECTOCELE. This term has been applied to a protrusion of the rectum into the vagina—the posterior wall of the vagina being pushed before it as a covering. It occasionally happens, when the perinæum has been partially ruptured, or when, without any rupture, the perinæum and vaginal outlet have been so much dilated, or have become so much relaxed as not to afford an adequate support to the pelvic viscera, that dilatation of the rectum and posterior wall of the vagina is gradually induced, and those parts are protruded through the vulva in the form of a tumor, which is at first of small size, but which may by degrees become as large as, or larger than, the fist. To this condition the term *vaginal rectocele* has been applied by Malgaigne, who gave a detailed description of it. (See “*Mém. sur un Prolapsus du Rectum dans le Vagin*,” &c., *Mém. de l'Acad. Royale de Méd.* t. vii. p. 486. *Paris*, 1838.) It had, however, been previously noticed by Sabatier, who pointed out the difference between simple prolapse of the vagina and the prolapse of the rectum with the vagina now under consideration. It was also well known to Sir Charles Clarke, who in 1814 gave a clear and accurate description of it under the name of *procidencia vaginæ*, while he called the analogous condition in which the bladder and anterior wall of the vagina are protruded, *procidencia vesicæ*. Such a nomenclature is confusing; it is better therefore, to adopt the terms proposed by Malgaigne, of vaginal rectocele for the one case, and vaginal cystocele for the other; and to restrict the term prolapse of the vagina to the descent of the vaginal membrane only, not involving the adjacent structures. This latter condition, if we except those cases in which it is associated with prolapse of the uterus, is of extremely rare occurrence. The vaginal cystocele has been described in this Dictionary under the heading of BLADDER, PROLAPSUS OF.

It should be understood that in rectocele there is no displacement of the entire rectum; its posterior surface maintains its normal relation with the sacrum and coccyx; its anterior surface only is involved, and becomes dilated into a pouch, which carries the vagina before it as a covering. When

fecal matters descend into the rectum, they distend this pouch, and the muscular fibres, being weakened by the dilatation, are unable to expel them; while the abdominal muscles, when called upon to assist, expend their force upon the pouch, which they tend still further to dilate. A rectocele is almost invariably of gradual formation. Malgaigne, however, mentions two instances in which it was suddenly produced, in one case by a fall, and in the other by lifting a heavy weight. Both these patients were far advanced in pregnancy.

On examination of the parts, protrusion of the posterior wall of the vagina is observed; and when the patient strains, the protrusion is increased in size. The finger, when introduced into the rectum, can readily be turned forwards into the swelling, thus showing that the rectum, as well as the vagina, is involved; while by passing the finger into the vagina in front of the swelling, the uterus is felt to be in its natural position or nearly so.

This affection causes great discomfort to the patient. There is a feeling of weakness and of bearing down in the perineal region, with obstinate constipation and great difficulty in evacuating the rectum. Often this cannot be effected until pressure has been made upon the tumor from the vagina to squeeze the contents out of it—until, in fact, the deficient contractile power of the rectum has been artificially supplied and properly directed towards the natural outlet.

It has been already stated that partial rupture of the perinæum predisposes to this affection. It is otherwise, however, when the rupture is complete and extends through the sphincter. In the latter case there is incontinence instead of constipation, for when the feces pass into the rectum there is nothing to prevent their escape, and dilatation, therefore, can hardly occur. Mr. Bryant, however, has recorded a case in which both conditions were present in the same person. (See *Guy's Hosp. Reports*, 1865, p. 276.)

It is necessary to remark that prolapse of the posterior wall of the vagina may occasionally proceed from other causes than that now under consideration. A vaginal hernia, for instance, in which the intestine descends between the vagina and rectum, pushing before it the recto-vaginal fold of peritoneum, might cause a tumor similar in external appearance. Sir Charles Clarke mentions a case in which protrusion of the vagina was caused by the descent of cysts connected with diseased ovaries. It might also possibly be dependent upon an abscess in the recto-vaginal septum. The nature of the case, however, is at once made clear by examination of the interior of the rectum, the cavity of which will be more or less encroached upon in any of the cases just mentioned; whereas in rectocele it will be dilated, and the finger can be passed forward into the swelling.

*Treatment.*—It is only within the last few years that any effectual remedy has been devised for this complaint. The measures formerly adopted were palliative only. Sir C. Clarke recommended the use of astringent injections, and in severe cases a globular pessary to be worn in the vagina. Malgaigne relates cases in which attempts were made to diminish the calibre of the vagina by dissecting away portions of the mucous membrane covering the swelling, and uniting the edges of the incision by suture; but the result was not encouraging, and he therefore was content with a pessary to retain

the swelling in its place. What is wanted is the restoration of that support to the pelvic floor, the loss of which is the essential cause of the complaint, and the only way in which this can be effected is by closure of the ruptured or relaxed perinæum to a sufficient extent to retain the protrusion. For this purpose the operation for rupture of the perinæum has been now frequently applied with very satisfactory results: in the first instance, we believe, by Mr. Baker Brown. The operation required is essentially the same as that for rupture of the perinæum, and its details will be described in the article on that condition, to which the reader is referred. If it is properly performed, a thick and firm perinæum is obtained, capable of effectually retaining the protrusion, and the result will be a complete cure of the complaint. The sensation of weakness and bearing down is no longer felt, and the constipation, so far as it depends upon the mechanical difficulty in emptying the rectum, is relieved. It may be objected that the restoration of the perinæum does not cure the dilatation of the rectum and vagina but merely prevents their protrusion externally. It will be found, however, that when these parts are retained in their proper place they gradually return to their proper dimensions. It must be remembered that the dilatation is not the essence of the complaint, but only takes place from mechanical reasons, in consequence of the loss of support in the pelvic floor. When that support is supplied, the dilatation by degrees disappears, or at any rate is so much lessened as to be of no practical inconvenience. The writer having operated in numerous cases in the manner suggested can speak from personal experience of the perfectly satisfactory results obtained. (See *Lancet*, Feb. 3, 1866, p. 117.)

James R. Lane.

[RECTO-VAGINAL FISTULA. A recto-vaginal fistula is an abnormal communication between the vagina and rectum. It is most frequently caused by sloughing of the recto-vaginal septum from long-continued pressure of the foetal head during labour, or from laceration of that part by the unskilful use of instruments. It may also arise from abscess, bursting on one side into the vagina and on the other into the rectum, from venereal ulceration, ulceration accompanying stricture of the rectum, or cancerous disease. When the aperture is small the inconvenience may not be great, and may be confined to the occasional escape of flatus, or of fecal matters when the bowels are relaxed. But when the aperture is larger, more or less of the feces will always escape from the rectum into the vagina, and the condition of the patient is most distressing, though the annoyance is perhaps less constant than in the case of a vesico-vaginal communication.]

When the aperture is small its closure may sometimes be effected by cauterisation with the actual cautery, or with some powerful caustic as nitric acid or the potassa fusa. But when it is of any magnitude, the only chance of closing it is by a plastic operation. The edges of the aperture should be carefully denuded, and the cut surfaces brought into accurate contact with metallic sutures. The mode of doing this will be described in detail in the article on vesico-vaginal fistula, it is therefore unnecessary to enter upon it here. After the operation, the bowels should be confined by opium for eight or ten days, when an aperient



should be administered, followed by an injection. The sutures should not be removed till after the bowels have been emptied. An operation of this kind, if the part is in a sound condition on both sides, will succeed in the majority of cases, and a perfect cure will be the result. It is useless, however, to attempt it under other circumstances. When there is ulceration in the rectum from stricture, and still more of course when there is cancer of either rectum or vagina, there is little or no chance of union following a plastic operation. The probability of success is greater when the operation is situated somewhat high up in the recto-vaginal septum than when it is low down near the sphincter. In the latter case the action of the muscle interferes greatly with the continued apposition of the edges, and is very likely to prevent union taking place. So much is this the case, that, according to the writer's experience, and in order to avoid disappointment, it is better at once to lay open the fistula completely by cutting through the perinæum and sphincter muscle, and afterwards to bring the parts together by the operation suited for laceration of the perinæum. (See RUPTURE OF THE PERINÆUM.)

James R. Lane.

[RECTO-VESICAL AND RECTO-URETHRAL FISTULA.—These can obviously only occur in the male subject. Both are rare, the former especially so. A recto-vesical communication is, however, a possible result of ulceration or abscess accompanying stricture of the rectum, or of malignant disease in either organ. In such cases any effectual surgical treatment is out of the question. The urine passes into the rectum, where it is retained by the sphincter, and where its pressure produces considerable irritation. The fæces also pass into the bladder, causing still greater distress. A recto-urethral fistula may be the result of abscess in the prostate, breaking into the rectum. Sir H. Thompson met with such a case, in which the urine passed by the anus for some weeks. After trying various means, the use of the catheter, &c., he found that when the patient lay flat on his face during micturition nearly all the urine passed by the urethra. This plan was therefore adopted for three months, and by the end of that time the fistula was soundly healed. (See *Holmes' Syst. of Surg.* vol. iv. p. 414.) A small communication between the urethra may perhaps be closed by stimulating its edges with nitrate of silver, and should that fail, by the application of the actual cautery. When the opening is larger its edges must be denuded and brought together with silver-wire sutures. The part can be reached without any great difficulty by using the duckbill speculum in the rectum. The method pursued should be the same as in vesico-vaginal fistula. A case of fistula which followed the operation of recto-vesical lithotomy, which was successfully closed in this way by the writer, has been mentioned in article LITHOTOMY, p. 245. See also *Lancet*, Feb. 6, 1864. Other cases of congenital communications between the rectum and the bladder or urethra have been mentioned in article ANUS, vol. i. p. 265.]

James R. Lane.

RECTUM, DISEASES OF.—Many cases, in which this bowel is more or less concerned, are treated of in other parts of this Dictionary, and therefore it will only be necessary for me here to refer to them, and then notice some diseases of the same bowel, which are not considered in other articles.

In the article ANUS will be found an account of abscess, fistula in ano, anal fissure, imperforate anus, and artificial anus. Under the head of *Intestinal Concretions*, I have noticed the dangerous obstruction of the rectum by masses of indurated matter. In the article LITHOTOMY, the mode of cutting through the rectum into the bladder, for the purpose of extracting a calculus from the latter organ is explained; and if the reader refer to BLADDER, he will there find a description of the method of tapping it from the rectum. The diseases of the rectum remaining to be described are hæmorrhoids or piles, prolapsus, polypus, ulcer, stricture, and cancer of the rectum.

PILES—HÆMORRHOIDS.—From αἷμα, blood, and πῆμα, to flow.

The lower end of the rectum is frequently the seat of tumors, which in many persons bleed from time to time, and hence are called *hæmorrhoids*, or, in common language, *piles*. Such as had not this hæmorrhagic character, were termed by the old surgeons *blind piles*; while those which bled were named *open*. More important practical distinctions are those of *external* and *internal piles*.

With respect to the nature of these swellings various opinions have been entertained. Some writers have expressed their belief, that the blood discharged from them comes neither from arteries nor veins, but from the intermediate capillary vessels. (*Montegre*.) Laennec and Abernethy espoused the doctrine, that piles are the result of the formation of new vessels. Lastly, Stahl, Alberti, Vesalius, Morgagni, J. L. Petit, and Pinel, regard them as dilated veins, true *varices*, and such was the opinion of Dupuytren. (See *Lecçon's Orales de Clinique Chir.* t. i. p. 340.)

The latter is the view entertained by Sir Benjamin Brodie:—"A patient consults you, complaining of swelling, pain, and tenderness in the neighbourhood of the anus. You examine the part, and find on its verge a number of tumors, about the size of the end of the thumb, or finger, with broad bases, not very distinct from, but running one into the other, covered by the common integuments, and of a more or less purple appearance. If you cut into one of these tumors, there is immediately a flow of venous blood, followed by a small quantity of arterial blood; such as might arise from a cut anywhere else. On making a section of the tumor, it presents to the eye the appearance of dilated and tortuous veins. In fact, you cannot doubt, that they are dilated veins; they are exactly like varicose veins of the leg. The tumors, which I have described, are situated below the sphincter muscle, and we call them *external piles*."

"Another patient consults you, complaining also of a swelling at the anus, accompanied by pain and tenderness. You examine the part, and find a number of tumors of a different kind. These, too, have broad bases, and run one into the other, forming a circle, which projects below the anus. They are covered, not by the common integument, but by the mucous membrane of the rectum, protruded from above the sphincter muscle. On making a section of one of these tumors, there immediately flows venous blood, and arterial blood may flow afterwards. On looking at the divided surface, it is evident that the tumor was composed of a large tortuous vein. It is the accidental enlargement of these tumors which causes them to

protrude externally ; but they are formed above the sphincter muscle, and we call them *internal piles*, or *hæmorrhoids*." (See *Lond. Med. Gaz.* vol. xv. p. 742.)

Mr. Syme divides hæmorrhoids, or the tumors which grow at the verge of the anus, into three kinds:—1. Those which depend on enlargement of the veins at the extremity of the rectum. 2. External hæmorrhoids formed by enlargement of the thin skin and subjacent cellular texture at the verge of the anus. 3. Those which consist of a vascular development of the mucous membrane, constituting tumors much disposed to bleed, when protruded from the anus. Of this character appear to Mr. Syme to be those named internal hæmorrhoids.

It will be convenient to consider separately the two varieties, viz., EXTERNAL and INTERNAL hæmorrhoids.

#### EXTERNAL HÆMORRHOIDS.

[An external hæmorrhoid is a small tumor situated just external to the sphincter muscle. What may be designated as the *true* external or venous hæmorrhoid, answers to the first of Mr. Syme's subdivisions, and is connected with a dilated and varicose condition of the hæmorrhoidal veins, the distended branches of which are in such cases visible through the thin integument near the anus. Sometimes, when more congested than usual, coagulation of the blood takes place in one of these varicosities, and a small hard circumscribed tumor is formed external to the anus. Inflammation then takes place in and around the swelling, and is often attended with very severe pain and distress to the patient. If not attended to, this will often proceed to suppuration ; a small abscess will form and break, and the coagulum will be expelled through the opening. Such an abscess, if small, will usually heal, but when large or situate in very close proximity to the sphincter, it may leave a small fistulous channel which will not heal till laid open in the usual way.]

Sir B. Brodie says: "Sometimes an abscess forms in one of these external piles, and bursts externally. The abscess may be troublesome to heal ; but, when it is healed, it is found that the cavity of the vein is obliterated, and that it is, in fact, cured. Such an abscess is essentially different from a fistula in ano. Sometimes, when an external pile is inflamed, the blood in it becomes coagulated, and it is then hard to the touch. If, under these circumstances, you slit open the pile with a lancet, there comes out a mass of hard coagulum, perhaps as large as a pea, or a horsebean : the cavity inflames, suppurates, and granulates. The same thing happens as though suppuration had taken place in the first instance, and the pile is obliterated. But if you do not slit open the pile, and leave the disease to take its own course, the cavity being blocked up by the coagulum, the vein becomes obliterated, after which the coagulum is gradually absorbed, and the pile is cured ; that which was a pile before being now converted into a flap of skin. Just the same circumstance happens with varicose veins of the leg, where sometimes there is a natural cure, in consequence of the coagulation of the blood in the dilated vessels. Sometimes, when a pile is thus distended with coagulated blood, the skin becomes so much attenuated, that it gives way in some one point,

and the blood being gradually squeezed out, suppuration probably takes place ; and the case proceeds just the same as if you had opened the pile with a lancet." (Sir B. Brodie.) The folds of skin, the remains of former piles, are at first large, loose, and pendulous, but may afterwards diminish so as to give no inconvenience.

[The most effectual treatment of such a case is to make a puncture with a lancet into the swelling ; the coagulum then escapes, or it may be easily squeezed out. The relief to the patient is immediate, the irritation subsides, and the small wound rapidly heals. On examining the cavity after the blood has been squeezed out of it, it will be seen to have the appearance of a cyst, with a smooth polished lining, evidently the inner membrane of the vein. The cyst is often only loosely connected with the surrounding textures, and by taking hold of it with the forceps, it may be easily detached, remaining however adherent by a sort of pedicle, where the varicose dilatation was connected with the trunk of the vein. I have repeatedly done this for the purpose of examining the nature of these swellings, cutting through the pedicle above mentioned after drawing out the cyst, and have satisfied myself that the coagulum is contained in the interior of the vein, and is not effused by rupture into the areolar tissue, as sometimes described. The drawing out the cyst in the manner described adds slightly to the pain suffered by the patient at the moment, but it has the advantage at all events of preventing the return of the complaint at that particular spot.

In cases where the inflammatory action is less severe, it may subside in a few days under the application of cold lotions, with rest in the recumbent position, and purgative medicines ; but the coagulum remains, and will require some time for its removal, its absorption being necessarily a slow and gradual process.

Such a case as has been described is a true external hæmorrhoid or pile, having its origin in a dilatation of a branch of vein in the vicinity of the anus. But after repeated attacks of this kind the dilated skin, which covers the swellings, does not entirely regain its former condition, but remains enlarged, and forms pendulous excrescences, which are at any time liable, from accidental irritation, to become swollen and painful, till at length the skin and subjacent areolar texture become much thickened and hypertrophied.]

Sir Benjamin Brodie explains that the ultimate changes which take place in cases of piles, are exactly similar to those which occur in connection with varicose veins of the leg. At first, these vessels are simply varicose, or dilated ; at last, they become inflamed ; lymph is deposited in the cellular tissue surrounding them ; and at length there is a great mass of induration, in which the diseased blood-vessels are imbedded. So it is with the veins of the anus. At first, they become simply dilated ; repeated attacks of inflammation cause an effusion of lymph into the adjacent cellular texture ; and then the pile appears like a solid tumor ; in the centre of which, however, the dilated vein, in which the disease originated, is still found.

Mr. Hodgson says: "The blood sometimes coagulates in the dilated vein, and the swelling becomes hard, inflamed, and very painful. The coagulum is subsequently absorbed, but the thickened coats of the vein and the surround-



ing parts form a tumor, which is liable to inflame and afford great distress." (*On Dis. of Arteries*, &c. p. 566.) This observation agrees with the statement of Sir E. Home, that in cases of long standing the contents of hæmorrhoidal tumors "coagulate and become solid; their coats increase in thickness, and they resemble pendulous excrecent tumors in other situations in the body." (*On Ulcers*, &c.)

[The cutaneous excrescences, usually denominated "external piles," are of very frequent occurrence. They often, no doubt, originate in the manner above described, but they are also often met with independent of any evident varicose condition. Any irritation of the delicate integument close to the anus is apt to produce inflammation and swelling, and to give rise to a permanently hypertrophied condition of the skin and subcutaneous areolar texture answering to Mr. Syne's second subdivision of the complaint. After the subsidence of the inflammation, loose flaps of skin remain, which may, for along time, occasion no pain or inconvenience to the patient, though they are at times liable to fresh attacks of inflammation, as a consequence of errors in diet, constipation, over-exertion in walking or riding, and such like causes. They then form painful swellings, of a bright red colour, forming a contrast in this respect to the dark purple hue of the true venous external hæmorrhoid, while they are also less abruptly circumscribed than the tumors formed by the coagulation of blood in a dilated vein.

The only permanently effectual treatment of these swellings is their removal by excision. They should be seized with the forceps and cut off at their base with a pair of strong scissors. It is better, especially where they are numerous, to let the incisions be made in a direction radiating from the anus rather than transversely. There is no danger to be apprehended either at the time or subsequently from the removal of these external folds of skin. The bleeding is seldom of any importance; in most cases it soon ceases spontaneously, or should it not do so, it can be arrested immediately and with certainty by slight pressure with a sponge held to the part for a few minutes. The wounds, in the great majority of cases, rapidly heal. The ligature should on no account be used for the removal of swellings *external* to the anal aperture. The danger of bleeding is entirely imaginary, while the strangulation of the skin by a ligature always occasions acute and prolonged suffering to the patient, and often excites considerable constitutional disturbance. The practice is not even yet entirely exploded, but it is one which cannot be too strongly condemned. As Sir B. Brodie observes, "if an abscess has formed which bursts, discharges, and closes at its orifice, and then bursts and discharges again, it may be expedient to cut off the pile and the abscess with it."

In cases where excision may not be thought necessary or expedient, or where the patient declines to submit to it, measures must be adopted to subdue the inflammation when present. For this purpose rest in the recumbent posture is essential; cooling and sedative applications should be used to the part, such as the acetate of lead lotion with opium or morphia; or, if the patient prefer it, a warm hip bath or warm linseed poultice. Leeches are frequently employed, but, according to the ex-

perience of the writer, they often do more harm than good by the irritation which they occasion. Free purgation with calomel and colocynth, followed by saline aperients, are of the greatest service, not only by clearing the bowels but by unloading the portal system and so relieving the congestion. When the inflammation and pain have subsided, the unguent Hydrarg. Ammon. Chloridi, or an ointment composed of half a drachm of calomel to the ounce of lard may be used to aid in the reduction of the swelling. These are better than the gall ointment so constantly ordered, which is a dirty and irritating application. Astringents, such as the gall nut, may be useful applications to a mucous membrane, but they have little or no influence, except to irritate, when applied to a cutaneous surface.]

#### INTERNAL HÆMORRHOIDS.

[The term hæmorrhoid is more appropriately applied to this condition than to the affection just described, a *flow of blood* being one of its most characteristic symptoms, whereas hæmorrhage is not a frequent accompaniment of the external hæmorrhoidal swellings.

Internal hæmorrhoids are tumors situated just above the sphincter muscle, and covered by the mucous membrane of the bowel. They consist of hypertrophied mucous membrane and submucous tissue, containing a very copious network of blood vessels. In some cases the swellings seem to consist mainly of the ramifications of vessels held together by a very limited amount of connective tissue.

The doctrine formerly very commonly taught, and indeed still held by some modern writers of repute, among whom may be mentioned Mr. Quain and Mr. Curling, was that internal hæmorrhoids are mainly caused by venous dilatation, that they are in fact an enlarged and varicose condition of the hæmorrhoidal veins.]

The opinion that piles are formed of cells filled with blood, was adopted by Dr. Ribes. The distention of the hæmorrhoidal veins with blood, he observes, gives rise to varices; but, if any of their blood is extravasated in the cellular membrane, at the inferior and internal part of the anus, hæmorrhoids are the result. If the inferior mesenteric vein be dissected in hæmorrhoidal patients, the ramifications of the vessel are seen terminating in these cysts of blood, and, on completely removing the whole, the hæmorrhoids appear suspended from the branches of the vein, as grapes from the vine. (See *Révue Méd.* t. i. 8vo. 1820.)

When piles consist of distinct cysts or sacs of blood, they are originally varicose enlargements of the branches of the hæmorrhoidal veins. Were this not the fact, how could cases like the following ever take place? "One of my patients (says M. Delatour) had several of these tumors, of very large size, and, at every contraction of the sphincter ani, the blood issued from them *per saltum*." (*Hist. Phil. Obs.* 212.) Montegre has likewise seen two instances, in which the blood spouted out of the tumors in a continued stream. (*Dict. des Sciences Méd.* t. xx. p. 453.) And Richerand mentions a merchant who lived to the age of eighty-nine, quite free from infirmity, and whose good health was ascribed to periodical bleedings from piles, during fifty years of his life; the evacuation being very regular, and so profuse, that the blood was thrown some distance, as from a vein opened in phlebo-

tomy. (See *Nosogr. Chir.*) If many piles were not either varices, or cysts in direct communication with the large veins of the rectum, Petit would not have succeeded in taking blood from them by puncture, as he often did, in lieu of the ordinary mode of venesection. (*Mal. Chir.* t. ii. p. 134.) The colour of the blood, when voided by puncture, as described by Sir B. Brodie, is a proof of common piles being dilated veins.

Sir B. Brodie regarded both external and internal hæmorrhoids as being varicose in their nature. Though piles are divided into *external* and *internal*, the same veins are affected in both cases. "The veins run on the inside of the sphincter muscle; and, where the muscle compresses them, there can be no dilatation of them; but, above and below the muscle, the veins become dilated." (*Sir Benjamin Brodie.*)

[Other authorities, however, have not accepted the theory of the exclusively venous origin of hæmorrhoidal tumors, and among them may be mentioned Mr. Syme, to whose valuable and practical work on "Diseases of the Rectum" the reader is referred. In an excellent treatise on these diseases, by Dr. Bushe of New York, will be found an enumeration of the authorities on the two sides of this disputed question. (*Bushe on Dis. of the Rectum*, p. 152.)

According to the observation of the writer, hæmorrhoidal tumors are essentially vascular in their nature, but they are met with containing every variety of proportion of arterial and venous branches. Some are dark purple in colour, firm in texture, and contain large branches of veins, which are visible through the mucous membrane. Such tumors, when cut into, will exhibit the cut extremities of large venous branches, often, if there has been inflammation, filled with coagulated blood. These may reasonably be supposed to be more or less varicose in their nature. Others, on the other hand, are bright red in colour, soft to the feel, showing no appearance of veins of any magnitude either on their surface or when cut into, but appearing to be composed almost entirely of the ramifications of small vessels, and these principally arterial. Between these two extremes every gradation may be observed. Where the veins are much enlarged, there are usually large arterial branches also. All these hæmorrhoidal tumors, however, have a very free arterial supply, derived from a main branch descending into each tumor from above, which may be felt pulsating immediately beneath the mucous membrane by the finger introduced into the rectum.]

With regard to the cause of hæmorrhoids, any thing capable of retarding the return of blood through the inferior mesenteric and hæmorrhoidal veins, may occasion the disease. The pressure of the gravid uterus, costiveness, and the retention of hardened feces in the colon and rectum, are very frequent causes; obstinate constipation, indeed, is the most common of all the causes, for "when the colon becomes loaded, and especially the sigmoid flexure, with hardened feces, there is a pressure on the trunk of the inferior mesenteric vein, which interrupts, in some degree, the return of blood from its branches." (*Brodie.*) Persons who lead sedentary lives are often troubled with the complaint. In reflecting on the various circumstances here adverted to, it is readily conceivable why women are more subject to piles than men. The pressure of

serous fluid, accumulated in the cavity of the peritoneum, may occasion piles. Individuals, whose livers are diseased, are often troubled with piles, because certain morbid changes in the liver may prevent the free return of blood from the abdominal viscera through the vena portæ; but, as Sir Benjamin Brodie has very truly observed, a great many persons have piles, who have not diseased livers; and it may be added, that many individuals who have diseased livers, have not piles. Another fact, well known to all experienced surgeons, is, that piles are more frequent in the upper classes of society, than in the lower. "The reason of this difference is to be found in the different mode of life in the various classes of society. The better classes take but little exercise, and they are more liable to constipated bowels than the lower classes, who take much exercise, and live a great deal in the open air." (*Sir B. Brodie, Op. et vol. cit. p. 743.*)

Some persons suffer from the complaint at puberty; but it seldom proves troublesome until the frame is fully developed, and is generally most distressing from the age of twenty to fifty. (*Syme, On Dis. of the Rectum*, p. 49.) Gluttony and hard drinking, by bringing on plethora, and deranging the functions of the chylopoietic organs, often seem to act as exciting causes.

When piles are produced by the pressure of the gravid uterus, no cure can be expected till after delivery, one generally then following spontaneously. Women, however, who have borne many children, are liable to piles ever afterwards; the veins, which have been repeatedly kept in a state of dilatation, not returning afterwards to their proper size; also, when piles are an effect of dropsy, they cannot get well before the pressure of the fluid in the abdomen has been removed by tapping.

*Symptoms.*—[While internal hæmorrhoids are developing themselves, there is a sensation of weight and fulness about the rectum, and the patient is conscious of some impediment to the passage outwards of the feces; a greater effort than formerly is required to expel them; bleeding at the time of defæcation, especially if the bowels are costive, frequently occurs.] By degrees they protrude through the anus, forming a tumor covered by the mucous membrane. If of considerable size, they always protrude when the patient goes to the water-closet, and afterwards recede again of themselves. If their size be yet more considerable, they descend at other periods, and especially when the patient is walking, so that he cannot well take any exercise. Sometimes, one small internal pile is seen permanently protruded, forming a red vascular tumor: this is painful, and keeps up a great and constant discharge of mucus. Sometimes large internal piles protrude for several days, then gradually diminish, and return within the sphincter. Whenever the protrusion happens, there is an abundant secretion of mucus from the rectum.

[In the majority of cases, when the disease is fully established, three tumors will be met with, one on each side, and one anteriorly towards the perineum; but there are exceptions to this, and as many as five or six are not unfrequently seen.]

When the tumors are protruded there is at the same time an eversion of the integument surrounding the anus, forming a ring of swollen and apparently redundant skin surrounding the hæmorrhoids; this, however, is not necessarily diseased, but is the natural eversion of the adjacent skin



caused by the protrusion of the mucous membrane, and when the tumors are returned it is no longer to be seen. A deep groove usually indicates the line of separation between skin and mucous membrane. It is important not to mistake the ring of everted skin for "external piles;" these latter, however, are very frequently present, but in the form of irregular and pendulous projections.]

In general, internal hæmorrhoids are less painful than those situated externally, and sometimes the patient is not conscious of having them till he begins to void blood from the rectum. In the former case, the veins or tumors are surrounded by soft and yielding substances, which do not make any painful pressure on them; but, when they are situated opposite or external to the anus, they are liable to suffer painful constriction from the action of the sphincter muscle.

[Pain is certainly not a prominent symptom in this complaint, unless the hæmorrhoids become inflamed, or descend and become strangulated by the sphincter. The sensations are rather those of extreme annoyance and irritation than of acute suffering, accompanied often, especially in the educated classes, with extreme nervousness and mental depression. If, independently of inflammation, there should be *acute* pain in defæcation and subsequently, it will generally be found that they are accompanied by an anal fissure, for which the appropriate treatment must be adopted.]

Internal piles sometimes occasion frequent desire to make water; or, by bringing on spasm of the muscles which surround the membranous part of the urethra, they may cause complete retention of urine. They are also liable to discharge a great quantity of blood, which, according to Sir Benjamin Brodie, is not venous, but arterial. "Piles (he says) do not bleed in the early, but in the advanced stage of the disease, when there is an increased determination of blood, not only to the veins, but to the mucous membrane, and cellular texture by which they are surrounded." Sometimes they bring on serious complaints, either by bursting and discharging blood so profusely as dangerously to reduce the patient; or by exciting inflammation of the adjacent parts, and causing abscesses and fistulæ; or, lastly, by becoming strangulated by the contraction of the sphincter ani, so as to occasion great agony. Piles, which bleed but little, and remain in a quiet state, are not of much consequence; but those which bleed profusely, cause violent pain, or which induce inflammation, and all its effects, demand the greatest attention. Lieutaud mentions a person who lost three quarts of blood from some piles in the course of a couple of days; and both Arius, and the celebrated philosopher Copernicus, thus bled to death.

I do not know what credit ought to be given to the extraordinary case cited by Panaroli, in which a Spanish nobleman voided every day, for four years, a pint of blood from some hæmorrhoids, and yet enjoyed perfect health! (See *Obs. Chir. pen-ter.* ii. obs. 46.) For other curious facts of this nature, see *Dict. des Sciences Méd.* t. xx. p. 458.

[The statement of Sir Benjamin Brodie that piles do not bleed in the early but in the advanced stages of the disease, is not quite in accordance with the experience of the writer. The account given by the majority of patients is that they lost blood in the early stages, but that after the pro-

trusion became habitual the bleeding was less frequent. The reason is, probably, that after habitual protrusion and exposure externally the mucous membrane becomes thickened, and is less easily abraded. In the later stages, indeed, the mucous membrane is often seen to have become almost cutaneous in its appearance. This appears to be the general rule: it is quite true, however, that in those cases where copious and alarming bleeding takes place, the disease has usually been of long standing.]

It sometimes happens, when hæmorrhoidal swellings are protruded, and attacked with inflammation, they become so violently strangulated by the spasmodic action of the sphincter ani, that the parts undergo a spontaneous mortification, and a radical cure is the result. (*J. Howship, On D.s. of the Lower Intestines, &c.* p. 210. ed. 3.) Sir Benjamin Brodie has known several cases cured in this manner; and observes, that there is little or no danger in the process. Amongst the patients of the Bloomsbury Dispensary, I have noticed similar occurrences: one of these was in a man who suffered from internal piles, one of which, in its inflamed and protruded state, equalled an egg in size. The strangulation of it produced mortification, followed by immediate relief, and a speedy cure. [More frequently the sloughing is less complete than this, and only extends from the surface to a limited depth into the tumor, so that when the slough separates, further measures are necessary for the removal of the remainder.]

*Treatment.*—When piles are in their early stage, and the patient has merely a slight protrusion, or none at all, but is complaining of heat and itching about the anus, the bowels are to be kept gently open. The best medicine for this purpose seems to Sir Benjamin Brodie to be an ounce and a half of *confectio sennæ*, half an ounce of sulphur præcipitatum, and a sufficient quantity of *mel rosæ*, to make an electuary, a teaspoonful, or any requisite quantity of which is to be taken every evening. The patient should also avoid taking wine freely, and all sedentary habits. If this plan should not afford relief, Sir B. Brodie recommends the injection of half a pint of cold pump water, as a *lavage*, every morning after breakfast. In some cases, the injection may be rendered astringent with alum, or the tinct. ferri muriatis, or cold lime-water may be used. In certain instances, the *confectio piperis comp.*, which resembles Ward's Paste, proves beneficial, the dose being a piece of about the size of a nutmeg, three times a day. According to the observations of Sir Benjamin Brodie, this substance passes into the large intestines, and gets into contact with the piles, acting directly upon them. As it is apt to accumulate in the bowels, its employment should always be accompanied by the occasional exhibition of some mild aperient. Cubebs pepper, he believes, acts in the same way as Ward's Paste. In some cases, where there is a great deal of irritation, the patient will derive benefit from taking, thrice a day, 5 ss of balsam of copaiba, and 15 drops of liquor potassæ, rubbed down with two or three drachms of mucilage and one ounce of cinnamon water. (*Brodie, Op. et vol. cit.* p. 747.)

Gentle laxative medicines, and an horizontal position of the body, commonly alleviate the uneasiness resulting from hæmorrhoids. The application of an ointment, composed of equal parts of

the powder of oak-galls, and of elder-ointment, or hog's lard, contribute to the same beneficial effect. The application of warm water by means of a bidet, or semicupium, is also frequently productive of great ease.

[The most appropriate purgatives for this complaint are those which will relieve hepatic congestion or obstruction, and also unload the congested vessels of the intestinal mucous membrane. For this purpose, two or three grains of blue pill, with colocynth and hyoseyamus, will be found eminently useful. This may be followed by a draught containing a drachm of the sulphate of potash, with ten or twelve grains of rhubarb. The sulphates of potash and soda are excellent medicines in diseases of the rectum, and their tendency to restrain hæmorrhage is an especial indication for their employment in these cases. The confect. piperis nigri, though in very common use, is for the most part objectionable, on account of its irritating properties. It is only adapted to cases where there is much relaxation of the mucous membrane and increased mucous secretion, without any tendency to inflammation. The same may be said of cubebs and copaiba.]

When piles are constricted by the sphincter ani muscle, the pain may often be at once removed, by pushing the swellings into the rectum, and using fomentations, or even the warm bath. When the disease is in a state of inflammation, leeches applied to the vicinity of the anus, and puncturing the dilated hæmorrhoidal vessels with a lancet, for the purpose of taking away blood, and the application of cold lotions, are measures occasionally employed to procure ease. The usefulness of leeches was particularly noticed by Schmucker. (*Vermischte Chir. Schriften*, b. i. p. 107.) Petit prefers the lancet; Sir Benjamin Brodie, acupuncture, and cooling lotions.

[When the tumors can be readily returned within the sphincter, this should always be done; but painful and prolonged efforts to effect it should not be persisted in: they cause great suffering to the patient, and are usually unsuccessful. When the protrusion is recent, it can generally be reduced, but when it has been down for any length of time, the tissues will be found to have become rigid and unyielding, in consequence of inflammatory effusion, and even if replaced they will descend again as soon as the pressure is removed.]

According to Mr. Howship, when there is "frequent hæmorrhage from the veins within the sphincter, with perhaps little or no external tumor, one of the best means of relief is the metallic bougie, regulated by the patient's feelings, and also by the promptitude with which inflammation and consolidation take place." (*On Dis. of the Lower Intestines*, &c. p. 215. ed. 3.) Of the merits of this practice I cannot speak from experience. I have never found any necessity for resorting to this practice, which is disapproved of by Dupuytren, and the generality of the best modern surgeons, as ineffectual.

When the number and size of hæmorrhoids are so considerable as materially to obstruct the discharge of the fæces; when they are severely painful, and subject to profuse bleedings; when the patient is disabled from following his usual occupations; and when the above means afford insufficient relief, the surgeon should recommend their removal.

[The methods which have been most generally adopted for the removal of internal hæmorrhoids are excision and the ligature. Excision would be the preferable operation but for one serious disadvantage, the liability to hæmorrhage. In consequence of this it is now rarely, if ever, practised, and the ligature is the operation preferred by the great majority of surgeons.

Besides these two methods, the extirpation of piles with the actual cautery or caustics, which was practised by the old surgeons, but relinquished by them, has been again introduced. A combination of excision with cauterization has also been recently recommended. And in France, the *écra-seur* is very frequently used.]

It is observed by Sir Benjamin Brodie, that the rule respecting the kind of operation was correctly settled by Sir Everard Home (*On Ulcers of the Legs, &c.*): external piles, which are covered by the skin, ought not to be removed by ligature, but by excision. On the other hand, internal piles, which are covered by the mucous membrane, ought, *for the most part*, to be removed by ligature. "The grounds of this distinction are as follow: the application of a ligature to external piles gives the patient extraordinary pain at the time, and afterwards excites much inflammation, swelling, and disturbance of the general system; whereas, if they be removed by excision, these ill consequences are avoided. After the excision of *external* piles, there can be no danger of hæmorrhage, because the parts are entirely within your reach, so that the bleeding vessels can be easily secured; and though some little inflammation may supervene on the operation, yet it is not of any real consequence. If, however, you remove large *internal* piles by excision, there may be copious and even dangerous hæmorrhage, since the parts which bleed are out of reach, above the sphincter muscle, where you cannot expose the cut surface so as to be enabled to take up the bleeding vessel. On the other hand, the application of a ligature to internal piles in general causes but little pain, and only a slight degree of inflammation follows; for the mucous membrane has nothing like the sensibility of the skin." (See Brodie in *Lond. Med. Gaz.* vol. xv. p. 843.)

The excision of internal piles is liable to be followed by dangerous bleeding. Encouraged by the advice of Mr. Cline, Sir B. Brodie formerly tried the practice of removing internal piles by excision. In the first case or two, he found no inconvenience follow; but a case soon occurred, in which the patient lost a great deal of blood; in another case, the hæmorrhage was so great, that the patient nearly died; and a third case occurred, in which also the patient lost an enormous quantity of blood, so that Sir B. Brodie now only wonders that death was not the result. Sir Astley Cooper has related the case of a Scottish nobleman, who perished in this way. On one occasion, Mr. Syme cut away an internal hæmorrhoid, which was partially protruded, and manual pressure was required to be kept up for several hours before the bleeding ceased. (*On Dis. of the Rectum*, p. 73.) Petit had a patient with hæmorrhoids, which were supposed to be external, but were internal ones temporarily protruded. Almost immediately after they had been cut off, the cut edges were drawn inward. An internal hæmorrhage ensued, which could not be suppressed, and proved fatal in less than five hours. The rectum



and colon were found full of black coagulated blood. Sir E. Home refers also to some instances, within his knowledge, where, after the removal of internal piles with the knife, the bleeding endangered life. (*On Ulcers*, p. 365.)

Notwithstanding the risk of hæmorrhage from the excision of internal piles it was practised by some of the best surgeons in France; this seems to have been for a long time their usual practice, the bleeding being afterwards suppressed by distending the rectum with a mass of charpie, to which a ligature was attached, as recommended by Boyer; or by long continued pressure on the bleeding point by the finger of an assistant, or by the introduction of M. Bermond's canula, which at once regulates the pressure on the bleeding vessels, and, when its central tube is taken out, enables the surgeon to ascertain whether effusion of blood is going on within the bowel. With it, also, the patient is able to empty the rectum as often as nature requires. (*See Velpeau Nouv. Elém. de Méd. Opér.* t. iii. p. 995.)

Dupuytren preferred excision:—"My maxim (he observes) is only to cut off the part of the tumor projecting externally; because, if the whole of it were removed, there would be a risk of dangerous bleeding, and a subsequent contraction of the anus. In this proceeding, it seems as if a very considerable mass were left at the margin of the anus, and not enough of the tumor cut off; but, as the part heals, everything becomes right, and the anus recovers its proper condition." He afterwards states, that whenever he removes internal piles, which he accomplishes with scissors curved laterally, after the tumors have protruded and been taken hold of, he leaves with the patient an assistant, who is directed to apply the cautery if any bleeding come on. Indeed, he expresses his opinion, that, as two-fifths of his patients, whose internal piles had been removed with scissors, were attacked with subsequent hæmorrhage, it would be better to apply the cautery directly after the operation.

The introduction of a pig's bladder, which is then filled with lint, is another expedient for stoppage of the bleeding. Dupuytren found it succeed in one instance; but acknowledges that it is a great annoyance, and usually cannot be retained. (*See Leçons Orales de Clin. Chir.* t. i. p. 349.)

When I add to these statements the recollection that a cautery of particular construction is necessary, and that few surgeons will ever be provided with it, it is needless for me to remark, that the candid account of the subject given by Dupuytren himself, amounts to as complete a condemnation of this part of his practice as could be drawn up by any of its opponents.

Sir B. Brodie lays it down as a general maxim, that internal piles should be mostly extirpated with the ligature. If they are small, however, he admits that it is not necessary to tie them; and they may be cut away with perfect safety. If a pile, not larger than the end of the little finger, protrude, or lodge in the orifice of the anus, covered by mucous membrane, the surgeon may take hold of it with a double tenaculum and apply the scissors to the base, and no inconvenience will follow the operation. But, whenever there are large internal piles, Sir Benjamin Brodie deems the removal of them by ligature the only safe plan.

In order to prepare the patient for the application of ligatures to internal piles, he should be

directed to take a dose of castor oil, or rhubarb, the day before the operation, so that the bowels may be first emptied, and no necessity occur for disturbing them again for two or three days afterwards.

Another requisite measure is that of bringing about the descent of the piles. For this purpose, the patient is to sit over a pan of hot water, which will relax the sphincter muscle, and at the same time, cause the veins of the rectum to be filled with blood. If this be not sufficient, Sir B. Brodie directs a pint or two of warm water to be thrown into the rectum, as an enema, and when this comes away, the piles will probably descend. Then the patient may incline over a table, or lie on one side in bed with his knees drawn up, and the nates held apart by an assistant. Each pile must be separately tied. If it be of small size, it may be raised with a double tenaculum, and a ligature at once placed round its base. But if the piles are of more considerable size, a large curved needle, armed with a strong double ligature, is to be introduced through the base of each of them. The needle is then cut off, and the double ligature thus converted into two single ones, which are to be tied round the base of the pile; one on one side, and the other on the other, with a single knot. When each pile has been thus secured, Sir Benjamin Brodie cuts off the convex portion of each pile, and by thus discharging the blood confined in it, is enabled to tighten each ligature in a still greater degree. In fact, the ligature should be drawn as tight as possible, for then the subsequent pain will be less, and the separation of the slough quicker. A double knot having been made on each ligature, the threads are to be cut off close to the knots, and the piles and the remains of the ligatures returned into the rectum.

In about a week, the ligatures are generally detached; and, at this period, the bowels should be kept gently open with lenitive electuary and sulphur, and cold water be thrown up the rectum every morning, in order to prevent a recurrence of the disease. (*Brodie, ib.*)

The removal of internal piles with ligatures is, generally, a safe proceeding. Untoward cases will, however, sometimes happen. Petit frequently practised this method, without any ill effects. In other instances, the consequences were bad. A woman, in whom he had tied three hæmorrhoids with narrow pedicles, did not at first complain of much pain; but, in five hours, she was attacked with violent sufferings, like those of colic, extending along the colon. She was bled four times without material relief. At last, Petit cut the ligatures, which could not be otherwise loosened. The pain then soon subsided. The ligatures had only been applied twenty-four hours; but the piles had become black, and they were then cut off without any effusion of blood.

Petit also relates a case in which a patient, after having had some piles tied, died of symptoms resembling those of strangulated hernia, and this notwithstanding the prompt removal of the ligatures.

Mr. Kirby mentions two cases, where bad and fatal effects followed the operation of tying piles: in one, the patient's life was saved with great difficulty; and, in the other, tetanus and death were the consequences. (*On Hæmorrhoidal Excrescence*, pp. 1—3, 8vo. Lond. 1817.) I have known patients attacked after the operation with frequent

vomiting, and pain and difficulty in passing the urine. "Difficulty in making water, sometimes amounting to complete retention, and requiring the catheter to be introduced (according to the observation of Mr Syme), very frequently occurs, but seldom continues beyond the first twenty-four hours. In two cases, I have found it last for nearly a fortnight." (See *Syme, On Dis. of the Rectum*, p. 85.)

With the exception of two instances, Sir B. Brodie never knew any ill consequences arise from tying piles. He saw one patient, who died after the operation, in consequence of diffuse inflammation of the cellular tissue running up on the outside of the gut, as high as the mesentery; but it was in a constitution broken down by long continued hæmorrhage, and in whom any slight accident might have produced equally bad consequences. He saw another patient, who, a week after the operation, and after having been quite well in the interval, had an attack of pain in the abdomen, and shivering, attended with fever, and who died. An examination of the body not having been allowed, the precise cause of death was not ascertained.

The following is the treatment recommended by Mr Syme for the alleviation of some of the unpleasant consequences occasionally following the operation:—"An opiate, containing thirty or forty drops of the solution of muriate of morphia, should be administered to the patient, if he complains of pain, and be repeated from time to time, if it continues severe; or a somewhat larger dose may be injected into the rectum with a teaspoonful or two of warm water. Fomentations may be at the same time applied to the anus. And if, notwithstanding these means, much suffering is still experienced, the hip-bath of poppy-head decoction should be employed. The retention of urine, if slight, may be relieved by giving the spir. ætheris nitrici, or the camphor mixture; and, if more obstinate, will require the catheter to be introduced occasionally as long as it lasts. The patient should restrict himself to the antiphlogistic regimen, and drink freely of simple diluents, such as barley water, or linseed tea. He should also confine himself to the horizontal posture, until the ligatures separate." (*Op. cit.* p. 85.)

[An operation which is a kind of combination of excision with the ligature, and which to a considerable extent combines the advantages, while it avoids the disadvantages of both plans, has been devised by Mr. Salmon, and practised by him at St. Mark's Hospital for many years with admirable results. It has also been adopted by the writer in many hundreds of cases. The tumors being protruded they are seized in succession with a hook or vulsellum, and are separated with scissors from the subjacent parts along the line of union of the skin with the mucous membrane. The cut made with the scissors should be sufficiently deep and free to detach the tumor from the muscular tissue on which it rests to an extent equal to about three-fourths of its base, leaving it attached by its upper fourth only. The ligature is placed in the deep groove thus made, and is tied tightly round the upper part of the tumor. The danger of hæmorrhage is effectually provided against, because the vessels which supply the tumor do not enter it indiscriminately at its base, but descend from above close beneath the mucous membrane, and their

trunks are therefore necessarily included in the ligature. After the ligatures have been applied the bulk of the tumors may be cut away, care being taken to leave sufficient tissue beyond the ligature to prevent it from slipping, and the parts may then be returned within the sphincter. This operation is preferable to the usual method of strangulating the whole base of the tumor by transfixing it with a needle and tying it in two halves—first, because it is accomplished in less than half the time; secondly, because scarcely more than one-fourth the amount of tissue is strangulated by the ligature; thirdly, because the ligature is tied round mucous membrane at some distance from the anus, where the sensibility is much less acute, and consequently the after pain and irritation are very greatly diminished. Instead of the whole of the base of the tumor being converted into a sloughing wound, the sloughing process is confined to the upper part only.

As evidence that the irritation is much less after this than after the old operation, may be mentioned the fact that the urinary organs are rarely affected by it, whereas after the ordinary method retention of urine is certainly the rule rather than the exception.

Whichever method be adopted the mode of dealing with the inflamed and swollen skin is a point of great importance to the ultimate success of the operation. All pendulous or projecting portions,—“external piles,”—should be removed freely by excision, but the collar of everted skin surrounding the protruded hæmorrhoids should on no account be interfered with. The removal of this is likely to be followed by a cicatricial contraction of the anal aperture which will be as painful and distressing to the patient as the original disease. The error is one not unfrequently practised by inexperienced operators. It may be best avoided by returning the ligatured parts within the sphincter before meddling with the skin. The surgeon will then be able to judge without difficulty how much of the latter is really redundant and requires to be removed.

It might be expected that there would be risk of a similar contraction taking place within the rectum when there has been a free removal of the mucous membrane. Practically, however, this is not found to be the case. Occasionally a certain rigidity may be met with for some time from this cause when the disease has been extensive, but the parts by degrees regain their elasticity, and the inconvenience disappears. The cicatrices of mucous membranes seem not to have the same tendency to contract or to remain firm and rigid which is found to be the case in cicatrices of the skin. In cases where any tendency of this kind is observed, the introduction of a full-sized rectum bougie every second or third day will be found beneficial.

There is probably no operation in surgery which affords so much relief at so small a cost of suffering and risk as the removal of hæmorrhoidal tumors with the ligature. On this point Sir B. Brodie has expressed himself very strongly. Having operated on between 200 and 300 cases, he “conceives that this is not only one of the most effectual but one of the safest operations in surgery.” He was cognisant of two fatal cases, which have been already alluded to, one from diffuse inflammation the other apparently from pyæmia, but with these exceptions he never knew any ill consequences arise. He contends therefore that the



operation is as safe as any operation can be expected to be, and that the chance of danger is at any rate so trifling that it need not be calculated upon (see *Works of Sir B. Brodie by C. Hawkins*, vol. iii.). Mr. Syme is of a similar opinion; he says, "I feel warranted after very extensive employment of the ligature to state that it may be used without the slightest risk of any serious inconvenience. Indeed, in the whole course of my practice, I never met with a case which terminated fatally, or threatened to do so, when the ligature simply was employed. (On *Dis. of the Rectum*, 3rd ed. p. 82.) The writer of this article has operated on more than 500 cases with the ligature, according to Mr. Salmon's method as above described, and has seen no serious consequences whatever except in two cases at St. Mark's Hospital in 1858, in which death took place from tetanus, but this was at a time when tetanus was unusually prevalent in London. Two other deaths of tetanus occurred at St. Mark's Hospital at about the same time, though none had been noticed before, and none have occurred since that period. There can be no doubt that these cases were the result of some special epidemic influence, and that this cannot be taken to indicate any special liability to tetanus after this operation, though of course it may occasionally follow this, as it will also occasionally follow every conceivable surgical proceeding. Out of more than 1000 patients operated on in St. Mark's Hospital in the last ten years, for this disease, there has been no other fatal case, and not a single example of pyæmia has occurred.

*Operation with the Clamp and Cautey.*—Another method which is a combination of excision with the cautey has been lately recommended. It was first suggested, we believe, by the late Mr. Cusack, of Dublin, and has been adopted in London by Mr. Henry Lee, and especially by Mr. H. Smith, by whose writings it has been brought prominently into notice.

The hæmorrhoids being protruded they are seized with a clamp, the blades of which being screwed together, the bases of the tumors are firmly compressed. They are then cut off with the knife or scissors, and to prevent bleeding, the cut surface is cauterised freely with strong nitric acid or with the actual cautey, the latter having been found more effectual. The clamp is then gradually loosened, and if any hæmorrhage is noticed, the cautey is again applied to the bleeding point. The clamp is then removed, and the cut surface, covered by the layer of slough produced by the cautey, is allowed to recede into its place within the rectum. Any external piles which may be present are then cut away with the knife or scissors. A representation of the screw clamp will be found in Mr. Smith's work (*On the Surgery of the Rectum*, p. 91). A lighter, and, in the writer's opinion, more convenient instrument has been contrived by Mr. Gowland, and is in use at St. Mark's Hospital for diseases of the rectum. This operation has been highly extolled by Mr. Smith, as being less painful than the ligature, as being followed by a much more rapid recovery, and as being entirely free from all its dangers, amongst which he especially alludes to pyæmia and tetanus. These statements have not been verified by other surgeons who have practised the operation. At St. Mark's Hospital, where it has had an ample trial both by the writer and his colleagues, it has

not been found that the pain is diminished, or that the convalescence is accelerated. With respect to the dangers alluded to, it has been already shown how rarely they follow the operation with the ligature, and there is not the slightest evidence or proof that they are not just as likely to occur after the operation with the clamp and cautey. Mr. Smith has equally overstated the advantages of the one, and the disadvantages of the other method. In the writer's opinion the clamp is best adapted to cases where the tumors are small, or where there is only one, but it is not so safe as regards bleeding, or so satisfactory in other respects, when the disease is extensive, as the operation with the ligature. (See *H. Smith, on the Surgery of the Rectum*, London, 1865. Also *Obs. on Dis. of the Rectum*, by J. R. Lane, Lancet, Sept. 2, 1865.)

*Cauterisation with Nitric Acid.*—This mode of treatment was introduced by Dr. Houston, of Dublin (see *Dublin Journal of Medical Science*, 1843), and has been recommended in London by Mr. Henry Lee and Mr. H. Smith. The cases to which it is best adapted are those in which there is a vascular condition of the mucous membrane, with a tendency to frequent hæmorrhage, but without the development of any distinct tumors which can be protruded. Such a condition is not unfrequent in the earlier stages of the complaint, when, as has been already explained, bleeding is more apt to occur than at a later period. In such cases, a free application of the strong nitric acid, and it should be the strongest procurable, will often be of the greatest service, by destroying the hyperæmic condition of the mucous membrane, and further, by preventing the development of large hæmorrhoidal swellings.

When, however, there are tumors of any magnitude, the treatment by nitric acid is very unsatisfactory. Repeated applications of the caustic are then necessary to reduce them to the level of the surrounding surface, and the treatment occupies a much longer period, is less effectual, and more severe than the operation with the ligature.

The most convenient mode of applying nitric acid to the rectum, in cases where the diseased membrane cannot be easily protruded, to which, as has been explained, it is most appropriate, is to introduce a three-bladed expanding speculum, and to paint the mucous membrane in the interval between the blades with a glass brush dipped in the acid. By turning the speculum round, the entire circumference of the bowel can in this way be easily reached.

Care must be taken that the acid does not flow over the integument external to the anus, or the pain will be greatly increased. In this, as in the other methods, any redundant skin should be treated by excision. In order to protect the external parts from the action of the caustic, they may be covered with ointment, or they may be washed with an alkaline solution after the acid has been applied. With proper management, however, these precautions are unnecessary.]

#### RECTUM, PROLAPSUS OF.

*Prolapsus ani*, technically called also *exania*, or *archoptosis*, but, more correctly, *prolapsus*, or *procidencia recti*, is commonly described as presenting itself under three forms; in one, the protrusion of the rectum involves both its mucous and muscular tunics; in a second, its mucous coat alone; in a

third, the upper portion of the bowel descends into the lower, and the displacement is truly what is termed a *volvulus*, or *intussusception*. In this account, Sir Benjamin Brodie believes that there is a mistake, and that prolapsus of the rectum is frequently confounded with internal piles. But the difference between internal piles and real prolapsus of the rectum, seems to him to be this: In the protrusion of the former, the mucous membrane covering them descends, and may be seen below the anus, but it is only the mucous membrane: whereas in a true prolapsus ani, the muscular tunic protrudes, as well as the mucous membrane. If one portion of bowel, inclusive of both these tunics, can slip down into another portion, why (inquires this distinguished surgeon) should not the rectum slip out at the anus? (See *Lond. Med. Gaz.* for 1834 and 1835, p. 845.) However, as I have already explained, the latter form of displacement is universally admitted; and the question which is raised refers to the point whether prolapsus ani ever really consists in a relaxation and protrusion of the mucous membrane of the rectum alone, without being essentially combined with internal piles. The inner coat of the rectum being connected to the muscular by a very loose elastic cellular tissue, naturally forms several folds, the use of which is to let this bowel dilate sufficiently for the retention of the excrement. This structure has appeared to some pathologists to account for the occasional protrusion of the mucous membrane, without being accompanied by the muscular coat.

In one page, Baron Dupuytren speaks of "*la procidence de membrane muqueuse du rectum*," in common with other surgical writers; but, in the next, he describes the displacement as consisting in a descent of the upper portion of the rectum into the lower, down to the anus, and even beyond it, so as to constitute a protrusion from two to six inches in length. (*Clin. Chir.* t. i. p. 157, 158.) His view then seems to me to agree with that of Sir Benjamin Brodie. The swelling occasioned by the protrusion of the inner coat of the rectum, or of this, together with the muscular, is subject to considerable variety in respect to length and thickness; when small, resembling a mere ring; when large, and reaching far downwards, having an oblong globular form. The tumor sometimes admits of reduction with ease; sometimes it cannot be returned without difficulty. The disease is now and then met with in persons of all ages; but it is most common in infants and elderly subjects. When it exists in young adults, which is only seldom, Sir Benjamin Brodie has found that it has generally begun in early life. Children whose bowels are habitually confined, whose bellies are large and tumid, and in whom the contents of the abdomen seem too large for it, are more frequently, than others, affected with prolapsus ani. Sir Benjamin Brodie refers to an anatomical reason for the frequency of the complaint in children:—"It is because the prostate gland, urethra, and vesiculæ seminales, are not so much developed as in the adult. The attachment of the rectum to the surrounding parts does not extend so high in children as in persons of mature age; while the reflection of the peritoneum takes place lower down; and hence the rectum is more liable to be pushed out." (*Brodie*, in *Lond. Med. Gaz.* vol. cit. p. 845.) Such examples as are combined

with thickening and relaxation of the inner coat of the rectum, internal hæmorrhoids, or other tumors, are often attended with copious discharge of a thin mucous fluid, mixed with blood.

With respect to *prolapsus ani*, Mr. Mayo refers to a preparation in the museum of King's College, showing that the muscular coat of the bowel may be inverted, as well as the mucous coat, and submucous cellular tissue; a point disagreeing with the statement of Dupuytren, that the prolapsus consists in extension of the mucous and submucous coats by the irregular action of the muscular coat. Mr. Mayo conceives that the use of the sphincter is to prevent protrusion of the rectum; and if this opinion be well founded, it follows, that no protrusion can take place, except in consequence of rupture, atrophy, or excessive relaxation of the sphincter. The atrophy of it in prolapsus ani of long standing has been ascertained and described by Cruveilhier; but here it may only be the effect, not the cause. Instead of Dupuytren's plan of removing several marginal folds of integument close to the anus, for the cure of some examples of prolapsus ani, Mr. Mayo prefers the method of pinching up small folds of the protruded mucous and submucous coats with forceps, cutting their surface with scissors, and then including them in silk ligatures. In one case, which he records, three such folds were tied on opposite sides of the bowel, and at different distances from the sphincter.

[The term prolapsus is still often erroneously employed to designate any descent of the bowel through the anus, whether from the growth of hæmorrhoids or from other causes, and much confusion is thereby occasioned. It is important, therefore, to understand clearly that where there is hypertrophy of the mucous membrane together with the submucous areolar tissue and blood-vessels, and the formation of distinct tumors, as described in a former part of this article, the case is one of hæmorrhoids; but where there is a descent merely of the unaltered textures of a relaxed but otherwise healthy bowel, the case is one of prolapsus, or procidentia, recti. In the true prolapsus, there may be a descent of relaxed mucous membrane only, or of the mucous and muscular coats together. The prolapse of the mucous membrane alone, unattended with any hæmorrhoidal formation, is not very common; when present, it is never of any great extent, not more than from half an inch to an inch of the membrane being protruded; indeed, a greater separation than this of the mucous from the muscular coats is obviously a very unlikely occurrence. In the ordinary form of the complaint, the lower part of the rectum, mucous and muscular coats together, descend through the anal aperture, often to the extent of several inches. In aggravated cases, even the peritoneum covering the upper part of the rectum may accompany the protrusion, a fact to which, as far as the writer is aware, attention has not hitherto been directed. In two cases, witnessed by him, this has been made evident by the descent of a portion of the small intestine into the peritoneal pouch, causing a hernial tumor which distended the anterior half of the prolapsus, and in consequence of which the entrance to the bowel, instead of being central, as usual, was displaced towards the posterior part. By manipulation, the protruded small intestine was found to be redu-



cible, with a gurgling noise, and when this had been effected, the entrance to the prolapsed rectum resumed its ordinary central position. In one of these cases the patient was a male, in the other a female; in the first, of course, it was the recto-vesical fold, and in the second the recto-vaginal fold of peritoneum which had been protruded.]

*Causes.*—Prolapse of the rectum may originate from various causes:—

1. From circumstances tending to relax and weaken the parts which retain the rectum, or its inner membrane, in its situation.

2. From various kinds of irritation and pressure on the bowel itself, having the effect of increasing the powers by which it is liable to be forced outward.

3. From any disease or irritation in the adjacent parts affecting the rectum sympathetically.

Hence, a prolapsus ani may be caused by long habitual crying, and great exertions of the voice; violent coughing; sitting long at stool; hard dry fæces, and much straining to void them; obstinate diarrhœa, in infants, kept up by dentition; dysentery; chronic tenesmus; various diseases of the rectum itself; the abuse of aloetic medicines and emollient clysters; hæmorrhoids; excrescences and thickenings of the inner membrane of the rectum; difficulty of making water; the efforts of parturition; a calculus in the bladder; paralysis of the sphincter and levator ani.

In general, the prolapsus takes place whenever the patients go to the water-closet, and, in some persons, it occurs whenever they are in the erect position. Dupuytren correctly notices, that this disposition of the rectum is often connected with a debilitated, relaxed constitution, and hæmorrhoidal complaints. (*Clin. Chir.*, t. i. p. 158.)

[Prolapsus may be associated with internal hæmorrhoids; when this is the case there is no great difficulty in distinguishing the one condition from the other, the altered state of the lower part, where the hæmorrhoids are situated, being strikingly contrasted with the upper part, which consists of the protruded coats of the bowel in a normal and unaltered condition. Here the prolapsus is often the consequence of the piles, and the cure of the latter by operation will be accompanied by the cessation of the prolapsus.]

The inconveniences vary in different cases.—Sometimes the bowel falls down only when the patient is costive, and he is expelling some hardened fæces; and when pushed up, it remains in its place till some accidental circumstance brings it down again. In some cases it may be returned; but the moment the patient begins to walk about, it descends again. In others, of long standing, the bowel becomes so fixed in its unnatural position, that it cannot be returned. Then it is apt to become inflamed from friction, exceedingly painful, and sometimes ulcerated. (See *Brodie, Op.* et vol. cit. p. 845.)

Considering the degree of the disease, and the constriction by the sphincter, the symptoms are sometimes mild, the rectum generally bearing pressure, exposure to the air, and other kinds of irritation, better than any other bowel. Indeed, when the protrusion has continued a long while, the mucous membrane of the bowel becomes covered with a kind of cuticle. But the urgency and danger of a prolapsus are greater, when the swelling is large, recent, and conjoined with violent

pain, inflammation, and febrile symptoms. When complicated with strangulation, the consequences may be a stoppage of the fæces, severe pain, swelling, inflammation, and even gangrene. In short, all the evils may arise which attend strangulated hernia. The prognosis, therefore, varies according to the different degree, species, cause, and complication of the disease.

[The writer has never witnessed a case of true prolapsus accompanied with strangulation of the bowel by the sphincter, and believes it to be exceedingly rare, if indeed it ever occurs. The cases of strangulation are cases of prolapsed and inflamed internal hæmorrhoids. In prolapsus there is too much relaxation, not only of the coats of the bowel, but also of the sphincter for this to take place.]

The recent small movable prolapsus ani, the cause of which admits of being at once removed, may be effectually cured. It should always be recollected, however, that when once the rectum has been affected with prolapsus, a tendency to protrusion from any slight occasional cause generally remains. The habitual prolapsus, which has existed for years, and comes on whenever the patient goes to stool, is the case most difficult of relief.

*Treatment.*—The treatment of prolapsus ani embraces three principal indications:—

1. The speedy reduction of the prolapsed part.
2. The retention of the reduced bowel.

3. The removal and avoidance of the causes by which the disease has been induced.

In general, when the case is recent, and the tumor not of immoderate size, the reduction may be accomplished with tolerable ease, by putting the patient in a suitable posture, with the buttocks raised, and the thorax depressed, and by making gentle and skilful pressure, either with the palm of the hand or fingers. When difficulty is experienced, the patient, if young or robust, may be bled, and the part fomented. The large intestines may be emptied by means of a mild unirritating clyster, and half an ounce of the oleum ricini should be exhibited. In the habitual prolapsus ani, the patient himself is generally accustomed to reduce the part, or it goes up of itself when he lies down. When, however, the inflammation and swelling are urgent, there is a difference of opinion about the treatment, many writers stating that the part ought on no account to be irritated by repeated attempts at reduction, and advising recourse to the anti-phlogistic plan, especially leeches, fomentations, or cold washes, the exhibition of mild aperients, such as the oleum ricini, and not attempting reduction until the swelling has been lessened. When the reduction is prevented by a spasmodic resistance, the use of an anodyne poultice, or fomentations, a clyster of the same quality, the warm bath, and the internal use of opium, are recommended. Should the complaint not give way to the preceding remedies, nor admit of reduction, and the symptoms become more and more pressing, perhaps the constriction should be obviated by dividing the sphincter with a bistoury, an operation sanctioned by Chelius. (*Handb. der Chir.* b. i. p. 775.) Cases are recorded, in which the protruded part, either in the state of gangrene, or of chronic hardness, thickening and elongation was removed with a knife or ligature. (See *Cheselden's Anatomy*, &c. 1741; *Kerstens, Historia Sedis procidue, resectione feliciter sanata*, Kilon. 1779; *Whately, in*

*Med. Trans. and Observ.* vol. viii. No. 16.) However, I should apprehend that, in the circumstance of gangrene, the measures best calculated for stopping its course, detaching the sloughs, and keeping up the patient's strength, must always be more prudent than such an operation.

On the other hand, we have high authority for not imitating the plan above specified, and for trying to accomplish the reduction with less delay. The examples attended with difficulty of reduction, and hazard of gangrene, are noticed by Dupuytren. "Sometimes (he observes) the swelling of the parts is so great, and the sphincter so much inverted, that it strangulates the bowel, and aid is urgently required. The displaced organ is then of twice or thrice its proper size; assumes a red purplish colour, with an appearance of ecchymosis, and is sometimes in danger of sloughing to a greater or lesser extent. Under such circumstances, the reduction should be immediately performed in the following way:—The patient should lie on his belly, with the pelvis raised up by one or two pillows under it, so that the anus may be the highest part of the trunk. The tumor having been everywhere covered with wet cloths, and a compress laid over the centre of its outer end, gentle pressure is to be made on its base, in order to lessen its size; and then it is to be very gradually pushed towards the interior. Thus, the reduction commences with the part last protruded." (*Dupuytren, Clin. Chir.* t. i. p. 159.) Scarifications and leeches he thinks objectionable. Undoubtedly, the removal of the part from its constricted state, by a prompt reduction of it, seems here as manifestly called for as in a case of hernia; and, at all events, it is only when this is not immediately practicable, that other expedients are indicated. [We have already stated that strangulation, or even compression, to any serious extent, though common in hæmorrhoidal cases, is extremely rare in cases of true prolapsus.]

The reduction having been effected, the forefinger should be passed up the rectum to ascertain that no intussusception exists above the sphincter. The bowel is then to be kept in its place by quietude and the recumbent posture; and, if there be a great tendency to relapse, it will be proper to apply to the fundament a piece of soft sponge, wetted with cold water, and supported with the T bandage. But if such means should not answer, and an habitual prolapsus ani recur, which is not unfrequent when the disease has been neglected, or its causes have long remained unremoved, some other apparatus like that described by Mr. Gooch, may be needed. (*Chir. Works*, vol. ii. p. 150. ed. 1792.) Trusses for prolapsus of the rectum may be procured. Others have used perforated balls of ivory. Callisen found the introduction of a piece of sponge within the rectum, fastened to a silver probe, give effectual support. In France, and also in other countries, instruments made of elastic gum have sometimes been employed. (*Richerand, Nosogr. Chir.* t. iii. p. 444. ed. 4.) On account of the elasticity, and unirritating quality of this substance, I conceive it is better calculated than any other material for the construction of such instruments. It cannot be denied, however, that all foreign bodies in the rectum create serious annoyance. In the female sex, a vaginal pessary, rather prominent behind, will usually hinder the recurrence of the prolapsus. The horizontal posture

should be observed as much as possible, and when the patient has a motion, a bed-pan should be placed under him. Astringent injections are to be employed daily. Sir Benjamin Brodie speaks also in favour of a course of Ward's paste. (*See Lond. Med. Gaz.* for 1834, 1835, p. 846.) Of the latter practice I cannot speak from experience, never having had confidence enough in it to give it a trial, which may not, I confess, be a fair way of deciding.

After the reduction of a prolapsus ani, the disposition which gave rise to the protrusion generally still continues; and therefore, as Dupuytren observes, the reduction is only to be regarded as a palliative, and, in some cases, as a means of preventing dangerous consequences; but never as a mode of accomplishing a permanent cure. Cold bathing and cold washes have been tried for the latter purpose, on the principle of strengthening the sphincter, so that the descent of the bowel may be opposed. But this method requires long perseverance, and is so disagreeable to some patients that it is soon given up. Astringent lotions and compression with a sponge and T bandage, suppositories, which Dupuytren admits do occasionally succeed in children, after a certain time, frequently fail, and especially in adults and old persons. (*Clinique Chir.* t. i. p. 160.) In such cases, recourse must be had to the operation first practised by Hey, or the modification of it adopted by Dupuytren.

The late Mr. Hey published some highly interesting remarks on the cure of the procidentia ani in adults. In one gentleman, the disease took place whenever he had a stool, and continued for some hours, the gut gradually retiring, and at last disappearing, until he had occasion to go to the privy again. After each stool, he used to place himself in a chair, and obtain a little relief by making pressure on the prolapsed part; and he then was in the habit of going to bed, where the intestine by degrees regained its natural situation. While the bowel was down, there was a copious discharge from it of a thin mucous fluid, blended with blood. When the part was up, the anus was constantly surrounded by a thin, pendulous flap of integuments, generally hanging down to the extent of three-fourths of an inch. Around the anus there were also several soft tubercles of a bluish colour, situated at the basis, and at the inner part of the pendulous flap. These were evidently formed by the extremity of the rectum. The patient, previously to the establishment of these habitual attacks of prolapsus ani, had been afflicted for several years with pain after each stool, protuberances at the extremity of the rectum, and discharge of blood and mucus. For these complaints he applied to Mr. Sharp, who gave him an ointment to be applied after each stool, some soapy pills to be taken, and recommended the use of a clyster a little before the time of going to stool. The latter remedy, however, could not be adopted, and no material benefit was derived from the others. Some years afterwards, when Mr. Hey was consulted, the foregoing symptoms continued; in addition to which there was the grievance of the prolapsus, which came on at every time of going to stool, and lasted for several hours. This judicious surgeon at first advised the patient to wash the prolapsed part with a lotion, composed of an infusion of oak-bark, lime-water, and spirit of wine, and keeping on the tumor compresses, wet with this fluid, and



supported by the T bandage. The disease, however, was too obstinate to be cured by this treatment. Nor could Mr. Hey succeed in reducing the bowel when it came down. "Although (says he) the prolapsed part of the intestine consisted of the whole inferior extremity of the rectum, and was of considerable bulk, yet the impediment to reduction did not arise from the stricture of the sphincter ani, for I could introduce my finger with ease during the procidentia; but it seemed to arise from the relaxed state of the lowest part of the intestine, and of the cellular membrane, which connects it with the surrounding parts. My attempt proved vain, as to its immediate object, yet it suggested an idea which led to a perfect cure of this obstinate disorder. The relaxed state of the part, which came down at every evacuation, and the want of sufficient stricture in the sphincter ani, satisfied me that it was impossible to afford any effectual relief to my patient, unless I could bring about a more firm adhesion to the surrounding cellular membrane, and increase the proper action of the sphincter. Nothing seemed so likely to effect these purposes as the removal of the pendulous flap, and the other protuberances which surrounded the anus." This operation was performed on the 13th of November. On the 15th the gut protruded, and did not gradually retire as it used to do. Mr. Hey attempted to procure ease by means of opiates and fomentations, and avoided immediately trying to reduce the prolapsed part. However, the prolapsus continued so long that the appearance of the part began to alter, and, therefore, on the 16th he made an attempt at reduction, and succeeded with great ease. However, as a good deal of pain in the hypogastrium was still complained of, the patient was bled in the evening, and gently purged with the oleum ricini. These means gave relief; but, as some pain in the belly yet continued, an opiate was given. A low diet, linseed tea, lac amygdalæ, &c. were ordered, and a little of the oleum ricini every morning, or every other morning, with an opiate after a stool had been procured. "By proceeding in this manner for some days, regular stools were procured, without any permanent inconvenience. My patient recovered very well, and was freed from this distressing complaint, which had afflicted him so many years." (See *Hey's Pract. Obs.* p. 483. &c. ed. 2.)

This, and some other cases, which this gentleman has related, convincingly exemplify the necessity of paying attention to the removal of redundant skin, excrescences, hæmorrhoids, and other tumors, situated about the lower part of the rectum, in cases of prolapsus ani; for, unless this object be accomplished, the disease may resist every other treatment. Mr. Howship prefers the ligature for the extirpation of the protuberances, but heartily commends the principle of the treatment proposed by Mr. Hey. (*Pract. Obs. on Diseases of the Lower Intestines*, p. 163. ed. 3.) An elderly gentleman, whom I know, was troubled for many years with a prolapsus ani, which used to come on several times a week, sometimes at the privy, and sometimes on other occasions. Several of the first surgeons were consulted, who failed in affording permanent benefit, because they omitted to extirpate some hæmorrhoidal excrescences, situated at the lower part of the rectum; for, when these were afterwards removed, the prolapsus ani entirely disappeared.

Dupuytren finding, as Hey did, that the excision of piles, which so often accompany prolapsus ani, commonly prevented the return of the latter complaint, was led to cut off more or less considerable portions of the internal membrane of the rectum. However, as in one case a profuse hæmorrhage took place, and, in another, a tedious suppuration, he subsequently adopted the plan of removing a certain number of the projecting folds, which may be seen converging from the circumference to the margin of the anus. The skin at the margin of the anus is thinner, and of a different colour from that of other parts; and contains numerous mucous crypts, which secrete an oily matter of a peculiar smell. It forms also prominent folds separated by fissures, which converge from the circumference of the margin to the centre of the anus. These folds extend up within the anus, and are the more numerous and prominent the closer the latter opening is; being effaced, when it is dilated. Their use is to facilitate such dilatation, and promote the evacuation of the fæces. Beyond the skin is a stratum of fibro-cellular tissue, erectile tissue, as Cruveilhier calls it; higher up, the external sphincter; and still further up, the internal sphincter. (See *Dupuytren, Clinique Chir.* t. i. p. 161.) The method, practised by this distinguished surgeon, consisted in taking hold of some of these converging folds of skin, one after another, with a pair of broad-bladed dissecting forceps, and cutting them away in succession with a pair of scissors curved laterally. The excision was extended quite up to the anus, and even a few lines within it, if the relaxation were considerable, by the degree of which the number of folds to be removed is also determined; two or three being taken away on each side in moderate cases, and a larger number where the relaxation is very great. (See *Dupuytren, in Clinique Chir.* t. i. p. 162.) I have practised this operation very successfully in several cases. The principle, on which it answers, is precisely what Hey and Dupuytren have explained; the anus being immoderately dilatable, the surgeon cuts away a portion of one of its textures, and the rest becoming more consolidated, the tendency to too much dilatation is obviated. The contraction of the cicatrices, and the adhesion of the textures together, induced by inflammation, have the principal share in bringing about this desirable change.

Dupuytren, in his first method, used to cut away the mucous membrane itself; in the last, only the folds of skin at the margin of the anus are removed. A woman had had a constant prolapsus for ten years; when she was in the upright posture, the swelling was ten inches in one diameter, and seven in the other; it hindered her from walking, and continually discharged a mixture of blood and mucus. Dupuytren removed five or six of the projecting folds from without inwards. The patient, who used to have more than twenty stools a day, now went six days without one; on the seventh, however, an abundant evacuation took place, and the prolapsus never returned. Only simple dressings, as lint wetted with cold water, and a T bandage, are needed. (See *Journ. Universel des Sciences Méd.* No. 81. Sept. 1822.)

Although Dupuytren's operation bears some resemblance to Hey's, and is founded on the same principle, the French do not admit that what the

latter did, will in any way affect the claim of the former to the merit of first suggesting a valuable improvement. They erroneously observe, that Hey's practice only related to prolapsus ani, as a consequence of piles; whereas that of Dupuytren is particularly adapted to examples, in which there are no piles. (See *Clinique Chir.* t. i. p. 166.)

[Dupuytren's method is imperfect in its operation, inasmuch as it only fulfils one of the indications required, namely, the contraction of the relaxed anal aperture itself; but has no influence on the dilated and relaxed mucous and muscular coats of the bowel within. To remedy the latter condition, the removal of portions of the mucous membrane will be found the most effectual practice. This should be done by ligature, and not by excision, the latter proceeding being attended, as in the case of hæmorrhoids, with the risk of serious bleeding. A portion of the mucous membrane, about an inch in circumference, just above the sphincter, should be raised with the vulsellum forceps, and strangulated by a ligature. It will be found convenient to transfix with a needle the base of the portion of mucous membrane which it is intended to ligature, and to tie it in two halves. Two, three, or four pieces of membrane, according to the size of the prolapsus, may be thus treated. The ligature of the mucous membrane should be accompanied by the excision of portions of the integument surrounding the anus, in a direction radiating from that aperture, as recommended by Hey and Dupuytren. This will often be followed by a complete and permanent cure. In cases where the disease is of long standing, however, even this will sometimes prove insufficient, or if sufficient for a time, the prolapsus will gradually be reproduced. In the case of a female, aged 27, with a very large prolapsus, which had existed from infancy, the writer has operated on four successive occasions in the way above described, at intervals of eight or nine months. The result, after each operation, was a diminution in the size of the prolapsus, and an alleviation of the symptoms, but the *upper* part of the rectum still continued to descend, although the *lower* part, which had been treated by the ligature, was sufficiently contracted and consolidated with the surrounding parts to retain its proper position.

Another mode of treating aggravated cases of prolapsus, is to paint the whole prolapsed portion lightly over with strong nitric acid. This will in many cases produce sufficient contraction of the relaxed coats of the bowel to cure the disease. It is important, however, not to use the acid too freely, or deep ulceration may take place, and be followed by deep ulceration and permanent stricture; while, on the other hand, if enough has not been accomplished at the first attempt, the acid can easily be applied a second, or, if necessary, a third time. The pain after this operation is not usually very severe, a superficial ulceration is induced, but this rapidly heals. The recumbent position should be enjoined until the healing is completed; the bowels should be kept confined for three or four days, and then acted upon by a mild aperient such as castor oil. Straining to evacuate the bowels should be carefully avoided for some time, and the motions should be passed while the patient is in the horizontal position. The writer has adopted this method in many cases; in all of them great advantage has been obtained,

in some the disease appeared to be completely cured; in none were any bad consequences, such as protracted ulceration or stricture, observed.

Perhaps a still better method is to apply the actual cautery to the prolapsed bowel. It should be applied in the longitudinal direction, in two, three, or four lines, as the case may seem to require. The cauterised surfaces should be each about half-an-inch broad, and they should be at equal distances from each other. When cicatrization takes place, sufficient contraction will probably be induced both in the longitudinal and transverse directions to prevent a recurrence of the prolapsus. Circular contraction or stricture is not likely to result, if the cautery is applied in longitudinal lines, with a sufficient space of mucous membrane intervening between them.

Operative proceedings for the cure of prolapsus are seldom required in children. In them due attention to the action of the bowels, the application of astringent lotions and injections, and the removal of any exciting cause, such as worms, polypus of the rectum, or vesical calculus will, in most cases, be found sufficient. The evacuation of the bowels into a flat vessel, while the child lies on its back, is also a very important ingredient in the treatment. Tonics, especially the *vinum ferri*, in combination with cod liver oil, are often of the greatest services in such cases.]

#### RECTUM, POLYPUS OF.

[Growths of a polypoid or pedunculated form are occasionally met with in the rectum. They are commonly described as of two kinds, the vascular and the fibrous, the former being more common in children, the latter in adults. It was stated by Sir A. Cooper, and his opinion has been very generally adopted, that the affection is more frequent in children. It is doubtful, however, whether this is really the case; on the contrary, in the experience of the writer, out of about forty cases which have come under his observation, more than three-fourths have been in adults.

The polypi met with in children differ somewhat from those seen in adults. They are softer and more vascular, with a greater tendency to bleed; they are usually attached by a very slender pedicle, which readily gives way. Those which I have seen have been of about the size of a raspberry, and of very much the same appearance. The polypoid growths seen in the adults are usually smaller than those met with in children—seldom larger than a nut, the majority being of about the size of a horse-bean. They are firmer in texture, but not sufficiently so to warrant the distinction which has been made between them by calling one the “fibrous” and the other the “vascular” polypus. Indeed they appear to be essentially similar in structure, both being composed of fibrous and fibro-nucleated texture continuous with the submucous areolar tissue, with an admixture of bloodvessels in variable proportion, and a covering of mucous membrane. Their point of attachment is usually from an inch to an inch and a-half within the anus.

The symptoms produced by polypi in the rectum are not usually severe. They consist of irritation and uneasiness in the part rather than actual pain, with frequent desire to evacuate and occasional loss of blood. The loss of blood is an especial characteristic of the disease in children;



indeed it is probable that many cases of irritation in the rectum accompanied by bleeding, observed in children, depend upon the presence of these growths, and that a spontaneous cure not unfrequently takes place from the accidental rupture of the slender pedicle, without the real nature of the case having been made out. In children they occasionally give rise to procidentia, but in that case the procidentia will ordinarily cease on the removal of the polypus.

Polypi in the rectum are not severely painful unless they are protruded through the anus, but when protruded they are liable to become inflamed and to cause great irritation with spasm of the sphincter muscle. In many cases they are not protruded at all, the length of the pedicle not admitting of it; or if occasionally protruded during the action of the bowels, they are immediately afterwards drawn back again within the rectum. But whether protruded or not, when they occur in adults they are exceedingly liable to irritate the sensitive region of the anal aperture, and to cause a fissure. This indeed would seem to be their very common result, for it has been present in about two-thirds of the cases of polypus in the adults which have come under the writer's notice.

When a polypus of the rectum is combined with anal fissure, the acute symptoms occasioned by the latter condition are apt to cause the polypus to be overlooked, and it is of importance that this error should be avoided, for the surgical treatment appropriate to the fissure will be of no avail as long as the polypus, which is its exciting cause, is allowed to remain. Practically then, in every case of fissure of the anus, it is desirable that a careful examination of the rectum should be made, to ascertain whether a polypoid growth is or is not present. When the two conditions are combined, an inquiry into the history of the case will usually show that there has been some feeling of irritation about the rectum for a considerable period, often with loss of blood, but at a later date the acutely painful symptoms of fissure have been superadded. The earlier and milder symptoms have doubtless been caused by the polypus, and this by continually falling against and irritating the anus, has in course of time produced the fissure. The above remarks on the combination of polypus with fissure refer especially to adult patients. It is never seen in children.

In examining the rectum to ascertain the presence of a polypus some care is required, for these little pedunculated growths, being very moveable, are apt to recede before the finger, and thus to elude detection.

*Treatment.*—The only satisfactory treatment of a rectal polypus is the application of a ligature around the pedicle at its point of attachment. By the administration of an enema of warm water the patient will usually be able to protrude the polypus, and the proceeding will be easy; but sometimes it cannot be made to appear externally. In that case a speculum may be introduced to bring the tumor into view, when it may be seized by a vulsellum; or the vulsellum may be introduced into the rectum guided by the finger without the speculum. In the softer tumors in children much traction must not be used, or the pedicle will be liable to give way. Very little pain or inconvenience follows the operation; the ligature separates in a few days, and the patient is speedily and effec-

tually cured. It is not safe, even when the polypus is small, to remove it by excision; in one case where I did so, thinking the little tumor too insignificant to deserve a ligature, hæmorrhage to a serious extent followed, which was only arrested with great difficulty, and by the application of the actual cautery to the wounded spot. In those cases in which a fissure is present, it should of course be treated by incision at the same time.]

[*Villous Tumor of the Rectum.*—This very rare disease may be appropriately described under the head of polypus. A case has been described by Mr. Quain occurring in a lady *Æt.* 68, in whom, at each evacuation, a tumor of considerable size was protruded from the bowel. Its descent was attended with a discharge of slimy mucus, and often with considerable loss of blood, by which the patient had become much enfeebled. The tumor when partially prolapsed was found to be a large pulpy mass separable into several loosely-connected lobes, consisting of pencil-like processes. It was connected with the posterior part of the bowel about three inches from the anus. The tumor was about five inches long by two in breadth. It was composed of elongated slender processes, hanging loosely together on a basis of white fibrous tissue. The principal characteristics were, the being formed of elongated processes—villi—the want of solidity or firmness, from the small amount of connective tissue; great vascularity, with slight restraint to the escape of blood, on account of the coats of the vessels being thin, and but slightly protected from without. The tumor was removed by Mr. Quain with the ligature; the patient recovered favorably, and was ascertained to be free from any return of the disease, or inconvenience in the part, eighteen months afterwards. (See *Quain, On Dis. of the Rectum*, p. 295.)

A tumor of similar character, about the size of an orange, was removed by Mr. Gowland in St. Mark's Hospital from a middle-aged male patient. The ligature was so applied as to separate the root of the tumor into four portions, each of which was tied separately. The patient recovered without any untoward symptoms. The tumor was cut off beyond the ligature, and was examined by Dr. Andrew Clark, who describes it as essentially an outgrowth of dense areolar tissue, permeated by bloodvessels and assuming a papillary form, the papillæ being flattened and curled so as to represent hollow cylinders, and being clothed with layers of epithelium, the free layers being cylindrical; its minute structure closely resembling the soft polypus.

Another case of villous tumor occurring in an elderly female, was under the care of the writer in St. Mark's Hospital. Here the growth was not so circumscribed, but was diffused so as to involve nearly the whole circumference of the bowel, and it therefore did not admit of complete removal. Two masses, however, were treated by the ligature, and the rest was afterwards lightly cauterised with nitric acid. By this means the bleeding was arrested and the patient much relieved. It was not thought advisable to reapply the acid, or to use it with sufficient freedom to destroy the growth completely, for fear of inducing a circular contraction of the bowel. When the patient left the hospital she was suffering but trifling inconvenience.

Mr. Syme mentions three cases of vascular

lobulated tumor, probably of this character, which were removed successfully by the ligature. (*On Dis. of the Rectum*, ed. 3. p. 104.)

Similar vascular lobulated tumors occurring in the bladder and elsewhere have been described by Rokitsky under the name of villous cancer, and are considered by him to be closely allied to the medullary form of that disease. (See *Puget, Surg. Pathol.* vol. ii. p. 503.) In none of the cases above recorded, however, does there appear to have been any tendency to recurrence, or, indeed, any of the usual characters of malignant disease, with the exception of the tendency to hæmorrhage. The surgeons, therefore, whose names have been mentioned are all disposed to regard them as innocent in their nature.]

#### ULCERATION OF THE RECTUM.

[The painful ulcer, usually denominated fissure, at the verge of the anus, has been described in article ANUS, and need not be further alluded to. Ulceration of the rectum is also frequently present in cases of stricture and of malignant disease, as will be explained in speaking of those affections. But independently of the above conditions, ulceration in the rectum is not of unfrequent occurrence, and is often very intractable in its character. It is met with for the most part in unhealthy or debilitated constitutions; being seen in persons of scrofulous habits; in those who have resided in tropical climates and have suffered from dysentery, and in those who are labouring under constitutional syphilis.

Tubercular ulcer in the rectum is recognised as an occasional cause of abscess and fistula in persons of strumous diathesis. Suppuration, however, is not a necessary accompaniment of the ulcer, but the latter may remain in a chronic condition, without extending beyond the mucous and submucous textures. Such an ulcer is commonly single, is circumscribed, and usually of small size. The writer has seen several cases of ulcer in the rectum in children of strumous diathesis apparently belonging to this class. In children, the irritation which they occasion not unfrequently gives rise to procidentia. Ulceration of the rectum occurring as a sequel of dysentery, or other irritation of the large intestine—is more irregular in shape, more diffused and more painful than the tuberculous ulcer. The same may be said of the ulceration which sometimes occurs in patients presenting symptoms of constitutional syphilis, and in whom there seems to be reasonable ground for concluding that the ulceration is one of the consequences of that disease.

From whatever cause arising, ulceration in the rectum is attended with more or less pain and irritation, with tenesmus and a feeling of weight and bearing down. The motions are often streaked with matter or blood, and a purulent discharge may sometimes be observed from the anus. Bleeding to a greater or less extent is also a very common symptom. The pain varies greatly; in some it is trifling, in others exceedingly severe. It is generally greatest when the ulcer is situated near the sphincter, in which case it approaches in character to the pain observed in fissure, but as a rule the pain in ulceration is very much less than in fissure. The situation and extent of the disease may be ascertained by examination of the rectum with the finger, or the speculum may be used to bring it into view, but for those accustomed to the examination of the rectum, the finger will usually

afford the better information, and is less painful to the patient.

*Treatment.*—In the management of these cases, a careful inquiry is necessary in the first instance into the health and constitution of the patient, and the general treatment must be directed according to the information thus obtained. In all, the bowels must be carefully regulated, they should be kept moderately relaxed, and either constipation or diarrhœa should be equally avoided. The most suitable aperients are blue pill or the Hydrarg. c. Cretâ in small doses combined with colocynth, castor oil, or the confection of senna. In strumous cases cod liver oil, combined or not with iron, according to circumstances, will often be of the greatest service. In cases following dysentery, the astringent preparations of iron, such as the Tinct. Ferri perchloridi, or iron combined with quinine, and opium in small doses to allay irritation, are especially indicated. In syphilitic cases, the iodide of potassium should be given in gradually increasing doses, and persisted in for a period of two or three months if necessary. Mercury is seldom required, the ulceration, if syphilitic, seeming to partake of the tertiary rather than the secondary character. But whether syphilitic in its origin or not, the iodide of potassium may be prescribed with great prospect of advantage in many of these cases. *Locally*, the ulcerated surface should be stimulated with the nitrate of silver, applied to it by the aid of the speculum, every four or five days, until a healthy reparative action is set up. In the intervals, mild astringent injections, such as tannin, in the proportion of three or four grains to the ounce of water, may be injected night and morning. A small quantity only should be thrown up, in order that it may be retained in the rectum without exciting expulsive efforts. Should the nitrate of silver prove ineffectual, the surface of the ulcer may be touched with a more powerful escharotic, such as the nitric acid, or potassa fusa.

When the ulcer is situated low down, implicating the sphincter, and there is severe pain during and after defæcation, a free incision should be made through the muscle and through the lower part of the ulcerated surface. In such cases, a speedy and effectual cure may often be obtained by this means, but the incision will be both useless and mischievous when the ulceration is situated higher up.

Sedatives and astringents may be conveniently introduced into the rectum in the form of suppository. For this purpose the cocoa butter forms a very convenient vehicle, and alum, tannin, acetate of lead, or nitrate of silver may be applied in this manner; with any of these either opium or morphia may be combined.

Ulceration in the rectum, when occupying any considerable portion of the circumference of the bowel, is apt to be followed by contraction when cicatrisation takes place. Therefore, when any tendency of this kind is observed, it will be desirable to pass a full-sized bougie into the rectum every three or four days. A like contraction may also take place independently of cicatrisation, and is a not unfrequent consequence of protracted unhealthy ulceration, and in this way ulceration may be the exciting cause of stricture of the rectum, though more frequently the ulceration observed in cases of stricture is the consequence, and not the cause, of the latter disease.]



## STRICTURE OF THE RECTUM.

[The rectum, like the urethra and œsophagus, is liable to contraction in consequence of inflammatory deposit in and around its walls. A stricture may be situated at any part of the canal, but in the great majority of cases it is near enough to the anus to be discoverable by digital examination. Those in which it is placed higher than this are of quite exceptional occurrence. Its most common position is at about one and a half or two inches from the lower termination of the bowel. It is more frequent in women than in men, according to the writer's experience, in the proportion of about four to one. It is characterised by a uniform circular contraction of the calibre of the intestine from the deposition of lymph in the submucous and muscular tissues, the mucous surface being in the first instance uninjured, but at a later stage it is exceedingly liable to ulceration. It may form merely a circular ring surrounding the bowel—annular stricture—or it may be of considerable longitudinal extent.]

In the various descriptions given of the complaint by writers, one great point of difference is remarkable, viz., that some of them represent the case as always of an incurable nature, while others consider it as admitting of relief, at least when it has not made considerable progress, and the parts are free from ulceration. "Many strictures of the rectum (as a judicious writer has remarked) are in their nature quite harmless, injurious only inasmuch as they present a mechanical obstruction, or disorder the functions of the alimentary canal, and fatal only from neglect. In many cases, also, great thickening and induration prevail, without the least tendency to cancer; at least, the latter disease has not supervened, even after an interval of many years."

There will be less confusion in the account of this subject, if the consideration of simple stricture, or contraction of the rectum, be separated entirely from that of cancerous, or malignant disease.

In dissecting a case of simple stricture of the rectum, Sir Benjamin Brodie found the mucous membrane thickened, of a harder structure than natural, and the muscular tunic also thickened. "The stricture sometimes occupies the whole length of the gut, for some way up above the anus, perhaps three or four inches; at other times, it is only of short extent. Frequently the gut is of its natural diameter close to the anus, and, about an inch and a half, or two inches above it, there is a circular contraction, and then above that the gut is of its natural diameter again. Although the contraction may occupy only a small portion of the length of the rectum, yet the disease of the tunics is generally more extensive." (*Sir B. Brodie, in Lond. Med. Gaz. vol. xvi. p. 28.*)

Mr. Calvert says the contraction is chiefly owing to a thickened and indurated state of the mucous membrane, arising from inflammation, or some chronic alteration of texture; but that when the disease has existed a considerable time, the mucous, cellular, and muscular coats become more or less affected; so that, on dissection, it is often impossible to determine in which the disease originally commenced.

As the disease, at first, is not very painful, it is usually not much noticed till somewhat advanced.

The patient is at first habitually costive, or affected with what is called a torpid state of the bowels, and usually voids his stools with a little difficulty. In time a good deal of pain is felt in the part affected, especially at stool, after which some relief is experienced. As the gut continues to decrease in diameter, the efforts to expel the fæces become more violent, and the consequent progress of the disease more rapid. The stools, which have been long evacuated with difficulty, become contracted in size, appearing like earthworms in their form, or small pellets; and, if the finger be introduced into the rectum, it will be opposed by a hard ring of a cartilaginous feel, composed of the diseased inner membrane of the intestines. These states, as Mr. Copeland observes, are very different from the regular tumor on the anterior part of the rectum, occasioned by an enlargement of the prostate gland; a case apt to be suspected. "As the disease advances (says the same author), the fæces become more fluid, and there is a thin sanious discharge from the anus, accompanied with tenesmus." Mr. Calvert notices as the most characteristic symptoms, an unusual distension of the colon; the extension of pain, felt about the upper part of the sacrum, down to the feet, in the course of the large nervous trunks; the decrease of the tenesmus after a sufficient evacuation; and the scanty motions of irregular or figured appearance. The latter effect, however, he says, is not always present throughout the disease; for, if the contraction be at the upper part of the rectum, the motion may be of the usual size and appearance. (P. 147.) Pus and blood may be noticed with the excrement, particularly when the disease has advanced to the ulcerated state.

Sometimes a small fistulous orifice at the verge of the anus communicates with the inferior portion of the diseased part.

Professor Syme had a female patient, who was admitted into the Edinburgh Infirmary on account of a fistula in ano, but, in whom, as soon as he introduced his finger for the purpose of guiding the knife, he found a close stricture of the rectum; yet she had been unconscious of its presence. The cause of deception Mr. Syme refers to the effects of a confirmed stricture being "in general the frequent, often almost incessant discharge of the feculent matters, owing to the copious secretion of mucus, which results from the irritation of the disease;" and to the "thin slimy stools, occasionally tinged with blood, attracting more notice, than the small indurated masses of fæces passed along with them." Hence the disease is mistaken and treated as a diarrhoea.

The following is Sir Benjamin Brodie's description of stricture of the rectum in the ulcerated stage:—"As the disease advances, some parts of the mucous membrane ulcerate. This causes the pain to be much aggravated; there being then a discharge, not only of mucus, but of blood and pus from the anus. If the disease proceeds still further, inflammation takes place in the cellular membrane around the gut; putrid abscesses form, which burst in various situations at every side of the anus; into the urethra in men, and occasionally in women into the vagina. In some instances, the patient dies with symptoms of strangulated hernia; that is, a piece of hard fæces is lodged above the stricture, and cannot pass through it. Thus, there

is a mechanical obstruction to the passage of the feces; the belly becomes tympanitic; the tongue dry; there is sickness, vomiting, and the other symptoms indicating strangulation. He may have one of these attacks, and, by means of injections, and the use of a bougie, may recover: he may have a second, and recover from that; and then he may have a third, which may prove fatal. In the most advanced stage of the disease, independently of these attacks, the patient suffers much in his general health, loses flesh, perspires at night; his digestion is deranged; he is emaciated and hectic; and thus gradually becomes exhausted." The progress of the disease is tedious. The patient, where no remedies are employed, may linger ten or twelve years. In other cases, if not cured, the disease may be mitigated, and never prove fatal. (See *Sir B. Brodie in Lond. Med. Gaz.* vol. xvi. p. 28.)

Sometimes in the advanced state of this disease, the patient is seized with symptoms of peritoneal inflammation, which puts a speedy termination to his sufferings. In such cases, on examination after death, it is discovered that the process of ulceration has opened the intestine immediately above the stricture, and that through this opening a portion of feces has passed into the cavity of the abdomen. (*Colles, in Dublin Hospital Reports*, vol. v. p. 136.)

The following statements made by this gentleman deserve attention. "Among a considerable number of patients afflicted with this disease (he observes), I have had an opportunity in two instances only of meeting with it in its incipient state. In both of these the patients complained of different symptoms of irritation of the rectum, frequent stools, discharges mixed with mucus, and certain feelings of uneasiness. On examination with the finger, a thickening and slight projection of the gut was felt at a small spot on one side. This morbid alteration spread gradually round the entire of the canal, and extended along it only to a small distance; but until the morbid derangement of structure had almost entirely performed the circle of the intestine, the patient did not exhibit those symptoms which I consider as the common and inseparable attendants on stricture of the rectum. However constant in their attendance or unvarying in their course may be the symptoms of this disease, yet will the surgeon desire to be confirmed in his opinion by manual examination. Proceeding to make this examination, we often observe at the orifice of the anus the following appearance, which is indeed almost always present when the disease is seated near the external sphincter; namely, at each side of the anus a small projection, which, on its external surface, appears as a mere elongation and thickening of the skin, but internally presents a moist appearance, not exactly like the lining membrane of the gut, nor yet can we say that it is ulcerated. These two projections lie close together below, and divaricate above, presenting a resemblance to the mouth of an ewer. Whenever this external appearance exists, I feel almost certain of finding a stricture of the rectum before the finger is pushed as far as the second joint into the gut. In some cases, however, this external mark has not been present." "When the stricture is situated pretty high up, the portion of gut, interposed between it and the anus, is found to be in a perfectly healthy state;

but, when the finger arrives at the stricture, it is arrested by the narrowness of the canal, which will barely admit the point of it. If now a slight degree of force, combined with a boring motion, be employed, the finger may be pushed through the thickened and indurated part, and will then find that the gut just above the stricture is in a very healthy state." Sometimes the stricture is a mere ring; but at other times it extends along the canal as high as the finger can reach. Dr. Colles has not yet met with any instance in which the intestine was strictured by means of bands thrown across its canal. Cases of this disease, examined after death, present all the coats of the intestine very much thickened, except the peritoneal tunic; the muscular, cellular, and mucous coats are much thickened, and the latter one is hardened and raised into irregular ridges, but not ulcerated. (See *Colles's Dublin Hospital Reports*, vol. v. p. 137, &c.)

Dr. Colles believes that stricture of the rectum most frequently attacks persons who are about the meridian of life; sometimes, however, children, as early as the seventh or eighth year of their age. He has not met with any instance where it attacked an individual at or beyond the age of sixty. (See *Dublin Hospital Reports*, vol. v. p. 131.)

Strictures of the rectum are mostly situated in the lower part of it, within the reach of the finger. About four inches from the anus is specified by Mr. Liston as their general situation. (*On Practical Surgery*, p. 366.) In a few instances met with by Dr. Colles, the stricture could not be well reached with the finger, unless the patient forced it down. There are exceptions, however: in the museum of University College, London, may be seen a stricture situated between the rectum and the sigmoid flexure of the colon, not of a scirrhus nature. The parts were taken from the body of a woman, aged 55, who had had no evacuation from the bowels for a fortnight previous to her decease. The abdomen was much distended, and around the ulcerated openings, just above the stricture, small abscesses had formed, communicating with the bowel, but not with the cavity of the peritoneum. There is also to be seen in the same museum another stricture of the rectum, attended with fistulous sinuses, terminating in the vagina and perinaeum.

Sir Benjamin Brodie has seen one example where a stricture of the rectum was about six inches above the anus, and another case where there was a stricture in the sigmoid flexure, manifestly the consequence of the contraction of a cicatrix. However, he deems strictures in these high situations very rare; yet he has known a great number of persons treated with long bougies on the supposition of their labouring under strictures so placed. "The only evidence of the existence of a stricture in these cases (he observes) has been *first*, that there was obstinate costiveness; *secondly*, that a bougie could not be made to pass beyond a certain number of inches above the anus. But (he asks) what is the value of this evidence when compared with that which anatomy affords of the rarity of this kind of stricture? Are there not many causes of a costive state of the bowels besides mechanical obstruction? Will it be always easy, even in the most healthy rectum, to introduce a bougie more than a few inches into it? Although we call the lower bowel the *rectum*, it is anything but a straight gut. Three or four inches above the anus



the rectum begins to make flexures, which increase as you trace it upwards, until they terminate in the sigmoid flexure of the colon. These flexures of the rectum differ in different individuals, and even in the same individual at different periods. When a bougie is introduced, be it small or large, it is certain that it will be stopped somewhere or another by one of these flexures; and nothing can be more unphilosophical than to conclude, because a bougie meets with an impediment at the distance of five, or six, or eight, or nine inches, that this is the result of an organic disease of the rectum, when the natural formation of the parts will account for it. But let us suppose that you actually meet with one of those rare cases in which there is a stricture in the upper part of the rectum, by what means are you to recognise the disease in the living person? Or, if you can recognise it, how can you know its exact situation? If the bougie can only be introduced to a certain distance, how are you to be sure that it is stopped by a stricture and not by a fold of the bowel, or even by coming in contact with the sacrum? If you employ the force which you would suppose to be necessary to make the bougie penetrate through the stricture, is there no danger of its penetrating the tunics of the intestine instead? I have been informed, on good authority, of seven or eight cases in which this frightful accident occurred, and the patients died in consequence." Taking all these things into consideration, Sir Benjamin Brodie lays it down as a rule, that bougies should not be employed, except when the stricture is within reach of the finger. (*See Lond. Med. Gaz.* vol. xvi. p. 30.)

The distinguishing characters between stricture of the rectum and other affections are ably explained by Dr. Colles. 1. In cancer of the rectum there is the same narrowing of the canal and hardness of its walls, the frequent straining stools and discharge of bloody purulent mucus; but the countenance presents a leaden sallow cast, and lancinating pains dart through the hips and pelvis into the groin and down the thighs and legs. Although cancer of the rectum, in its early stage, presents to the finger a feel very similar to that of stricture, yet by repeating the examination in a few weeks we discover that the cancerous ulceration has in the interval destroyed some portion of the hardened wall of the intestine. 2. Dr. Colles notices a rare form of scirrhus of the uterus and vagina, in which the latter passage is almost obliterated by a cancerous thickening of its walls. This gives rise to symptoms not unlike those of stricture of the rectum. Here manual examination will remove all doubt. 3. The same test will apply to enlarged prostate gland, if the symptoms should simulate those of stricture of the rectum. 4. An ulcer of the rectum, if low down, will become visible by expanding the anus, or by introducing a blunt polished gorget into the bowel with its concavity towards the disease. The cavity of the ulcer may be felt with the finger, and more pain attends the evacuation of the bowels than in cases of stricture. 5. A tumor in the pelvis may compress the rectum: here the projection comes from one side only, and the coats of the intestine retain their healthy structure. (*See Colles, in Dublin Hospital Reports*, vol. v. p. 140.)

[The important point of distinction between

stricture and malignant disease is, that in the former the contraction is circular and uniform, but in the latter it is produced by irregular and indurated growths varying in size and shape, which project into the cavity of the bowel, and in that way diminish its calibre.]

Sir Benjamin Brodie has given the description of a disease of the rectum, in which there is generally, but not always, a contraction of the gut, which is not a malignant affection, and yet ought not to be confounded with ordinary stricture. He has observed it chiefly in women, and especially in those who have borne children. In the great majority of cases, it has begun some time after a difficult labour. The patient complains of pain referred to the rectum, pain in the lower part of the back, a discharge of mucus from the anus, and some difficulty in passing the evacuations. These symptoms gradually increase in severity; and the patient then complains of exceeding difficulty in passing the evacuations, and of constant pain, which, however, is greatly aggravated after the fæces have been voided. There is a discharge of mucus; and sometimes of blood, or of mucus tinged with blood. If the bowel at this period be examined with the finger, the inner surface of the mucous membrane is felt to be irregular, as if it were lined with a multitude of small flat excrescences, some of which may generally be observed, at the same time, on the margin of the anus, somewhat like shrunk or collapsed external piles, but smaller. In some instances, the mucous membrane appears to be here and there in the intervals ulcerated. The examination gives extreme pain. Generally, about an inch and a half, or two inches above the anus, a circular contraction, or stricture is perceived; but, in other instances, there is no contraction whatever in this situation, but a very contracted state of the anus itself. A contraction, however, is not an essential accompaniment. When the disease has advanced further, an abscess forms in the cellular tissue near the gut, and bursts near the anus, or on the nates, or in the perinæum. These abscesses burst in other situations one after another, in the same manner as after common stricture of the rectum. Sometimes an abscess forms in front of the rectum, and bursts into the vagina, making a communication between them. Ultimately the fistulous openings are numerous, the abscesses having no disposition to heal, though they sometimes get into a quiet state, and discharge but little matter; and then all at once inflammation takes place again; and a fresh collection of pus is produced, followed by copious discharge. The disease, if left to itself, always proves fatal in the end. Many years, however, may elapse before it has run its course, the patient all the time suffering miserably. At last she has shiverings, nocturnal perspirations, a rapid pulse, and becomes hectic and dies. (*Sir B. Brodie*, Vol. cit. p. 236.)

*Treatment.*—When the disease is not attended with ulceration, the contraction and thickening of the gut may be diminished by introducing bougies, keeping them for a certain time every day so introduced, and increasing their size gradually. The pressure of these instruments seems to lessen the disease and stop its progress; a proof, at all events, that the nature of one form of indurated and contracted rectum differs from that of malignant scirrhus. Desault used long tents, made of linen,

smeared with cerate, and passed into the bowel by means of a probe with a forked end. Their size was gradually increased, so as to keep up the compression, to which, it was conceived, all the good was owing. Their length was also augmented by degrees. At first, fresh ones were introduced twice a-day. When any hardnesses were situated on the outside of the anus, Desault cured them on the same principle, viz. by making pressure on them with compresses and a bandage.

Instead of tents, modern surgeons employ bougies for the dilatation of strictures in the rectum. When, from habitual costiveness, the altered figure of the stools, and other circumstances, there is reason to suspect organic obstruction to the passage of the fæces, and this suspicion is confirmed by an examination of the rectum with the finger, "the first object of the surgeon (says Mr. Copeland) should be an enlargement of the obstructed part, by the introduction of a bougie. This should be of such a size, as to pass, when well lubricated with oil, without much difficulty or pain. Sometimes, when the disease has been of long continuance, it will be necessary to begin even with a large-sized urethra bougie, or one of the same size as those which are made for a stricture of the œsophagus, and of a length that is likely to pass beyond the end of the stricture, that is, about six, or seven, or eight inches. But, I think it of consequence to use a bougie at first, which is rather too small, than too large." (P. 29.) When it has remained for half an hour, or more, it is to be removed, and passed again the next day, the same sized bougie being continued for several days. In the introduction of the bougie, Mr. Copeland cautions the practitioner not to mistake the projection of the sacrum for a stricture of the gut; a mistake which, he says, has often been made, and, as I believe, too often wilfully, and from motives of imposition.

Mr. Syme relates a case in which some respectable practitioners were deceived. "In the feeble and unhealthy persons, who are usually suspected to labour under the disease, the coats of the rectum are so thin and relaxed, as readily to catch the point of the bougie employed for exploring the cavity, and thus impede its progress, which is also apt to be arrested by the promontory of the sacrum." The case of an elderly lady is then detailed, in which two medical gentlemen had spent three hundred hours in endeavours to dilate a supposed stricture with bougies. The patient died, and in the post-mortem examination not the slightest trace of contraction could be discovered. A bougie was introduced by one of these gentlemen in the accustomed way, and on arriving at the depth it used to reach, its point was ascertained to be stopped by the promontory of the sacrum. (See *Syme, On Dis. of the Rectum*, p. 112.)

Pressure on the rectum by the retroverted uterus (*C. Bell*), an enlarged ovary, or other tumor, may also lead an inattentive surgeon to mistake the case for a stricture. Mr. Calvert has seen the bougie employed a long while in one example, where the real disorder arose from a biliary concretion imbedded in the parietes of the rectum. (*On Hemorrhoids and other Diseases of the Rectum*, p. 167.) This gentleman conceives, that an ivory ball, affixed to the end of a silver wire, is a good instrument for ascertaining the exact situation and extent of strictures of the rectum.

(P. 169.) When the stricture is just above the sphincter, some information of the state of the parts, he says, may be gained by employing the speculum ani; but, he adds, that whenever there is organic stricture near the anus, this instrument should be used with caution, as any sudden distension of the parts is always injurious. (P. 170.) Mr. Copeland advises the bowels to be kept constantly lax, by the use of castor oil, or electuary of senna, during the whole of the treatment. (P. 30.)

The plan of gradual dilatation is to be persisted in until a full-sized bougie will readily pass, and even after all symptoms have disappeared, it is recommended to introduce the bougie, and withdraw it again, once every two or three days, for some time, in order to prevent a relapse. The indurated, annular stricture, which long resists the bougie, Mr. Copeland sometimes divides with a probe-pointed curved bistoury on the side which is contiguous to the os sacrum; and he has frequently seen the late Mr. Ford perform the same operation. (P. 34.) This practice, which originated with Wiseman, has also been followed by others with success. (See *Jameson's Case in American Recorder*, April, 1822.) When the disease is either combined with venereal symptoms, or there is any reason for suspecting it to be itself "the solitary symptom" of lues, Mr. Copeland joins Desault in recommending a trial of the effect of mercury, in conjunction with bougies. (P. 44.) The formation of abscesses, he remarks, is very frequent in the advanced stages of the disease, and he has often seen the common operation for fistula done under such circumstances without success. (P. 35.) Sir Benjamin Brodie also joins in representing the inutility, and even the mischief of laying open abscesses formed under these circumstances; for they will not heal till the stricture has been removed.

Besides tents and bougies, which latter Mr. Calvert thinks may be sometimes usefully made the vehicle of local applications, or be what is called medicated, this gentleman enumerates amongst the plans of dilating the stricture a prepared gut, introduced beyond the stricture, and then distended with water; in other words, Mr. Arnot's dilator. This method, he thinks, may be adopted where the bougie causes great irritation. (P. 173.)

If the stricture be not in a very irritable and tender state, Sir Benjamin Brodie is of opinion, that the patient may at once derive benefit from mechanical dilatation by the use of a bougie. The diameter of the stricture is to be ascertained, as nearly as possible, with the finger, and a bougie of proper size introduced through its orifice. He recommends the bougie to be kept in the stricture five or ten minutes, or in some cases, for a longer time; and the operation must be repeated every day, according to circumstances. In this manner, though the gut may not be restored to its full diameter, the stricture will be so much dilated, that the fæces will readily pass, and the patient suffer little inconvenience. Here, as in cases of stricture in the urethra, the use of the bougie must be continued. If it be neglected, the stricture will return. In some cases, where the stricture is situated about two inches above the anus, and occupies only a small portion of the length of the gut, forming a circular band, which embraces the finger, Sir Benjamin Brodie precedes the use of bougies by dividing the stricture in two or three places with



a *bistouri caché*. The knife is introduced with the blade shut, and the screw so adjusted, that the blade may be opened about the sixth of an inch, but certainly not more than a quarter. The handle being pressed upon, the blade is opened, and being drawn out, the stricture is cut first at one point; then at a second; and again at a third. This having been completed, a larger bougie may be introduced than was previously applicable, and the cure is much expedited.

A bougie, made of a long piece of common sponge, dipped in a concentrated solution of gum arabic, is sometimes preferred. The whole length of it is tied up with a string, the circular turns of which must be close together. After being dried, the string is taken off, and the surface is made smooth with a knife or file. As soon as the gum arabic is dissolved by the moisture of the part into which this bougie is introduced, the sponge gradually regains its natural elasticity, and extends the part without pressing or irritating it, as it assumes the shape of the gut. (See *Edinb. Med. and Surg. Journ.* No. 134, p. 290.)

Mr. Syme is not much in favour of dividing a stricture of the rectum with a knife; because, "in certain conditions of a constitutional and local kind, wounds of the rectum, even though of very small extent, are followed by serious, or fatal consequences; and as the bougie, though not so speedy in its operation as the knife, is equally effectual, and not exposed to the same objection, prudence seems to require that the practice of incision should be either entirely abandoned, or only used in particular cases with extreme caution." (*Syme, Op. cit.* p. 120.) In London, surgeons do not find cause for the apprehension here expressed, and as the division of the kind of stricture specified by Sir Benjamin Brodie promotes the cure materially, I believe it receives general approbation.

Instead of introducing the bougie daily, and allowing it to remain in the passage for hours, Mr. Syme employs it only every third or fourth day, and withdraws it immediately it has been passed through the stricture. Bougies, composed of iron or elastic gum, appear to him the most convenient. (P. 122.)

The late Dr. Bushe invented particular kinds of rectum bougies; a whalebone stalk, mounted with an ivory ball, three inches long; and also a silver instrument (see Pl. VIII. *Bushe on Malformations, &c. of the Rectum and Anus*); but a judicious critic expresses disapprobation of them. (See *Edinb. Med. and Surg. Journ.* No. 134, p. 290.)

In some cases, it is necessary previously to the use of a bougie, to lessen the irritable state of the bowel by the introduction of an opiate suppository every night, and the exhibition of a gentle aperient in the morning.

When the fæces accumulate above the stricture, and distend the bowel into a large bag, attended with aggravation of the disease, Sir Benjamin Brodie recommends an elastic gum catheter to be introduced through the stricture into the feculent mass; and tepid water, or tepid soap and water, or a weak solution of caustic alkali to be injected. By repeating this operation every day, or every other day, the fæces will be dissolved, and their evacuation brought about. When this has been accomplished, the injection of warm water should be frequently repeated, in order to prevent another accumulation.

Formerly it was a common practice to apply mercurial ointment to strictures of the rectum. Morgagni followed this plan on the supposition of the cases being connected with syphilis. Sir Benjamin Brodie states his belief, that this treatment has sometimes been beneficial. The bougie is covered with lint, smeared with mercurial ointment, and allowed to remain in the stricture a few minutes. Other practitioners have been content with smearing the bougie itself with the ointment.

From what I have seen of strictures of the rectum, I incline to the opinion expressed by Sir Benjamin Brodie, that the degree of success of the treatment will depend upon the stage of the disease in which the surgeon is consulted. If proper means be employed in good time, the stricture may be dilated, and, though the disposition to its return may yet continue, the patient may be kept from experiencing much inconvenience, and his life will not be shortened by the disease. But, in a more advanced stage of the complaint, when abscesses have formed, the symptoms will only admit of palliation.

When a stoppage of urine occurs in the advanced stage of the disease, Mr. Copeland advises surgeons not to use the catheter hastily. (P. 39.) And, in the event of great pain and irritation in the rectum, he has seen the greatest benefit derived from the local application of opium, either in a clyster, or by the introduction of one or two grains of the medicine within the anus. He also speaks favourably of the effects of the warm bath, and fomentations, in giving temporary relief; and he has exhibited in these cases the pil. extracti conii cum hydrarg. chlorido with considerable advantage.

Sir Benjamin Brodie has seen some advanced cases, where much benefit was derived from the exhibition of four or five minims of liquor arsenicalis, three times a day. The effect was to lessen the discharge, diminish its irritability, improve the general health, and sometimes put an end to the rigors, to which the patient was liable.

Notwithstanding the alleviation derived from bougies, Dr. Colles is confident that a perfect cure of an organic stricture of the rectum has not yet been accomplished by any plan of treatment. He has not been contented with applying the bougie, but has often made it the means of conveying various applications to the seat of disease, employing for this purpose bougies with a deep groove running spirally their whole length, so that the ointment should not be rubbed off them by the tightness of the anus. Mercury, arsenic, cicuta, and preparations of iron, he has not found possess any power over this disease. Large quantities of mucilage appear to him to give most relief. Blue pill, however, combined with twice its quantity of compound powder of ipecacuanha, he notices as having sometimes afforded much temporary relief. (See *Dublin Hospital Reports*, vol. v. p. 143.)

[The modern treatment of stricture of the rectum varies little from that above recommended by the older authorities. Gradual dilatation by means of gum elastic or metallic bougies is practised in all ordinary cases. If the bougies are conical in form they will be more easily introduced. In cases of close contraction, the treatment is greatly accelerated by incisions of limited extent in the manner recommended by Sir B. Brodie. Or in preference to this, forcible dilatation may be employed. For this purpose a convenient instrument

has been devised by Mr. Armstrong Todd, consisting of two blades, which are separated by means of a screw, after the instrument has been introduced through the stricture.

Stricture of the rectum, unless perhaps when treated in its very early stages, when it is seldom discovered, is a most obstinate, and, it may be said, incurable disease. It is remediable to a great extent by dilatation, and when so treated, it seems to exercise but a slightly prejudicial influence on the health of the patient, who may remain for years without any material aggravation of his disease; but if the use of instruments be discontinued, rapid recontraction will always take place. Even in the most favourable cases, the coats of the bowel seem never to recover their original elasticity and distensibility. The general treatment consists of mild laxatives, and tonics; in some cases, especially where there is much ulceration, the iodide of potassium is of very great service. Stricture is common in patients suffering from syphilis, and may probably in such cases be one of the consequences of that disease; but when once established, syphilitic stricture, if it deserves to be so called, differs in no respects in its symptoms or progress from strictures arising from other causes.

Cases of stricture are occasionally met with, especially when the disease is situated high up, in which the symptoms of obstruction are so urgent, that the propriety of opening the colon in the lumbar region may require to be considered. The question is discussed in the article on *INTESTINAL OBSTRUCTIONS*. Modern experience goes far to show that colotomy is a much less serious operation, both as regards immediate risk, and the condition in which it leaves the patient, than it was formerly considered.]

#### CANCER OF THE RECTUM.

*Malignant Disease; Scirrhus-Contracted Rectum.*  
—According to Desault, scirrhus of the rectum is not uncommon at an advanced period of life, and afflicts women more frequently than men; as from a table, kept at the Hôtel Dieu, it appears that ten cases out of eleven occurred in females; a proportion far exceeding what has been noticed in this country. Indeed, Mr. Calvert sets down the greater frequency of the disease in one sex than the other, as a doubtful point. (*Op. cit.* p. 122.) If it were not for the fact, that Desault sometimes effected the cure of the disease in its early stage, I should venture to conclude that his observations apply entirely to true scirrhus, or cancer of the rectum, which I believe rarely or never occurs in young patients, but, as Desault states, is not very unfrequent in elderly persons. My friend, Mr. Copeland, does not confine his remarks to really cancerous affections, but comprehends strictures of the rectum from a variety of causes; and this accounts for his statement that the disease "*attacks people of almost all ages,*" but is most common about the middle age. However, he agrees with Desault, that women are more frequently the subjects of it than men. He believes that stricture of the rectum is not so often cancerous as is imagined; the mere induration not being an unequivocal proof of it. When the disease is truly cancer, it is usually attended with more severe pain, darting through the pelvis to the bladder and groin; the countenance is sallow (*On the Principal Dis. of the Rectum*, p. 15 17); and

the patient frequently labours under hepatic, or some other visceral affection. (*Sir B. Brodie, Lond. Med. Gaz.* vol. xvi. p. 237.)

[This difference of opinion as to the relative frequency of this disease in the two sexes probably arose from the imperfect distinction between stricture of the rectum and malignant disease. Stricture is without doubt much more frequent in females, but this is not the case with cancer; on the contrary, if there is any difference the preponderance is certainly, in the experience of the writer, and as shown by the records of St. Mark's Hospital, on the side of the male sex.]

The disease is represented as most frequently beginning just above the internal sphincter. (*Calvert.*) Mr. Salmon believes that it originates in the mucous glands of the intestine, which are here most prevalent. (*On Stricture of the Rectum*, p. 21.) Mr. Calvert's investigations lead him, however, to admit the situation of the disease to be occasionally higher up, and especially in the sigmoid flexure. Cancer of the rectum rarely begins before the middle period of life, and the symptoms come on slowly and insidiously. The patient at first experiences slight uneasiness about the rectum, followed by some difficulty in passing his evacuations. This difficulty increases, and the uneasiness changes into pain; the stomach becomes disordered, and the health begins to fail. In the advanced stage, there is for the most part great difficulty in passing the evacuations; but this depends upon the degree of obstruction. At length, there is a constant discharge of bloody mucus, and incessant pain, aggravated after each evacuation from the bowels. The pain is especially referred to the lower part of the back, but there is also pain in the thighs, nates, and hips. "If at this period of the disease you institute an examination of the rectum, you find the morbid growth a little way up the bowel, within reach of the finger. But it varies in size, in figure, and in position in different cases. Sometimes there is a hard solid tumor, occupying only a portion of the circumference of the rectum, and usually situated at the back part, with elevated edges, and, as it were, excavated in the middle, the bowel not being contracted in size, but as capacious as ever. At other times, the morbid growth occupies the entire circumference of the bowel, which takes a winding course through its substance. Then, if you introduce your finger into the rectum, you meet with a large solid mass, and with some difficulty discover the orifice of the intestine in its centre. Sometimes the diseased structure extends down quite as low as the anus. More frequently it begins about two inches above it, the intestine below being in a healthy state. There is great variety also as to the extent of the disease upwards. The whole of it may be within reach of the finger, so that the healthy portion of the intestine may be perceived above it; or it may extend so high up, that you can in no way trace its upper border. In some instances, the disease is complicated with the addition of several pendulous excrescences, which come down through the anus when the patient passes his evacuations, and this very much aggravates his sufferings. In the advanced stage, there is sometimes, but not frequently, a large hæmorrhage from the bowel. Abscesses form in the neighbourhood, and burst externally. In females they burst into the vagina, and the opening



is increased by ulceration, so that a large quantity of fæces may be passed by that canal. In the male sex, ulceration will frequently make a communication between the rectum and bladder, or the rectum and urethra, and then the patient voids, not only wind, but fæces with his urine. Spasm may be induced in the urethra, and hence the patient is liable to a retention of urine." At length the patient dies, worn out by great suffering. In some cases, the morbid growth completely obstructs the passage of the fæces, which accumulate above it, and symptoms, somewhat resembling those of strangulated hernia, are produced, and with which the patient sinks; or the bowel may ulcerate above the obstruction, and the fæces escape into the cavity of the peritoneum, and then death takes place from peritonitis. (*Sir B. Brodie, in Lond. Med. Gaz.* vol. xvi. p. 237.) Cruveilhier records the particulars of an interesting case, in which numerous cherry-stones were stopped by a circular medullary cancerous tumor of the colon, and death took place from peritonitis, in consequence of the passage of three of them by an ulcerated opening into the cavity of the peritoneum. (*See Anat. Pathol.* t. ii. pl. vi. livre 26.)

According to Cruveilhier, cancer of the rectum may occur at any point of it, and the disease assume every possible form of cancerous degeneration. The diseased mass is sometimes quite indurated like scirrhus; and in other instances, softer, like medullary cancer. The two may be blended together, though for the most part a primary disease; it is in women often a mere extension of cancer of the uterus, or rather of the vagina. Cruveilhier has seen several women in the Salpêtrière, in whom, while the uterus was perfectly healthy, cancer was confined to those parts of the parietes of the rectum and vagina which rested against one another, and it was impossible to decide whether the disease had commenced in the one or the other of these passages. He never met but with one instance in a man where cancer originated simultaneously in the rectum and bladder. He considers the obstacle to the evacuation of the fæces as the most serious effect of cancer of the rectum, and he proves that obstruction may proceed so far as even to confine the gas completely within the bowels, and occasion from this cause the rupture of them. A cancerous disease of the rectum, beyond the reach of the finger in the early stage, may afterwards be forced lower down by the accumulation of fæces above it, so as to admit of being touched. The same thing happens when the patient strains. Cruveilhier saw one case in which the disease could be touched with the finger, though it was five or six inches from the anus. Amongst other important remarks made by this eminent pathologist, I find a statement, that cancer of the rectum is mostly a local disease (*le plus habituellement exempt de toute infection cancéreuse*); an observation bearing upon the question, whether amputation of part of the rectum is ever an advisable proceeding.

[Rokitansky gives the following description of the various forms of cancerous disease affecting the rectum. 1. Erectile tumors developed in the tissue of the mucous membrane, and infiltrated with medullary carcinoma, assuming the shape of broad sessile or pediculated fungi. These are commonly placed at the commencement and posterior surface of the rectum, three or four inches from the orifice, and only exceptionally at or near the sphincter.

2. Annular carcinoma and stricture of the rectum. This occurs almost exclusively at the upper portion of the rectum, especially at the point at which the sigmoid flexure terminates in the rectum, and which in its normal condition presents a distinct contraction. The strictured part is either unattached, as is most commonly the case, or firmly agglutinated laterally to the promontory; notwithstanding its elevated position it is, as Cruveilhier correctly remarks, pushed down by the feculent accumulations above, which generally precede the occurrence of ileus; it is therefore easily reached in exploring with the finger. 3. Scirrhus degeneration of the rectum over a large surface, or throughout its entire extent. This primarily affects the submucous cellular tissue, from which it extends through the entire muscular coat to the cellular sheath of the intestine; the cellular and adipose tissue of the pelvic cavity, to the posterior surface of the vagina, and even to the uterus; or it originally attacks one of the last named tissues, and involves the rectum secondarily. The rectum is firmly attached, from being agglutinated in its entire extent to the sacrum, or adherent to the vagina, or it appears wedged into the vagina by the surrounding morbid growth; its calibre may be variously diminished, though it sometimes is unaltered; its internal surface is uneven, nodulated, and hard, or it is filled with soft fungous bleeding growths; the anus especially, if the morbid product extends to the sphincter, is patent, everted and varicose; even the peritoneum appears more or less swollen, protracted, and hardened; and this induration extends to a considerable extent over the nates, in consequence of the condensation of the subcutaneous adipose tissue. (*Rokitansky, Pathol. Anat.*, vol. ii. *Syd. Soc. Translation*, p. 108.)

Of the three forms of cancerous disease described by Rokitansky, the first is of rare occurrence, the second is more frequent, but the third is decidedly that most commonly seen. Ordinarily the whole or the greater part of the circumference of the bowel is affected, producing a concentric obstruction more or less complete; but sometimes an isolated tumor is observed. The character of the disease, as ascertainable by examination, is often greatly altered during its progress. In a case seen by the writer, a tumor the size of an orange was discovered springing from the anterior surface of the rectum, about two inches from the anus. This not only greatly interfered with the passage of the fæces, but by its pressure caused retention of urine, which necessitated the employment of the catheter. Two months later this tumor had entirely disappeared by ulceration, and the obstruction of both passages was removed. Later still the ulceration extended into the bladder, and the greater part of the urine was discharged through the rectum.

But besides the truly cancerous growths, epithelioma of the anus and lower extremity of the rectum is occasionally seen. Epithelial cancer commences usually, if not always, close to the line of junction between skin and mucous membrane, but may spread itself to a greater or less depth into the interior of the rectum. Like epithelial cancer of the lip, or of the prepuce, it originates as a hard warty growth, spreading more or less rapidly, and with a tendency to ulcerate on the surface. This form of cancerous disease, which has not been much noticed by writers, is well described by Mr Curling, who records several cases in which

excision of the diseased growth was effectually practised, and in which the disease did not return. He describes it as less painful than ordinary cancer, and without much tendency to produce contraction and obstruction of the passage. There is also an absence of the cancerous cachexia, of the emaciation and pale and anxious countenance so frequently marked in malignant disease. When the surgeon meets with a raised ulcer, with an uneven surface, and indurated edges, causing, if it extend into the rectum, but little pain, and producing no contraction in the passage, he may suspect the disease is an epithelial cancer, and treat it accordingly. Its true character can only be determined with accuracy by a microscopical examination of the morbid tissue. (*On Diseases of the Rectum*, ed. 3, p. 154.)

Two cases of well-marked epithelial cancer have been under the writer's care. In the first, the growth affected the integument at the verge of the anus, and extended into the rectum for a considerable distance—too far to render any operation for its removal justifiable. The patient died in about two years from the commencement of the disease. In the second case, there was an indurated and ulcerated growth on the integument of the buttock, just outside the anus, about two inches in diameter, but extending also within the anus for about three-fourths of an inch. This was so distinctly circumscribed that there was no difficulty in removing it completely. The patient recovered favourably from the operation.]

*Treatment.*—When stricture of the rectum is of a cancerous nature, every known remedy is inadequate to arrest its progress. A mitigation of suffering is all that can be aimed at. "Diluent injections, combined with opium, conium, or similar remedies, may afford a temporary relief in the ulcerative stage;" but, according to Mr. Calvert, "the greatest advantage is derived from carefully introducing a hollow tube of elastic gum, through which the feces are drawn off by injecting tepid water." Dilating the passage, with any other view than that of maintaining an outlet for the feces, he considers quite useless. A soft tent composed of lint, smeared with some mild fresh ointment, will in general answer this purpose. If there be much pain and inflammation, fomentations may be used; and leeches applied in the vicinity of the anus, or over the sacrum. The bowels should be kept moderately open with castor oil, or other mild laxative, which, if it is thought necessary, may be combined with the extract of hyoscyamus, cicuta, or opium; but the latter is in general less admissible, because it is more liable to counteract the effect of the laxative, and produce a torpid state of the bowels." (*Calvert*, p. 187.)

Mr. Salmon is of opinion that, in true carcinoma of the rectum, bougies greatly aggravate the disease. The only palliative means recommended by him, are leeches to the anus, the introduction of a grain or two of opium into the rectum, and perseverance, night and morning, in injections containing from forty to sixty drops of laudanum. He particularly cautions the surgeon not to introduce the clyster-pipe more than an inch, or an inch and a half, within the sphincter, lest too much irritation be excited. (P. 65.)

[In passing either the bougie or the injecting tube, great care is required, and force must on no account be employed. Mr. Curling mentions a case in which the tube passed through the soft carcino-

matous mass, and penetrated the abdomen, causing death in twelve hours. A similar occurrence has come under the cognisance of the writer.]

Sir Benjamin Brodie recommends opiate injections, and injections of linseed oil, either in its pure state, or combined with limewater, as useful in allaying irritation; and he gives alkalies internally, either with balsam of copaiba, or otherwise combined. In the advanced stage, he deems the exhibition of opium indispensable to render life supportable, though he fully acknowledges the inconveniences of it in causing constipation, checking the secretion of the liver, disordering the stomach, injuring the general health, and rendering the patient nervous and irritable. (*Lond. Med. Gaz.* vol. xvi. p. 239.)

Mr. Syme deems opiate injections and the hip-bath useful palliatives. "The patient should be enjoined to abstain from every kind of stimulating food and drink, and also to avoid any exertion of body likely to aggravate the complaint, resting as much as possible in the horizontal posture. The introduction of bougies, and all other operations, not only can do no good, but must even produce an injurious effect." (*On Dis. of the Rectum*, p. 129.)

Great differences of opinion are entertained about the excision of cancer of the rectum. All parties admit the practicableness of the operation in a certain stage and form of the disease. Sir Benjamin Brodie objects to it on the ground of the probability of a relapse from the existence of the disease in parts above the tumor. If even the operation be justifiable, he thinks that it can only be so under some peculiar circumstances, as where the disease is very low down in the gut, and quite in its earliest stage.

Mr. Syme likewise condemns the operation: he admits that a considerable portion of the rectum, even to the extent of a couple of inches, may be cut out, without immediately fatal or very bad consequences at first; but he asserts, that the patient will derive no benefit from it, and an impulse will be given to the morbid action. "If (says he) there are any cases in which this excision of the rectum has been followed by a permanent cure, the disease could not have been of a malignant nature. He makes an exception of cancer at the verge of the anus. (*Op. cit.* p. 129-131.) In one case, however, Mr. Mayo removed a portion of the entire cylinder of the rectum, and though it was followed by prolapsus, the patient's comfort is said to have been much increased by the operation: she died, however, in two years afterwards, of abdominal inflammation.

Cancer of the rectum was universally regarded as incurable, until M. Lisfranc demonstrated that a considerable portion of the lower end of the rectum could be removed without danger. He commenced this practice under the idea that cancer was mostly restricted to the mucous coat; but having been emboldened by experience and anatomical considerations, he afterwards ventured to attack cases in which all the coverings of the rectum were involved. Two conditions, however, are indispensable: 1. The finger must be capable of reaching above the limits of the disease. 2. The surrounding cellular tissue must be healthy, so that the bowel, free from adhesions, may admit of being brought down sufficiently low.

In the time of Morgagni, the operation was attempted by a surgeon, who was unable to com-



plete it, and M. Béclard, who about the year 1822 or 1823 advocated its performance, never had the opportunity of practising it himself. It appears to have been first executed with success by M. Faget in 1739, who removed an inch and a half of the whole circumference of the bowel. The evacuation and retention of the fæces were accomplished in this patient as well after the operation as before it, notwithstanding nearly all the external sphincter had been taken away; and Faget declared his own belief that the removal of a much more considerable portion of the rectum might be effected. It remained for M. Lisfranc to furnish a proof of this: his first patient, operated upon in February 1826, was perfectly cured by the 13th of the following April. In January 1828, he operated on a woman; and in the following October on another female; both cases ending successfully. In a fourth patient the result was doubtful. A fifth died in March 1829, four days after the operation, with abscesses in the pelvis and probably of phlebitis. The sixth patient, a man 72 years of age, died the day after the operation, and no post-mortem examination was instituted. The seventh patient died on the 25th day, with supuration in the pelvis and inflammation in the veins. In addition to these cases, M. Lisfranc had two other successful ones, so that the total result is, five cures, one case doubtful, and three deaths. (See *Velpéau*, in *Nouv. Elém. de Méd. Opér.* vol. iii. p. 1,033.)

The patient being placed in the position usually chosen for lithotomy, two semilunar incisions are made, about an inch from the anus, on each side of it. These cuts, which are to extend through the skin and cellular tissue, are to unite behind and in front of the rectum. The end of the bowel is then to be separated by careful dissection from all the surrounding parts. The forefinger, half bent, is then passed into it, for the purpose of drawing it downwards, and, by this means, the mucous coat, which may be the part alone, or principally, diseased, may be made to descend a good way; and a considerable portion of it may be easily removed with scissors curved sideways, or with a bistoury. Even if the cancerous affection should implicate the whole thickness of the parietes of the rectum, the advocates for the operation assert that the rectum may be turned inside out, and the whole of the disease brought into view, provided it does not extend more than an inch above the anus.

When all the coats of the bowel and some of the adjoining cellular tissue are involved, the surgeon, after making the semilunar incisions, and detaching the end of the bowel, at the whole of its circumference, is to pass his forefinger into the bowel in order to serve as a guide for a pair of strong straight scissors, with which the gut is to be divided parallel to its axis, through its entire thickness, and as far as the limits of the disease. This incision is to be inclined towards the posterior wall of the bowel, so as to be further from the vessels and the peritoneum. The latter cut enables the surgeon to unfold the gut, and expose the disease through its whole extent; but if it should be concealed by the hæmorrhage, a sponge, full of cold water, must be held for a few minutes on the wound, for the purpose of stopping the flow of blood; and the lower portion of the rectum is to be kept downwards with hooks.

In operating on a female, the assistant's finger

introduced into the vagina, will be of service. When the patient is a male, it is prudent to introduce a catheter into the bladder, which should be entrusted to an assistant. The surgeon then proceeds to dissect away the cancerous parts, which is difficult and tedious, especially near the vagina and urethra. Every vessel that bleeds copiously should be at once secured. Thus M. Lisfranc has removed portions of the rectum extending upward from one to three inches from the anus.

If the hæmorrhage is not entirely commanded by ligatures, a sponge dipped in cold water is to be applied. M. Lisfranc, fearful of exciting inflammation, is never in a hurry to plug up the wound; and, whenever he is compelled to resort to this proceeding, he discontinues it in a few hours. He employs superficial dressings, and changes them thrice a day, so as to let the pus be discharged; but, as soon as all risk of inflammation is past, he introduces a thick roll of charpie into the rectum, and advises the patient to continue to wear it for some time after the cure. This usually takes place in the course of two or three months. "The functions of the rectum are preserved; a new mucous canal becomes a substitute for the portion removed; and a ring, in the form of a sphincter, capable of retaining the fecal matter, if it be not liquid, is produced from the muscular fibres of the rectum, and perhaps also from the insertion of the levator ani." (See *J. F. Malgaigne*, *Manuel de Méd. Opér.* p. 591-592; ed. 2.)

[Excision of the lower extremity of the rectum, as above described, is, in this country at least, now entirely abandoned. The only cases in which any operation of the kind is admissible are those of epithelial cancer, commencing at the anus and extending only a limited distance into the rectum. Several such cases are mentioned by Mr. Curling, in which the disease was completely removed, and did not return. These cases show that a considerable portion of the sphincter muscle may be excised without seriously weakening the retentive power of the anus, or contracting the orifice so as to produce any important impediment to the passage of the stools. (See *Curling on Dis. of the Rectum*, vol. iii. p. 154) In these cases only a portion of the circumference of the bowel was implicated in the disease. The incisions should be made in the healthy structures beyond the limits of the disease, and the greatest care should be taken to insure the complete removal of every portion of it. Bleeding vessels should be secured, if possible, with the ligature; or, if there is much difficulty in getting at them, the actual cautery may be used with advantage.

The writer has recently removed a growth of this kind from the neighbourhood of the anus, extending about an inch within that aperture. It was distinctly circumscribed, and admitted of complete excision without difficulty; but deep incisions were found necessary, and one-half of the sphincter required to be taken away. When the wound healed, the power to retain the fæces was found to be but slightly interfered with. No vessels required a ligature.

In some cases of cancer, the obstruction is so complete that the life of the patient is in immediate danger, and the question will then arise as to the propriety of opening the bowel above the obstruction. Of late years the operation of colotomy has been practised somewhat frequently in

such cases, and the success attending it has been considerable. Mr. Curling mentions six cases operated on at the London Hospital, four by himself, one by Mr. Adams, and one by Mr. Critchett, with three recoveries and three deaths; but a better average than this may be hoped for, as the propriety of the operation becomes more generally recognised, and it is undertaken at an earlier period, before the powers of the patient have become exhausted.

But in other cases, where the obstruction is not complete, the pain produced by the passage of the feces over the ulcerated surface is sometimes so acute, that the patient is glad to purchase relief at any cost, and will readily assent to a proposal to divert the contents of the bowels from their natural course. Mr. Nathaniel Ward performed lumbar colotomy in a case of this kind in the London Hospital. The patient recovered, and lived for eight months. His severe symptoms were greatly relieved by the diversion of the fecal matter through the artificial anus. A similar case, in which the patient's sufferings were extreme, was operated on in St. Mary's Hospital, by the writer, but the patient, an elderly female, whose powers were much exhausted, unfortunately died four days afterwards from peritonitis. The pain, however, produced by the cancerous disease, almost entirely ceased from the time of the operation. Several cases of the kind have been operated on in St. Mark's Hospital by Messrs. Gowland and Allingham, with satisfactory results.

Further observations on this subject, and a description of the operation, will be found in the article on **INTESTINAL OBSTRUCTIONS.**]

#### FOREIGN BODIES IN THE RECTUM.

*Foreign bodies* introduced into the rectum by accident or design occasionally require to be extracted, as clyster pipes, bougies, portions of fish bone, or of the bones of chickens, rabbits, &c. This may generally be accomplished with forceps, or the lithotomy scoop guided on the finger. In the third volume of the *Mém. de l'Acad. de Chir.* M. Morand has given the particulars of many cases of this kind. In a case for which M. Maréchal was consulted, a pig's tail had been introduced with the thick end uppermost, into the rectum of a woman of the town by a medical student, whom she had offended. The tail had been prepared for the purpose, the bristles being cut short; the consequence was that any attempt to remove it gave rise to most excruciating pain; the rectum became inflamed; and the bowels obstructed. Death must have been the result, had not the surgeon succeeded, by a clever yet simple plan, in extracting the foreign body. Having tied a piece of strong cord to the lower end of it, he introduced a tube over it, and without pain or difficulty removed both together. An anonymous writer extracted from a boy's rectum a wooden dragoon with his horse; a toy which his playfellows had great trouble to introduce; and he had to dismount the dragoon before extraction; that is, he broke it with a strong bent forceps for extracting polypi. The same author considers the introduction of the finger into the vagina of great use as a means of promoting the removal of some foreign bodies from the rectums of prostitutes, who are sometimes the victims of drunken brutality. (See *Edinb. Med. and Surg. Journ.* No. 134,

p. 279.) Mr. Liston once extracted from the rectum half the jaw of a rabbit which had been swallowed. Fish bones, or small spicula of large ones, are apt to penetrate and pass into the cellular tissue in the vicinity of the bowel, where they may produce abscess and a fistula in ano. (See *Liston on Practical Surgery*, p. 356.) Of such occurrences, Sir Benjamin Brodie has met with instances.

An instance is mentioned by Mr. Mayo, in which the rectum was torn by an injection pipe, and death occasioned by the passage of a pint of water-gruel through the laceration into the abdominal cavity.

James R. Lane.

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**RESOLUTION.** The subsidence of inflammation without abscess, ulceration, mortification, &c. Also the dispersion of swellings, indurations, &c.

**RETENTION OF URINE.** See URINE, RETENTION OF.

**RETROVERSIO UTERI.** A turning backward of the womb. (See UTERUS, RETROVERSIO OF.)

[**RHEUMATISM.** The Rheumatic Diathesis. Lactic acid is now regarded by some of the most eminent pathologists as the materies morbi of the rheumatic diathesis and paroxysm. We have the authority of the late Dr. Prout and also of Dr. Todd in favour of this view. The former detected large quantities in rheumatic cases, especially in the perspiration, and the latter refers to the causes of the disease, mal-assimilation or imperfect primary and secondary digestion, combined with vicissitudes of temperature, in support of the theory.

Lactic acid ( $C_6 H_8 O_8 + H O$ ), is a constituent of the juices of the flesh, and believed to be one of the products of the retrogressive metamorphosis of the gelatinous and albuminous materials in every part of the economy, which, in the condition of health, is oxidated in the blood, and excreted in the form of carbonic acid gas. When procured artificially it is a liquid extremely acid to the taste, and so strong and biting as to be almost insupportable. It is one of the changes also through which starch and glucose pass in their conversion into carbonic acid and water. In health no appreciable quantity of lactic acid is detectable in the urine, and only a minute portion, if any, in the perspiration; but in some diseased states it escapes freely from the skin. As it can be readily formed out of the body from sugar made to ferment in contact with an animal substance, and as it has often been detected in the primæ viæ, it is held also to be a product of imperfect primary digestion.

The skin is the natural emunctory of lactic acid developed in excess, and therefore whenever, from food of bad quality, or from too little or too much food, it occurs in the alimentary canal, and is too copiously absorbed to admit of immediate oxidation in the blood, or when it is produced in excess from mal-assimilation in the secondary processes, the influence of cold when brought to bear on the skin by checking perspiration, must cause it to accumulate as an acrimony in the blood, and by the laws of elective affinity to be directed to particular structures. That lactic acid absorbed into the blood will produce the salient symptoms of rheumatism in animals is shown by Dr. Richardson's experiments. (*On the Coagulation of the Blood*, 1856, p. 371, et p.) The entire history of rheumatism indicates that the general nutrition of the body is disturbed by a morbid material in the blood; and the long continuance of agencies that disturb the digestion, and of those that produce defective cutaneous secretion, which at the same time are conducive to a defective metamorphosis of lactic acid in the blood and prevent its excretion by the skin, are the agencies directly concerned in the production of rheumatism.

As bearing upon surgery, the rheumatic diathesis—in other words, according to the theory before us, a lactic acid condition of the blood—occurs most commonly in children, and persons under the age of thirty, and is characterised by: a liability to a febrile state variously developed and indicated by a quick pulse, and occasional exacerbations,

with heat of skin and more or less profuse perspirations having a sour odour. Lactic acid may in all cases be detected in the urine. (*Day's Physiol. Chem.*, p. 20.) Pains, often of a migratory character, occur in the joints, not always occasioning swellings or enlargements, but for the most part severe and obstinate, impeding motion, and of frequent recurrence. There are pains also in the muscles or in the course of the tissues of the limbs, not stationary, but now affecting one joint or limb and then another; or there may be attacks of "chronic rheumatism," the shoulders, elbows, or knees being singly or simultaneously affected, or pains chiefly felt in the loins and shoulders upwards (lumbago), or in the hip shooting from the thigh (sciatica), or in the chest. After a time the joints attacked swell, and fluid is effused into their cavities, causing fluctuation; or what is designated a "rheumatic white swelling" may occur, consisting of a tense prominent often colourless swelling, chiefly of the larger joints, with slow and deeply-seated inflammation, and severe and diffused pain originating and chiefly seated in the cartilages and ligaments. The subjects of this condition of the blood are often also anæmic and cachectic, with a tendency to emaciation, their countenances pale, or of a greenish or yellowish hue, the red corpuscles being deficient; and there is want of appetite, some thirst, indisposition to exertion, and keen sensitiveness to vicissitudes of temperature. To this general or chronic state must be added a liability to attacks of rheumatic fever or acute rheumatism, an irritative fever of a specific character, from an acrimony or special stimulant in the blood, producing a state of hyperinosis; its prominent symptoms being a quick, bounding pulse, increased heat, copious clammy perspirations, and a large deposit of lithates in the urine. This fever may precede or supervene upon any of the local affections described, but whether so or not, it is usually but not always attended with a local affection, consisting of inflammation, with severe pain, chiefly of the fibrous tissues in the neighbourhood of the larger joints, often with extensive effusion, and wandering from one joint to another. During an attack of this fever, the pericranium, the dura mater, the pericardium, the endocardium, and sometimes the pleura, the diaphragm, and the fibrous tissues of the eye, are liable to suffer.

When the progress of the metamorphosis of the gelatinous and albuminous tissues is arrested at the stage of lactic acid, the lactic acid may act as an acrimony in the tissues themselves and produce irritation, with pain, as in those chronic swellings around joints which are so often met with in rheumatic subjects. When the arrest takes place in the blood, or the acid is absorbed in excess from the tissues or from the alimentary canal, the acid becomes saturated by the alkalies of the blood, and would destroy the alkalinity of the liquor sanguinis very rapidly if the lactates were not equally rapidly converted into carbonates or quickly removed. Hence, the oxidising powers of the blood depending upon its alkalinity, the lactic acid has a direct tendency to deteriorate that power, and not only the series of transpositions to which the lactic acid belongs, but the series which leads up to the formation of urea from the nitrogenous tissues is interrupted, and in the rheumatic paroxysms we have lithate of soda and even lithic acid as deposits. These remarks are applicable to the formation of

other organic acids, as the oxalic, formic, and butyric acids, which transude into the blood, or occur there as the result of defective oxygenation.

The foundation of the lactic acid or rheumatic diathesis is often laid in dietetic errors, more especially as respects the staminal principles of food necessary for the nourishment of the body, for the due oxidation of the materials in the blood and tissues, and for the maintenance of animal heat. Too frequently no attention is paid to the proportions of food derived from the four great groups which furnish these principles—the protein bodies, the fats, the carbo-hydrates, and the mineral substances, either actually or relatively to the age, sex, temperament and habits of the individual. The moment an infant is deprived of the mixture furnished by nature in the breast-milk, which too often occurs prematurely, all is apt to be left to chance. Some children are fed upon a great excess of animal food. Others are allowed to exclude or are debarred from fat and all oleaginous matters. Attempts are sometimes made to nourish a child wholly, or nearly so, on amylaceous matter, with or without sugar. Dietaries are often defective in the essential saline and mineral constituents of the blood and of the animal tissues. These errors most frequently become habitual. Many of them tend to the development of an excess of lactic acid in the alimentary canal or in the blood, and produce a disturbance or arrest of the metamorphosis of matter, whereby substances which, on a due regulation of diet and exercise, would pass out of the system as urea, carbonic acid and water, occur not only as lactic acid but in the form of lithic acid and its compounds, formic acid, oxalic acid, and other acrimonious and poisonous substances. There can be no question that a predisposition to the lactic acid diathesis is often hereditary, nor that it is also frequently produced by errors of diet and exercise, taking their rise in infancy; hence the frequency of mal-nutrition and the rheumatic affections which result from it, many of which become surgical diseases, in children and young persons.

Rheumatism in its various forms and grades demands the attention of the surgeon, inasmuch as it gives rise to various affections of the joints and limbs which induce rigidity or lameness. From this cause there may be thickening and permanent enlargement of the structures forming and surrounding the joints, as of the periosteum at the articular ends of the bones, the tendons of the muscles inserted into them, and the subsynovial membrane. After a time, the cartilages and bones alter in shape and become enlarged, the ligaments become stretched, a mechanical impediment to motion is produced, and the joints are severely disabled, resulting in a gradual absorption of the cartilages. There is at first chronic effusion, but subsequently the synovia becomes absorbed and the capsular ligament thickened. Suppuration or ulceration of the cartilages occurs very seldom, but the inter-articular cartilages of the knee-joint, of the wrist, and of the lower jaw have been absorbed (*Garrod*), and the ligamentum teres of the hip and tendon of the biceps destroyed and even removed. In prolonged cases, the synovial membrane sometimes droops into the articular cavity, and as remarked by *Dr. Fuller*, arising probably from some alteration of this kind, a dense ligamentous substance is soon interposed between the articulating surfaces; or

small irregularly-shaped cartilaginous or bony bodies, sometimes vascular, are found, either loose within the joint, or attached to it by pedicles formed of thickened synovial membrane; the denuded surface of the bones rendered smooth by attrition, become white, glistening, and ivory-like in appearance (*"Arthrite Chronique Sèche," Eburnation*); there is also, in some instances, a pulverated deposit of lithate of soda, occasionally containing also lithate of potassa, ammonia and lime. To these consequences of the malnutrition resulting from long-continued prevalence of a lactic acid condition of the blood, may be added the more definite hip-joint disease, or *morbus coxae senilis*, or *nodosities*, sometimes affecting all the larger joints, which become semi-flexed and almost ankylosed, rendering the patient a cripple; and occasionally affections of the skin occur, of the testes, of the periosteum, and of the aponeuroses generally. (See art. JOINTS, DISEASES OF.)

Lactic acid is also associated with some cutaneous eruptions. Without giving in his adhesion to the lactic acid theory of rheumatism, *Dr. Begbie* pointed out in 1850, the connection of Erythema Nodosum with the rheumatic diathesis. (*Contrib. to Pract. Med.*, by *J. Begbie, M.D.* 1862.)

The close analogy subsisting between gout and rheumatism, and the intimate association of their symptoms in many cases, has led some pathologists to refer both to the morbid effect of the retention of urinary constituents in the blood. (See arts. URIC ACID; URÆMIA.) *Dr. Hughes Bennett* (*Clinical Lectures on the Princ. & Prac. of Med.*), *Dr. Copland*, and others, consider uric acid the materies morbi of rheumatism as well as of gout. In the one case its excess is supposed to be derived from the primary, and in the other from the secondary digestive processes. In both diseases an arrest of the metamorphosis of organic matter and defective secretion are admitted to occur. There are numerous cases in surgical practice presenting a combination of the characteristics of rheumatism and gout, very generally denominated "Rheumatic Gout," a term which has been greatly objected to by many pathologists. Such a connection or fusion of the two diseases as the term implies was not recognised by the older practitioners, and is denied by many moderns, but chemical pathology tends to establish and explain such a connection. Recent chemistry seems to say that pure uncomplicated rheumatism is never associated with lithate of soda deposit or chalk stones, and *Dr. Garrod* never found an excess of lithic acid in the blood in rheumatic affections, although this is a constant occurrence in gout. Nevertheless, when fever occurs in a rheumatic subject, it is accompanied with a great excess of lithates in the urine; and cases of rheumatic gout, not resembling either disease as a whole, but partaking of the nature of both, are explained by *Dr. Prout* and others by the fact of the concurrent action of lactic and lithic acids in the system.

This constitutional diathesis is important to the surgeon also, inasmuch as it occurs as a complication in those scrofulous affections so frequently coming under surgical treatment, both in hospital and private practice; and it is often attended with disease of the heart. *Dr. Todd* remarks—"I have now so frequently met with instances of diseased heart in young persons, not traceable to an actual paroxysm of rheumatic fever, but, nevertheless, showing evident marks of a rheumatic diathesis,



which had existed for a longer or shorter time, that I cannot but regard this state of constitution as a fertile source of those cardiac diseases which are met with in early life." (Lib. cit. p. 111.) The pericardium, the endocardium, or the valves may be affected and the cardiac inflammation date its origin from the same period, and be produced by the same cause as the other local affections. These affections of the heart, although most frequently the results of attacks of acute rheumatic fever, are nevertheless met with in rheumatic subjects who have not previously experienced an acute attack. (See *Fuller*, lib. cit.)

In surgical practice care is required also that an attack of rheumatic fever be not confounded with pyæmia, glanders, and some other diseases. The early symptoms of glanders consist of pains and swellings of the joints and copious foetid perspirations. Cases of puerperal fever with purulent affection of the joints, and of pyæmia occurring under various circumstances, have been mistaken for rheumatism. Puerperal disease, assuming a typhoid type, with swellings of the large joints and destruction of the cartilages, particularly when unattended with pain or tenderness at the lower part of the abdomen, has a strict resemblance to rheumatic fever. Rheumatic affections generally have also, as already intimated, to be distinguished from gout, or, in mixed cases, the effects of the lactic acid from those of the lithic acid acrimony. The history of the case, the age, the sex, the constitution, and the habits of the patient, aid in the diagnosis. Gout shows a disposition to an elective affinity for the *materies morbi* in one particular spot, whereas the malnutrition in rheumatism locates itself more generally; in the former disease the larger joints are most frequently affected; in the latter the small joints of the lower extremities; in the former, also, there is an absence of any excess of lithic acid in the blood or any deposit of lithate of soda, two circumstances which characterise the latter. (See arts. *Pyæmia*; *URIC ACID DIATHESIS*; *URÆMIA*.)

The treatment of the lactic acid condition or tendency in the blood requires the strictest attention to diet and regimen for a very long period. Dr. Todd remarks—"It cannot be expected that a state of system which has perhaps been inherited, or which has been the result of a morbid element slowly and gradually from an early period mingling itself with the elements of nutrition, in the molecular changes of the frame . . . can be removed in a short time. Years are required to remove or to diminish the strumous diathesis; the rheumatic constitution cannot be expected to change in a much shorter time." The indications are:—1. To avoid all articles of food which favour the development of lactic acid. Sugar and beer should be proscribed, the less oxygenised acids avoided as much as possible, butter and milk taken sparingly. Independently of any tendency these substances have to transmute into lactic acid in the alimentary canal, they all absorb the oxygen of the blood, and render it less efficient in the oxygenation of the products of secondary assimilation, whether of the lactic acid or lithic acid series. Light animal, cereal, and farinaceous diet is to be preferred; and if stimulants be necessary, the purest spirit diluted and without sugar, or the lightest and driest wines. Sydenham remarked—"With young persons, and those who have not over indulged in wine, rheu-

matism may be dispelled simply by spare and very cooling diet, provided that it be moderately nourishing." In an attack of acute rheumatism which, as already stated, so often supervenes upon the lactic acid condition of the blood, according to the same authority, a system of diet constitutes an essential part of the cure:—"Let the patient live on nothing but whey for four days, afterwards taking, besides the whey, some fine wheaten bread once a day as his dinner, until he is thoroughly convalescent. During the last days he is allowed a little bread at supper. When the symptoms are giving way, he may take a little tender chicken boiled, or some similar digestible food. Every third day, however, he must be limited to the whey alone, and this until his strength has wholly returned." In the present day, active depletion being so much objected to, a strict diet is all the more necessary to prevent permanently injurious or fatal consequences in many of the violent commotions of the blood which depend upon specific acrimonies.

In rheumatic dietetics there is another important principle not to be overlooked, particularly when we have to deal with a constitutional vice of young people. A just admixture of the staminal principles of nutrition is necessary, taking care not only that the diet as a whole is devoid of any excess of those materials which are most prone to run into the lactic acid formation, and that it contains all that is essential to growth and nutrition, but also that there is a proper admixture of such materials at each meal. The digestion of protein substances being promoted by the admixture of hydrocarbons, and the digestion of the hydrocarbons by the admixture of oleaginous matter, and saline and mineral substances being essential to the digestion of the whole; the lactic acid tendency is to be counteracted by an admixture of these at each principal meal in quantities and proportions such as is suited to the age, the state of development, the temperament and the habits of the individual.

2. In this diathesis all external agencies which have a tendency to prevent the excretion of lactic acid by the skin should be avoided, and those resorted to which promote the healthy functions of this organ. Undue exposure to cold and draught, especially when the body, or any particular part of it, is rapidly cooling from perspiration, is dangerous; and warm clothing, exercise, friction, warm bathing, the vapour and the hot air bath, are indicated. The Roman bath has undoubtedly the power of very materially aiding the evacuation of lactic acid from the system, and together with these remedies, which prevent the excessive formation of the acid and promote its oxidation, is one of the most efficient of our remedies. Where painful local affections set in, anodyne sudorifics, and particularly Dover's powder, should be employed.

3. To promote the digestion of food and counteract the effects of indigestion, by sustaining the alvine discharges, administering alteratives to counteract the tendency to form lactic acid in the stomach, and tonics, particularly iron and quinine, to give increased power to this organ.

4. To promote the oxidation of lactic acid, lithic acid, and every effete substance in the blood, by exercise where it can be taken, by the respiration of a pure air, and by special remedies having that tendency. The lactic acid is believed, like vegetable acids, to require combination with an alkali before it can be oxidised, hence the further use of

alkalies. The lactates of potassa and soda are readily acted on by oxygen and converted into carbonates. By the use of alkalies the excess of lactic acid may be neutralised in the blood and the secretion of urine promoted. On the other hand, even lemon juice has been found by experience to be remedial; and by its use the acidity of the urine is not increased, the citric acid being decomposed in the blood. As a highly oxidised acid, containing more oxygen than protein or lactic acid, Mr. Headland suggests that it may carry oxygen to the lactic acid, and "so help it on towards its transposition into carbonic acid." Nitro-hydrochloric acid and nitrate of potassa have also been found to be useful remedies, acting also probably as oxidising agents. The iodide of potassium, which has been extensively employed, has probably a double action, promoting the absorption of the acid from the affected tissues, and thereby diminishing the acrimony of the parenchymatous fluids, and also the pain, and promoting the oxidation of the fluid after its entrance into the blood.

5. To these indications may be added:—To secure the elimination of such portions of the acid as are not transposed into carbonic acid, the most favourable channels for which are the skin, the kidneys, and the bowels. The irritative nature of the rheumatic matter, be it the lactic or the lithic acid or any other acrimony, renders rheumatic patients in general very tolerant of opium; and where painful local affections exist, the fourth indication arises to mitigate these, and the affections of the joints or of the heart, which so frequently supervene, by the use of opiates, either alone or in conjunction with other remedies.

The surgeon is frequently consulted for these local affections of joints already referred to, consisting of a spurious hypertrophy of the surrounding tissues, effusions, impeded motion, and more or less of pain. These may progress to stiffness and absolute lameness; the patient complains little or not at all of any constitutional affection, although on investigation an unmistakable rheumatic condition exists, and the local malnutrition belongs, manifestly, to an acrimony developed in the part or conveyed to it by the blood. In such cases local treatment alone has ever been found inefficient, and, indeed, a large proportion proceed from bad to worse without deriving any benefit from remedies. In addition to local alkaline, or otherwise medicated, baths, or the shower bath, a strict code of regimen, medicine, and dietetics requires to be laid down. The object here is, as in other rheumatic affections, to correct the malnutrition by avoiding the introduction of acid acrimony into the blood, and to promote the metamorphosis of effete matter.

These are the principal indications in the treatment of the rheumatic or lactic acid condition of the system, with which so many surgical cases are complicated. For a full statement of the treatment of rheumatism, acute and chronic, and of the diseases of the heart, brain, uterus, and other organs, arising from it, medical writers must be consulted.]

Henry Ansell.

[BIBLIOGRAPHY.—For an account of the Lactic Acid, and Rheumatism as depending upon its development in the animal economy, consult:—Dr. R. B. Todd, Practical Remarks on Gout, Rheumatic Fever,

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RICKETS. (*Rachitis*.) The latter term was adopted by Glisson as a derivation from the Greek *ῥάχis* (spine), because the disease was once supposed to originate in the vertebral column. *Rickets* was a word by which the complaint was commonly known in England even before his time. (See David Whistler, *Dissert. de Morbo. Puerili. Anglor. dicto. "The Rickets,"* Lugd. Bat. 1645.) This tract, which preceded Glisson's work, is stated by Dr. Cumin to be now exceedingly rare: a copy of it is preserved, however, in the Bodleian library. The disease is mostly met with in young children; seldom in adults. Morand, however (*Acad. des Sciences*, 1753), mentions an instance, in which an adult became affected. Dr. Cumin even divides the disease into two species; 1st, softening of the bones of children, or common rickets; 2nd, that of adults, or mollities ossium; and to the disorder in this more extensive sense, he conceives that the term *osteomalakia* might be properly applied. (See *Cyclop. of Pract. Medicine*, art. *Rickets*.)

[Rickets and mollities ossium were long considered to be varieties of the same disease, and were described as such by Portal, Duvernay, Boyer, Richerand and others: in later times Beylard (*Thèse sur le Rachitisme*, Paris, 1852), and Gerdy (*Maladies des organes du mouvement*, 1855) have supported this view, and described mollities ossium as *rickets in the adult*. Costello also, in his *Cyclopaedia of Practical Surgery*, has placed the two diseases under the head of rickets. Levacher was the first to distinguish these two affections (*Traité du Rachitis*, Paris, 1772), and most modern pathologists regard them as totally distinct diseases.

Mollities ossium and rickets present many essential points of difference: thus the latter is a painless disease, not usually fatal, nearly always met with in young children, and arrests the growth of the bones; it generally attacks the extremities, having preference for the lower limbs, the bones are softened, and bend in the direction of their normal curves, their articular ends become enlarged, and the shaft itself often thickened. The tissue of the bone is altered, not destroyed; both sexes are equally liable to it; and the muscles, which at first waste and lose their power, recover their action as the disease gets better. Mollities ossium, on the contrary, is a most painful affection, and nearly always proves fatal; it is invariably found in persons past the age of puberty, and mostly when the bones are fully developed; the bones of the trunk are involved as frequently as those of the extremities, and when the latter are the seat of this disease, they yield, not in the course of their natural curves, as in rickets, but in any direction; the shaft of a long bone is more usually attacked than its articular ends, its structure being completely destroyed and replaced by an abnormal material: females are much more subject to mollities ossium than males, and it has generally been met with in them after repeated pregnancies.]

Rickets may even take place in the fœtus in



utero; Pinel has given a description of the skeleton of a rickety foetus. Further illustrations of the same fact may be found in the writings of Borde-nave, Soemmerring, Otto, Sartorius, and Loder. (*Fourcroy's Journal*.) Many specimens may also be seen in our Pathological Museums.

[According to Gerdy, intra-uterine rickets may occur from some mishap to the mother during pregnancy, such as a blow or a fall, or from extreme misery, whether mental or bodily. Jenner, in his Lectures on Rickets (*Med. Times and Gaz.* 1860, vol. i. p. 415), states, however, that he has never met with a case of congenital rickets.]

The most common period for the commencement of this disease is in children between the ages of seven or eight months and two years, and it rarely begins before the child first attempts to walk. Mr. Wilson observes, that its origin has frequently been imputed to the effects of dentition; but he adds, that he has often known it make its appearance after this time, and that it not unfrequently attacks the spine a little while before puberty, and may do so even later. (*On the Structure and Physiology of the Skeleton*, &c. p. 162.)

[It very rarely commences though after the period of the second dentition.]

The disease seems to consist of a want of due firmness in the bones, in consequence of a deficiency in the phosphate of lime in their structure.

[Bostock states that he found the earthy salts present in rickety bone in the proportion of  $\frac{1}{3}$  only, instead of  $\frac{2}{3}$ , which is the usual amount in the healthy state. (*Med. Chir. Trans.* vol. iv.) Becquerel met with great variation in the several specimens which he examined; in some he found  $\frac{1}{3}$ , in others  $\frac{1}{5}$ , and in others, again, as little as  $\frac{1}{8}$  of the phosphate of lime. (*Traité des Maladies des Enfants*, 1842.)]

The causes of the affection are involved in great obscurity.

[It has been attempted to show that rickets has its origin in various diseases; thus, syphilis, cancer, scrofula, tubercle, scurvy, rheumatism, cretinism, fevers, visceral diseases, &c., have each been charged with causing it. Beylard (*Op. cit.* p. 27) states that it is sometimes hereditary, but Jenner disputes this.]

Rickety subjects are often at the same time scrofulous; and this is, probably, the only reason for scrofula being accounted a cause of the other affection.

[Stanley denies that scrofula and rickets are often associated (*On Diseases of the Bones*, p. 229); but their frequent coincidence is admitted by most other observers. The occurrence of tubercle with this disease, though occasional, is not common. (Rufz, *Recherches sur le Rachitisme chez les Enfants*, *Gaz. Med.* March 1834.—Rokitansky, *Path. Anat.* vol. iii. p. 174. *Syd. Soc.*, translated by Moore.) Jenner states that rickets is absolutely unfavourable to the development of tubercle. (*Op. cit.* p. 260.) Rickets appears to be the result of a deranged or imperfect nutrition, and therefore improper food, poverty, damp, cold, bad ventilation, in short, defective hygienic influences, conduce to the disease, so that it is much more common in large towns than in the country, and in the children of the poor than in those of the rich; for the same reason it not unfrequently accompanies or follows a difficult dentition in weakly children. Stanley (*Op.*

*cit.* p. 218) considers that the disease is caused by a deficiency in the inorganic constituent of a bone, whilst its animal ingredient is in excess. According to Simon, a rickety bone is so altered in its composition, that neither gelatine nor chondrine can be obtained from it by boiling. (*Simon's Animal Chemistry*, translated by Day, *Syd. Soc.*) Jenner regards rickets as a general or diathetic disease, exclusively limited to children, and by far the most common and fatal of all the diatheses to which childhood is liable; it is rarely associated with other diseases of this class, and as a rule the youngest children in a family are the subjects of it, whilst the firstborn are healthy. It manifests itself by its effects upon the bones, but it "is no more a disease of the bones than is typhoid fever a disease of the intestines." The morbid condition consists in an excessive formation of the structures which precede or form the nidus for ossification, whilst there is a retardation or incomplete performance of the ossifying process, and a decrease in the amount of the earthy salts whereby softening of the bone takes place. (*Op. cit.* pp. 260-1.)

According to Gerdy, rickets is an inflammatory lesion, although not purely so, being complicated by a special form of osseous degeneration which produces its own peculiar effects. He proposes to call the disease *Rachitic Osteitis*; and from a comparison of its symptoms with those of scrofulous caries, he is of opinion that the two affections are not very dissimilar. (*Op. cit.* p. 325.) Rufz first described a soft reddish sponge-like material which he called *éponge fine*, as existing between the end of a rickety bone and its epiphysis; he considered this to be an unhealthy product, and to constitute the disease. (*Gaz. Méd.* Mars 1834.) Guérin, who named this material the *spongoid tissue* (*Mém. sur les caractères généraux du Rachitisme*, Paris, 1839), and Bouvier (*Bull. de l'Acad. de Méd.* 1836-37), are agreed with Rufz as to the pathological origin of this substance, and further demonstrated its presence not only between the epiphysis and the shaft, but beneath the periosteum forming a layer upon the surface of the bone, and even infiltrating its tissue.

Broca does not admit that the spongoid tissue is a morbid product, but states that it is always found in the development of bone from cartilage. When, in consequence of impaired nutrition, the ossific process is checked, an accumulation of this material takes place, constituting the condition known as rickets. This disease is, therefore, according to him, the result of a suspension of the regular and normal processes, by which calcareous matter is withheld from, or very sparingly supplied to, the growing bone. (*Recherches sur quelques points de l'Anat. Path. du Rachitisme*. *Bull. de la Soc. Anat.*, Paris, 1852.)]

Rickety children are usually of a bad, weak constitution, and their limbs and bones become bent in directions determined by the action of the muscles, and the weight and pressure which they have to sustain. When the affection is very general, the spine becomes shorter, and is curved in various directions; the breast becomes deformed, not only in consequence of the curvature of the spine, but by the depression of the ribs and projection of the sternum. The bones of the pelvis fall inwards, and the os pubis generally approaches the sacrum. The clavicles become more bent and pro-

minent forward; the os humeri is distorted outward; the lower ends of the radius and ulna are twisted in the same direction; the thighs are curved forwards or outwards; the knees fall inwards; the spine and front surface of the tibia become convex; and the feet are thrown outwards.

But, as Mr. A. Shaw has explained, rickets, besides producing softening and distortion of the bones, has the effect of interrupting their growth. Notwithstanding the statement made by Mr. Wilson, we are not to regard the mere distortion of the spinal column, which sometimes takes place a little before puberty, as a certain indication of rickets. The late Mr. John Shaw examined an extensive series of specimens of morbid spine, and demonstrated the fact, that the spinal column may be incurvated in a lateral direction, and may present a distortion of the same appearance in two different conditions of the system. "In one class of these specimens, he observed that there was a lateral curvature of the spine, combined with distortion of the ribs, but this constituted the whole of the deformity; in none of the other bones of the skeleton, however weak or exposed to pressure they might be, was there any trace of distortion to be discovered. In the other series of preparations, on the contrary, not only was there lateral distortion of the spine and ribs, but a universal deformity of the whole skeleton, including the cylindrical and solid, as well as the most delicate and pliant bones." And, with respect to the pelvis, this gentleman was led to conclude "that in whatever state of distortion the spine and ribs may be, the bones of the pelvis will not be found distorted, unless there be at the same time marks of rickets in some of the long and solid bones." Now, as neither the bones of the upper, nor those of the lower extremities, become incurvated when the distortion commences near the age of puberty, it is argued, that a cause totally different from rickets gives rise to it, and that the pelvis is in no danger of being implicated in such deformity. (*On Distortions of the Spine and Chest*, by John Shaw, 1823.)

With reference to deformity of the spine, Mr. A. Shaw joins his brother in considering those skeletons only as true specimens of the effects of rickets, "in which the distortion is exhibited throughout all the osseous system together; in the skull, the cylindrical bones of the extremities, and the large bones of the pelvis, as well as in the spinal column and the thorax." He very ably contrasts the configuration of the properly formed and the rickety skeleton. The human figure at maturity (he observes) is characterised by the lower extremities having a remarkable length, as well as breadth and solidity; while the superior parts are comparatively small and light in their structure. On the contrary, the rickety skeleton is distinguished by the head, the thorax, and the arms being preponderating and large, while the pelvis and lower extremities are in a relative degree diminutive and short. He notices the fact, that all the bones of the skeleton, deformed by rickets, are more or less deficient in size. But this want of development is much more considerable in the pelvis and bones of the leg, than in the skull, spine, thorax, or bones of the upper extremity; so that whilst the spine and bones of the arm scarcely lose one-fifteenth of their natural strength, those of the leg lose somewhat more than a third. (*See Med. Chir. Trans.* vol. xvii. pp. 441-3.)

M. Jules Cloquet has given an account of the aorta of a rickety child, ten years of age. The vertebral column is twisted to the left and backwards, and the aorta, adapting itself precisely to this curve, is doubled on itself in such a manner, that two inches of its outer coat are in contact and adherent to one another. The vessel gradually lessens as it descends, so that in the abdomen, it has not more than one-third of the size which it has in the chest. The lower limbs are stated to be, as it were, in a state of atrophy; which M. Cloquet suspects might be in a great measure owing to the accidental bend of the aorta. (*Pathol. Chir.* p. 97.) Such want of development in the lower limbs, however, is usual in very rickety subjects.

The following observations with reference to midwifery, are highly deserving of recollection. "In women who have simply the lateral curvature of the spine, the pelvis is not only fully developed and capacious, but its brim does not suffer any encroachment, such as could prevent the descent of the child's head, from the falling down of the lumbar vertebræ. When, therefore, it becomes an anxious question of a mother, with regard to her marriageable daughter, how far the twist observable in her shoulder and back is likely to affect her life in the event of her pregnancy, the foregoing observations may furnish us with an answer, in addition to the marks which we find pointed out in books of midwifery, as indicative of a distorted pelvis; the more important signs will be discovered in the condition of the long bones. If the length of the extremities be natural, and there be no gibbosity of the tibia, we may be assured that the pelvis has not suffered. On the other hand, in the case of distortion from rickets, the pelvis is not only distorted, but it is preternaturally small; and, as a relation is established between the growth of the long bones and that of the pelvis, we may be able to estimate, from the proportionate length of the limbs to the body, what is the degree of diminution of the pelvis, resulting from the stoppage of the growth." (*A. Shaw in Lond. Med. Gaz.* vol. xvi. p. 49.)

When the tibia and fibula become curved, they sometimes "acquire increased breadth in the direction of the curve, losing a proportionate degree of thickness in the opposite direction. Hence the bones become, as it were, newly modelled, passing from the cylindrical into the flattened form. This would seem to be designed for the purpose of enabling them to support more efficiently the weight of the body, since by this alteration they acquire increased breadth and power of resistance in that direction, where the greatest strength is required. I have never noticed (says Mr. Stanley) any expansion in the articular ends of rickety bones, as is mentioned by some authors. I should therefore feel inclined to believe, that there has existed only the appearance of such a phenomenon, the ends of the bones having appeared swollen, in consequence of the emaciation of the surrounding soft parts. (*See Stanley, Med. Chir. Trans.* vol. vii. p. 402-405.)

Dr. Cumin states, however, that an attentive examination of rickety cases has convinced him of the correctness of the opinion respecting the enlargement of the extremities of the bones. "The extremities of the long bones, which are least concealed by muscle (he observes), as those of the wrists and ankles, and the sternal ends of the ribs,



particularly these last, are swelled out into knobs." That the ends of the bones may become thus expanded, seems to be proved by the case published by Mr. Thomas Brayne. (See *Trans. of Provincial Med. Association*, vol. iii.) In this instance, the enlargement of the articular ends of the larger joints is extreme, and the engraved representation of the patient very curious.

[Expansion of the articular ends of the long bones is very constant in rickets, and many authors regard this deformity as the first indication of the disease. Gerdy thinks rotation of the spine is a more frequent symptom of rickets than articular enlargement, and states that when this swelling occurs it is situated around the free end of the epiphysis and not at the point of junction between it and the shaft of the bone, as some have asserted; indeed, there is often here a constriction.

Stanley and others maintain that articular swelling occurs only in those bones which are thinly covered by soft parts; but Jenner claims this lesion as one of the most striking in rickets, affecting the ends of those bones which are deeply placed equally with those which are more exposed.]

When the thoracic viscera are considerably oppressed by the alteration in the figure of the chest, produced by rickets, the disease may bring on fatal consequences.

[In rickets the thorax is often much deformed, and its capacity greatly diminished, especially in the lateral diameter; the angles of the ribs are bent abruptly both from above downwards and from behind forwards, so as to form a very acute angle, from which the body of the rib passes forwards and inwards to the sternum, causing a great projection of this bone, and presenting the condition known as *pigeon breast*. Rokitsky states that this deformity is due to a want of power in the inspiratory muscles to expand the cavity of the chest. Jenner excludes muscular action from any direct share in the production of thoracic deformity, but attributes it to atmospheric pressure, aided by the elasticity of the lungs and the softening and consequent loss of resilience in the ribs. According to Broca, muscular action and a habitual vicious position must be added to the pressure of the atmosphere upon the softened bones. If there be lateral deflexion of the spine as well, the deformity of the chest is very great, and its space encroached upon to such a degree as to produce injurious and often fatal pressure of the viscera.

The pelvis is not unfrequently distorted and its cavity contracted by projection of the promontory of the sacrum and folding back of the pubes upon that bone. When this occurs, the brim or upper aperture may be so much narrowed as to render the passage of a fœtus through it impossible; and the encroachment upon the pelvic cavity is sometimes so great as to force the bladder and uterus upwards into the abdomen. Sir Henry Thompson relates an instance where, from this cause, the extraction of a calculus in the operation of lithotomy was a matter of extreme difficulty. (*Med. Chir. Trans.* vol. xlvii.) This form of distortion is the result of pressure upon the softened or imperfectly ossified bones, and therefore commences in early life. The pelvis may also be much twisted without alteration in the size of its cavity; this is owing to a deviation of the spine, or a diminution in length, or some other deformity of the lower extremity, occasioned by rickets.

When the cranium is affected in very young subjects, enlargement of its cavity may result, and sometimes to a very considerable extent. The process of ossification being retarded in this disease, closure of the fontanelles and union of the sutures are prevented; the continuous pulsation of the brain may therefore cause a gradual separation of the bones of the skull, and the size of the head thereby becomes increased until it presents the appearance of hydrocephalus. Gerdy asserts that the cranial bones are rarely involved in this disease, and then only to a very slight degree; whilst Stanley states that the head in rickety children is generally *below* the standard dimensions in consequence of an arrest of growth in the bones, and particularly in those of the face.

In common with the other flat bones, those of the skull, when affected with rickets, become enlarged from expansion of their cancelli and thickening of the pericranium covering them; this condition takes place mostly along the growing margins of the bone, so that in the cranium the thickening is found at or near the sutures, and it may remain permanent after recovery from the disease. Dugès has remarked that the natural protuberances of the skull are often much exaggerated from expansion of their cancelli, whilst the compact tissue forming their walls is thinner than usual. (*Dict. de Méd. et. Chir. Prat. Art. Rachitisme.*)

Boyer has thus described the appearances of rickety bones:—They are lighter than natural, and of a red or brown colour. They are penetrated by many enlarged blood-vessels, being porous, and as it were spongy, soft, and compressible. They are moistened by a kind of sanies, which may be pressed out of their texture, as out of a sponge, or rather a macerated hide after it has been tanned. The walls of the medullary cylinder of the great bones of the extremities are very thin, while the bones of the skull are considerably increased in thickness, and become spongy and reticular. All the affected bones, especially the long ones, acquire a remarkable suppleness; but, if they are bent beyond a certain point, they break, &c. Instead of being filled with medulla, the medullary cavity of the long bones contains only a reddish serum, totally devoid of the fat oily nature of the other secretion in the natural state. (*Traité des Maladies Chir.* t. iii. p. 619.) The consistence of several rickety bones, examined by Mr. Stanley, was nearly that of common cartilage. They presented throughout an areolated texture, and the cells were in some parts large, and contained a brownish gelatinous substance. This gentleman did not find the periosteum thickened, as Bichat has described it. (*Anatomie Générale*, t. iii.) The investigations of Mr. Stanley also prove that, in the process by which rickety bones acquire strength and solidity, there is always an undeviating regularity in the situation, extent, and direction of the deposited earthy matter. "Thus it is obvious (says this gentleman) that, in the curved bone, the part where there is the greatest need of strength, to prevent its further yielding, is in the middle of its concavity, or, in other words, in the line of its interior curve; and it is just in this situation that strength and compactness will be first imparted to the bone by the deposition of phosphate of lime. It will be further found, that the greatest resistance being wanted at this part, the walls are accordingly rendered thicker here than elsewhere, and the degree

to which this excess in thickness is carried, bears an exact ratio to the degree of curvature which the bone has undergone."

Mr. Stanley's observations also demonstrate that the bony fibres are arranged obliquely across the axis of the bone, in a direction calculated to augment its strength. Lastly, if a long bone, like the tibia, be very much bent, while it has to support a great superincumbent weight, the deposition of the bony matter may not be confined to the thickening of the walls of the concave side, but may extend across the medullary cavity, rendering the bone here perfectly solid, and thereby greatly strengthened. (See *Medico-Chir. Trans.* vol. iii. p. 404, *et seq.*)

We learn from the late Mr. Wilson, that, for many years, he had also exhibited in his lectures preparations illustrating the fact of the abundant deposition of osseous matter, "when the bones begin to recover from the disease, at the part where it is most wanted, viz., on the inner part of the concave surface of their curve." (*On the Skeleton, &c.*, p. 167.)

[Deformity of the long bones takes place mostly in the direction of their natural curves. In the very young child it may be produced by the weight of the legs and feet hanging down, but after it has begun to walk, the weight of the body pressing upon the softened bones, and muscular action determine it. In the upper limbs, it is also generally caused by the child supporting its weight upon them, as in crawling, &c.]

When the spine is affected, the normal curves of its several regions are exaggerated, and antero-posterior curvature is commonly produced: this variety is much more frequent in the young child than the lateral deviation. The increase of the curves is due to muscular weakness, and softening of the bodies of the vertebræ, and is also, to a very considerable degree, compensatory.

The constant tendency of the head to fall forwards of its own weight, requires a corresponding muscular effort to prevent it, and an anterior curve in the cervical region is thus normally produced. In rickets, the muscles are weakened, and fail to maintain the head erect, so that it sinks forwards or falls backwards, according to circumstances. The child instinctively throws the head backwards, so as to raise the eyes from the ground, and at the same time to balance the weight of the head upon the spinal column, by which posture it rests the extensor muscles, and avoids fatigue. The cervical curve is thereby much increased, and a posterior curvature compensatory to it is produced; this is often very considerable, and is continuous throughout the dorsal and lumbar regions when the child is still unable to stand or walk, but limited to the dorsal vertebræ, with an anterior curve of the lumbar spine, if it has begun to do so. When there is softening of the bodies of the vertebræ, they yield under pressure, and the curvatures are further increased, permanently reducing the length of the spinal column to a varying degree. It occasionally happens that the spine alone is implicated, the long bones escaping the disease. In this case the height of the trunk may be much diminished, whilst the extremities attain their full development.

Lateral curvatures of the spine, though sometimes dependent upon rickets, are more usually met with towards the age of puberty, and are

preferable to muscular debility, weakening of the spinal ligaments, and a habit of constantly inclining in the same direction, so as to throw the weight of the body upon the sides of the bodies of the vertebræ: interstitial absorption of the bone on one side is thus ultimately caused, and permanent curvature results, but this condition is essentially distinct from rickets. When rickety bones are examined, the periosteum covering them is found to be much thickened, highly vascular, and more adherent than usual. Dugès and some other authors deny that the disease causes any alteration in this membrane. Jenner describes the periosteal thickening as being greatest opposite the point of junction between the bone and its cartilaginous extremity. The bones are softened, sometimes to such a degree as to resemble one which has been steeped in acid; they may then be readily cut with a knife or bent in any direction, and in this condition are very liable to fracture: when this occurs the fracture is usually incomplete, of the so-called *greenstick* variety, is not attended by laceration of the periosteum, and readily unites. The softening is due to a diminution in the amount of earthy salts supplied to the bone. The analyses of Lehmann and others show that rickety bones do not contain more than one part of the inorganic element to three or four of the organic, the normal proportion in health being two parts of the former to one of the latter, and a still greater deficiency in the mineral constituent has been related. (*Simon's Chemistry*, by Day, *Syd. Soc.*, vol. ii. p. 284.)

The bone itself is redder and of a darker colour than usual, from the presence of a pulpy sanguineous substance which completely infiltrates the osseous tissue. At first this material is fluid or gelatinous, but it ultimately becomes organised, and, according to certain observers, converted into bone.

Under the microscope, this pulp is seen to consist of nucleated colourless cells, with numerous blood corpuscles, some granular matter, and often a large quantity of oil globules. It more or less completely replaces the marrow occupying the medullary canal, the cancelli, and even the interstices of the compact tissue.

The disease of the bones is usually preceded by general cachexia, and first manifests itself by a swelling of their articular extremities. This swelling depends upon the presence of an elastic reticulated structure first observed by M. Ruzé, who described it as resulting from hypertrophy of the normal cancellous texture of the bone. Dugès and Stanley incline to this opinion, attributing the enlargement partly to this cause, and partly to an expansion of the osseous cells. Guérin considers this spongy tissue to be derived from the organisation and ossification of the real pulpy matter above mentioned. Bouvier states that it is formed by the original bone, which is first rarified and then transformed into fibrous tissue by the loss of its calcareous element: as recovery takes place, this fibrous material slowly undergoes ossification, enclosing small round cellules, thus presenting the sponge-like appearance of bone which has been the subject of inflammation. Nélaton is disposed, also, to favour this view. Gerdy regards it as an entirely new product, resulting from inflammatory action of a specific character. Jenner (*Loc. cit.* p. 261) mentions the large development of the



spongy tissue in the ends and epiphyses of a rickety bone, as well as "of that layer of cartilage in which the primary deposit of calcareous matter takes place." His observations lead him to regard the disease as an "excessive preparation for the process of ossification and arrest of the completion of that process." He directs attention to the fact that the linear rows of cells in the ossifying cartilages are very much more widely separated than in health, and also that they are calcified before the matrix. He regards this to be a pathological condition, and therefore differs from Kölliker, who refers his readers to a rickety bone as affording a peculiarly good opportunity for observing the normal process of ossification. (*Manual of Human Histology*, translated by Busk and Huxley, *Syd. Soc.*, 1853.)

This spongy material is found everywhere, expanding the cancellated structure of bone, separating the concentric layers of the compact tissue, and, according to Guérin, encrusting the surface beneath the periosteum. The same author points out that this substance is especially deposited in the concavities of the curves formed by the yielding of the long bones, and, when it becomes ossified, serves as a buttress or column to strengthen the shaft where its curvature is greatest. The solidification of the bone at this part is also referred to by Stanley.

When this material is deposited in large quantity between the lamellæ of the shaft of a bone, it may interfere so much with their nutrition that they perish, and a thin external shell only is left, enclosing a red and somewhat oily fluid, in which osseous scales and débris are found floating. The bone is then highly fragile, and when thus degenerated, constitutes the condition named by Guérin, *Consumption Rachitique*.

As the disease subsides, the bloody semi-gelatinous fluid either becomes absorbed and the bone regains its natural condition, or it is converted into the spongy tissue above described: this becoming solidified, the bone is rendered much denser than usual, and it may even acquire the consistence of ivory, forming then the *Eburnéation* of Guérin. In these cases the medullary canal is commonly diminished in size, being encroached upon by osseous deposit, and occasionally where the bone is very much bent it may altogether be obliterated at the extreme point of curvature.

The most important result from ossification of this spongoid tissue, consists in the consolidation of the epiphysis with the shaft, whereby the further growth of the bone is permanently arrested.

The flat bones are considerably increased in thickness in consequence of expansion of their lacunæ and thickening of the periosteum, the compact tissue being generally much thinned.

The condition of the marrow varies in different specimens: it is usually softer than in health and gorged with blood. Boyer states that it is replaced by a "reddish serosity." Ruz describes it as paler than usual, whilst Dugès says it is less greasy and of a redder colour than in health.

The constitutional symptoms which usher in the bone disease usually commence during the first year after birth, though seldom before the third month. The child becomes dull and spiritless, appears languid and drowsy, is unwilling to move about or to play, loses appetite, is very thirsty, with a hot skin, and often bathed in perspiration;

is restless at night, throwing off the clothes so as to be exposed to the air. The digestive organs are deranged, the appetite capricious, bowels irregular, at times costive, at others the reverse, the motions very foetid, unnatural in appearance, and frequently contain no bile. The teeth are cut late, often with much suffering and general irritation. As the disease progresses the muscles become soft and flabby, allowing the spine to bend and the head to droop; the body appears to be universally tender, so that the child cries when moved or even touched. The abdomen is enlarged from distension of the bowels with flatus; the fontanelles do not close, and the skull expands, the intellect becoming deficient. The bones then commence to soften and deformity ensues. The urine in rickets deposits a thick sediment on cooling, which is shown by the experiments of Marchand and others to contain phosphate and other salts of lime in very large excess. These important ingredients of bone are absorbed from the skeleton, conveyed into the blood, and removed by the kidneys from the body. Walther mentions a tendency in rachitic children to the formation of calculi, and accounts for it by the large quantity of earthy phosphates present in the urine; but the attention of other authors does not appear to have been drawn to this point.

Jenner alludes to the emaciation which is often seen in this disease. He attributes it to "albuminoid infiltration" of the lymphatic glands and spleen (*Loc. cit.* p. 105), which he considers to be a not uncommon attendant upon rickets, and a frequent cause of death. The glandular enlargement in these cases has been set down to deposit of tubercle, but according to the above authority the two conditions of rickets and tubercle are not often met with in the same person.

A rickety child is peculiarly liable to bronchitis, which very commonly terminates in death. Laryngismus stridulus is also, according to Jenner, nearly always associated in children with a rickety condition. Fatal collapse of the lung occasionally takes place in consequence of the softened ribs yielding under atmospheric pressure during inspiration, and preventing expansion of large portions of the pulmonary tissue. Convulsions from nervous irritation are by no means an unfrequent cause of death in this disease.]

Although the osseous system is principally affected in rickets, no doubt can be entertained of the dependence of the disorder upon constitutional causes. With regard to the bones, a deficiency in the secretion of the phosphate of lime is certainly not the only thing that marks the disturbance, or imperfection in them; for, from what has been stated above, it appears that there is a disorganisation of their minute textures. In the bones of the skull, as Mr. Shaw observes, there is commonly exhibited, in a very remarkable manner, some parts of the calvarium acquiring an extraordinary degree of thickness, while other parts are reduced to the thinness of paper, and here the divisions of the tables are lost. Sir Charles Bell had in his possession the skull of a rickety subject, in which the parietal bones were seven-eighths of an inch in thickness at their central parts. He had also the skeleton of a child, seven years of age, in which the parietal bones were five-eighths of an inch in thickness. In both these specimens, the calvarium was remarkably thin in the situation of the sutures and fontanelles.

Hunaud exhibited to the Academy of Sciences the skull of a child, between three and four years of age, the bones of the upper part of which were in some places seven or eight lines in thickness; and, when compressed, blood and serum oozed out of the interstices. (See *Shaw*, in *Med. Chir. Trans.* vol. xvii. p. 456.)

Many rickety and deformed infants improve as they grow up, and acquire strength. The deformity of their limbs spontaneously diminishes, and the bones gain a proper degree of firmness, a due quantity of the phosphate of lime being deposited in their texture. Though the bones may never acquire their right shape, they become exceedingly firm; and some rickety subjects, after attaining the adult age, have been celebrated for the performance of great feats of strength.

It is a question, whether the restoration of the proper figure of the bones can be promoted by the constant pressure of bandages, and mechanical contrivances, sold in the shops. Some authors contend that, in very young children, machines are useless, as the confinement and inactivity of the muscles, necessarily occasioned by such contrivances, must increase the general debility, and consequently the disease.

Notwithstanding the praises which have been bestowed on mechanical means by their inventors, and even by respectable authors, says Boyer, they are not now used by any enlightened judicious practitioners, it being generally agreed that it is best to leave to nature alone, aided by good medical treatment, the duty of rectifying bones deformed by the rickets. (*Traité des Mal. Chir.* t. iii. p. 627.) Delpech expresses himself still more strongly against the employment of machinery. (See *Précis Élémentaire des Maladies Chir.* t. iii. p. 740, &c.) However, these opinions against mechanical contrivances for the improvement of rickety bones, are not meant to apply to machines for rectifying distortions of the foot. In such cases, the malformation does not depend on constitutional causes, and mechanical means will often do whatever is possible. Club-foot we know may frequently be cured by dividing the tendon Achilles.

With regard to this part of the subject, Dr. Cumin observes, that as soon as the constitution appears to be rallying, and the bones gaining strength and firmness, attempts should be made to restore them to their natural shape by well directed manipulations, and the employment of such mechanical contrivances as will give support without injurious confinement. Considerable success is known to have attended the treatment adopted by Dupuytren in deformity of the chest. (*Repertoire Gén. d'Anal. &c.* t. v. p. 198.) His plan was to place the child with its back against the knee or a wall, and to make moderate and gradually increasing pressure with the palm of the hand on the sternum, so as to diminish the diameter of the chest from before backwards, and to force out the ribs towards their natural convexity. This practice was repeated frequently every day, until the desired change had been brought about. (See *Cyclop. of Practical Med.*, art. *Rickets*.) However, some of these deformities of growing youth would not be looked upon by Mr. A. Shaw as examples of true rickets, and we know that nature herself is often capable of removing them, without the tedious process resorted to by Dupuytren.

Mechanical supports and contrivances are of doubtful utility in the treatment of rickets, and much difference of opinion exists as to their employment. *Merci*, in his valuable work (*On Disorders of Infantile Development and Rickets*, 1855), states that the mechanical compression exercised upon rickety debilitated children by instruments is injurious rather than the reverse, and should be avoided. *Shaw*, *Jenner*, and other eminent authorities are of the same opinion. In certain cases, however, the careful and judicious application of splints to the extremities will often prevent further deformity, and, if employed whilst the bones are still soft, will aid the muscles in straightening the crooked limbs; they may also be used advantageously in such a manner as to hinder the child walking or standing, and thus prevent further yielding of the legs. When the spine is involved, rest in the recumbent position, upon a firm bed or couch, is essential, so that the weight of the body shall not exercise undue pressure upon the softened bones, and is far preferable to any spinal apparatus yet contrived, and more especially if fresh air, and above all sea air, can be obtained, without disturbing this position.

[When the ribs are softened and yield under the pressure of the atmosphere, a bandage around the abdomen will be found useful in preventing the too great descent of the diaphragm, which tends to contract further the thorax, and thus forces the abdominal viscera downwards from beneath the ribs, increasing the protrusion of the abdomen.]

No medicine is known that possesses any direct efficacy in rickets. Tonics are indicated, and should be employed. Bark, especially the sulphate of quinine, may be tried, as well as steel medicines; to iron filings, a great deal of efficacy has been ascribed. (See *Med. Comment.* vol. ii. p. 48.) In particular, the functions of the bowels should be duly regulated by medicine. From the disease appearing to consist in a deficiency of lime in the bones, proposals have been made to exhibit internally the phosphate of lime; but this chemical project has had no success. (See *Bonhomme's Memoir on Rachitis*, in *Duncan's Annals* for 1797.)

Several circumstances, considered by Mr. Wilson, tend to prove that this scheme could present no chance of benefit, because there is no proof of a deficiency of lime in the system, though the arteries of the bones do not deposit it in the natural degree. (See *Wilson, on the Skeleton*, &c. p. 163, &c.)

[Impairment of the digestive organs being the most prominent and constant symptom, requires especial attention; to this end the bowels must be regulated with mild purgatives, from which mercury in every form is to be rigorously excluded. It has been suggested that the unhealthy condition of the gastric fluids is due to an excess of lactic acid in the secretions of the stomach, and to remedy this, bismuth, soda, and other alkalies have been recommended; although this theory is now abandoned, these drugs may be given, beneficially, combined with some warm stomachic and tonic. When the irritability of the stomach is allayed, iron in its most soluble forms is very serviceable, and of these no preparation agrees better with children than steel wine.]

Cod-liver oil has been vaunted as a specific for rickets by M. Bouchaut and other French writers. It is without doubt a most valuable agent, although



it cannot be shown to possess any special therapeutical action, beyond supplying fat, an essential article of diet to young children, in a form which is easily digested and assimilated.

An attempt has been made to supply phosphate of lime to the system by giving lime water and milk at intervals, with occasional doses of phosphoric acid and iron, trusting to the formation of a lime salt in the stomach, which will be more readily absorbed into the blood; but, as might be expected, no better result has attended this treatment than when phosphate of lime was internally administered.

Milk is perhaps the best food that can be given, and when the child is very young nothing equals the breast milk of the mother, if she be in a good state of health. When older, meat broths, or a little meat is desirable; but this must be finely chopped; and in feeding a rickety child its imperfect or deficient dentition must always be borne in mind.

The complications which arise in the course of this disease, as bronchitis, hydrocephalus, &c., must be treated in accordance with the principles laid down for ordinary cases, regard being had to the debilitated condition of the patient, which will admit of a depletive treatment unless in a few exceptional cases.]

More good is generally effected by keeping children in healthy situations, and in a salubrious air, than by any medicines whatever. Light, wholesome, nutritious, easily digestible food; cold bathing; good nursing; regular gentle exercise; or airings in a carriage; the use of the flesh-brush, &c. are also highly serviceable. The constitutional treatment of rickets belongs more properly to the physician than the surgeon; and it is not necessary to introduce more of the subject into a Dictionary expressly allotted to surgery. (See *MOLITIES OSSIUM*.)

G. G. Gascoyen.

*Dav. Whistler*, De Morbo Puerili Anglor. dicto "the Rickets," Ludg. Bat. 1645. *Glisson*, De Rachitide, sive, Morbo Puerili, Ludg. Batav. 1671. *Duvernay*, Traité des Maladies des Os. Paris, 1751. *Levacher de la Feutrie*, Traité du Rachitis. Paris, 1772. *Bonhomme*, Mém. on Rachitis, in *Duncan's Medical Annals* for 1797. *Richerand*, Nosographie Chir. t. 3. p. 142, &c. ed. 4. *Leveillé*, in Mém. de Physiologie et de Chirurgie, par *Scarpa*, &c. *Boyer*, Traité des Maladies Chir. t. iii. p. 607, &c. *Stanley's Obs.* in Med. Chir. Trans. vol. vii. p. 404. *Delpsch*, Précis Elémentaire des Maladies Chir. t. iii. p. 739, &c. *Trnka de Krzowitz*, Historia Rachitidis, 8vo. Vindob. 1787. *R. Hamilton*, On Scrofulous Affections, &c. 8vo. Lond. 1791. *A. Portal*, Obs. sur la Nature et sur le Traitement du Rachitisme ou des Courbures de la Colonne Vertébrale et de celles des Extrémités, 8vo. Paris, 1797. *J. Wilson*, On the Structure and Physiology of the Skeleton, Diseases of Bones, &c. p. 159, &c. 8vo. Lond. 1820. *J. Shaw*, On Distortions of the Spine and Chest, 1823. *A. Shaw*, in Med. Chir. Trans. vol. xvii. *J. Cloquet*, Pathologie Chir. p. 97, 410. Paris, 1831. *Thomas Braghe*, in Trans. of Provincial Medical and Surgical Association, vol. iii. *W. Cumin*, in Cyclop. of Practical Medicine, art. Rickets. *Herbert Mayo*, Outlines of Human Pathology, p. 18, 8vo. Lond. 1835. *Rufz*, Recherches sur le Rachitisme chez les enfans, Paris, 1834. *Bouvier*, Bull. de l'Acad. de Méd. Paris, 1836-37. [*Guérin*, Mémoire sur les caractères généraux du Rachitisme. Paris, 1839. *Dugès*, Dict. de Méd. et Chir. Pratiques, 1829. *Guserent*, Dict. de Médecine, 1827. *Nélaton*, Elémens de Path. Chir. Paris, 1847. *Stanley*, Treatise on Diseases of the Bones, 1849. *Beylard*, Du Rachitis de la Fraîgité des Os. de l'Osteo-Mal. Paris, 1852. *Broca*, Recherches sur quelques points de l'Anat. Path. du Rachitisme, Bull. de la Soc. d'Anat. Paris, 1852. *Geray*, Maladies des Organes du mouvement.

Paris, 1855. *Costello*, Cyclopædia of Practical Surgery. *Rokitansky*, Manual of Path. Anatomy, Syd. Soc. *Simon*, Animal Chemistry, Syd. Soc. *Kölliker*, Manual of Histology, Syd. Soc. *Merei*, On Disorders of Infantile Development and Rickets, 1855. *Jenner*, Lectures on Rickets, Med. Times and Gazette, 1860, vol. i.]

RINGWORM. (See SKIN, DISEASES OF.)

RUPTURE. A protrusion of the abdominal viscera. (See HERNIA.)

RUPTURED PERINÆUM. (See VAGINA.)

SABINA. Savine. The use of the leaves of this plant, in forming the active ingredient in the ointment, commonly preferred for keeping open blisters, has been explained in the article *Blisters*. The other chief surgical use of savine, is as a stimulating application for destroying warts and other excrescences. For the latter purpose, it is generally powdered, and mixed with an equal proportion of subacetate of copper. The same powder is also sometimes employed by surgeons for maintaining the hollows in which peas are inserted in issues. The best plan is, first to wet the peas, then roll them in the powder, and put them, in this state, on the issue. But, when the whole surface of the issue has risen high above the level of the skin, the powder must be sprinkled all over the sore, so as to produce an absorption of the high granulations. Indeed, even in this manner, a good cavity often cannot be obtained; and it becomes necessary to destroy the surface of the issue, by rubbing it with caustic potassa, or potassa cum calce.

SALIVARY FISTULÆ. (See PAROTID DUCT.)

SANIES. The thin, serous, fetid matter discharged from fistulæ, unhealthy sores, &c., sometimes tinged with blood.

SARCOCE'LE. (from *σὰρξ*, flesh; and *κήλη*, a tumor.) A chronic enlargement of the testicle. (See TESTICLE, DISEASES OF.)

SARCO'MA, or SARCO'SIS. (from *σὰρξ*, flesh.) A fleshy tumor. (See TUMORS, SARCOMATOUS.)

SARSAPARILLA. The root of sarsaparilla was brought into Europe about 1530. It was at first reputed to possess singular efficacy in venereal cases; but afterwards lost all its fame. It was again brought into notice by Dr. W. Hunter, who advised Dr. Chapman to make trial of it in a bad case of phagedenic bubo; and the benefit obtained in this instance led Dr. Hunter to extend the recommendation of the medicine. Sir W. Fordyce stated that sarsaparilla would quickly relieve venereal headache, and nocturnal pains, and, if persisted in, cure them; that in emaciated, or consumptive habits, from venereal cause, it was the greatest restorer of appetite, flesh, colour, and strength, which he knew of; that when mercurial frictions had been previously employed, it would generally complete the cure of the disease of the throat, nose, palate, or spongy bones; and that it would promote the cure of blotches and ulcers, and sometimes accomplish it, *even without mercury*; though, in this circumstance, there was danger of a relapse. Sir W. Fordyce pronounced sarsaparilla to be of little use in chancres; but, that when these or buboes could not be healed by mercury, it would often cure, and always do good. He allows, however, that, in all venereal cases, *sarsaparilla is not to be trusted, unless preceded by, or combined with, the use of mercury*; and he thought

sarsaparilla would, probably, always cure what resisted mercury. (*Medical Obs. and Inq.* vol. i.)

Cullen considered sarsaparilla as possessing no virtues of any kind; for, says he, "tried in every shape, I have never found it an effectual medicine in syphilis, or any other disease." (*Mat. Med.* vol. ii.)

Mr. Bromfield declares, that he never saw a single instance in which sarsaparilla cured the venereal disease without the aid of mercury, either given before, or in conjunction with it. (*Pract. Obs. on the Use of Corrosive Sublimate*, &c. p. 78.) Mr. Pearson also contends, that sarsaparilla *has not the power of curing any one form of the lues venerea*; but he allows, that it may suspend, for a time, the ravages of that contagion, the disease returning, if no mercury should have been used. This gentleman admits, also, that sarsaparilla will alleviate symptoms derived from the venereal virus. He maintains, that the exhibition of sarsaparilla does not diminish the necessity for giving less mercury. Nocturnal pains in the limbs, painful enlargements of the elbow and knee, membranous nodes, cutaneous ulcerations, and certain other symptoms, resembling venereal ones, are often experienced after a full course of mercury. Such complaints, Mr. Pearson allows, are greatly benefited by sarsaparilla, and exasperated by mercury; and, he observes, that it is from these complaints having been mistaken for venereal ones, that the idea has arisen, that sarsaparilla has cured syphilis, when mercury had failed. Mercury and the venereal poison may jointly produce, in certain constitutional, symptoms which are not strictly venereal, and are sometimes more dreadful than the simple effects of syphilis. Some of the worst of these appearances are capable of being cured by sarsaparilla, while the venereal virus still remains in the system. When this latter disease has been eradicated by mercury, sarsaparilla will also cure the sequelæ of a course of the other medicine. (*Pearson, On the Effects of various Articles in the Cure of Lues Venerea*, 1807.)

The value of many of the foregoing opinions is much affected by the results of modern inquiries into the nature of the venereal disease, the general possibility of curing which, without the aid of mercury, seems well established, though the expediency of the method is another question.

[There can be no doubt that sarsaparilla is of great service in all cases of syphilitic cachexia, ranking next in efficacy to the hydriodate of potash in tertiary syphilis, whether manifested in the form of nodes, caries or necrosis, rupia, or sloughing of the palate and larynx. (See **VENEREAL DISEASE**.)]

**SCA'LPEL.** (from *scalpo*, to scrape.) Originally a raspatory, or instrument for scraping diseased bones, &c. The term now generally signifies any common surgical knife.

**SCA'RIFICATION.** (from *scarifico*, to scarify.) The operation of making little cuts, or punctures, in a part, for the purpose of taking away blood, letting out fluid in anasarctous and erysipelatous cases, or the air of emphysema.

**SCIRRHUS; SCIRRHOMA; SCIRRHOSIS.** (from *σκιρῶω*, to harden.) The etymological import of these terms seems merely to be induration. The first is now generally restricted to the induration which attends scirrhus cancer. (See **CANCER**.)

**THE SCLEROTIC** [The Sclerotic (The Sclera, "the white of the eye") is a fibrous capsule with a larger opening for the passage of the optic nerve and numerous smaller ones, especially immediately in front and behind the insertion of the recti-muscles, and round the optic nerve, for the blood-vessels and nerves of the choroid. The surface of the sclerotic is slightly grooved just behind the insertion of the recti-muscles, for the reception of their tendons. It is very slightly depressed at the line of junction with the cornea. At this spot is situated the circular sinus or canal of Shlemm (a web of vessels for venous blood). Anteriorly, the sclerotic assists in forming the boundary of the anterior chamber, so that a knife thrust through it half a line behind the margin of the cornea, enters the chamber without wounding the iris.

The sclerotic glides within a capsule termed "Tenon's capsule," which is attached to the margin of the orbit behind the suspensory ligament of the eyelids and further back merges into the sheath of the optic nerve.

This capsule isolates the eyeball from the soft parts of the orbit. Through it, the muscles of the eyeball (loosely attached to it) have to pass, to reach the sclerotic. Behind their insertion, loose connective tissue is found between the capsule and the sclerotic.

The sclerotic receives few blood-vessels and nerves. The sub-conjunctival tissue in front of the insertion of the recti-muscles is nourished by capillaries which anastomose with blood-vessels going to the ciliary processes, and overfulness of the latter, whether chronic or acute, betrays itself by enlargement of vessels upon the sclerotic near the margin of the cornea.

The sclerotic, otherwise of a dead white colour, appears brilliant white where it is covered by conjunctiva. The thicker the sclerotic, the whiter it appears, the thinner, the more blueish. In dark persons, small or large brown or black pigment spots may be seen in its ciliary portion. In highly myopic persons, it often appears blueish (semi-transparent) about the region of the yellow spot. Prolonged congestion of the ciliary veins leads to enlargement of their respective sclerotic apertures.

We make ourselves familiar with the shades of colour of the sclerotic, which lie within the limits of health, by examining the sclerotic of many fair and dark persons.

The colour of the inner (choroidal) surface of the sclerotic can in fair persons readily be recognised with the ophthalmoscope, while in dark ones (in choroids with much pigment) too little light reaches the sclerotic to render it conspicuous. Some of the light, if the sclerotic is very thin, passes through it, and the large blood-vessels can be perceived in its substance.

The thickness of a healthy full-grown sclerotic near the optic nerve amounts to  $\frac{1}{2}$  in., a quarter of an inch behind the margin of the cornea to  $\frac{1}{8}$  in., and immediately behind the insertion of the recti-muscles to  $\frac{1}{16}$  in.

In some cases when the "vitreous" is removed the sclerotic and the adjoining tunics are thrown into folds, in other equally healthy eyes they remain expanded, and retain their curvature though all the "vitreous" may have been removed. The arrangement and proportions of the different kinds of tissue of which the sclerotic is composed, vary in its different parts, especially



along the margin of the cornea, at the sclerotic aperture, at the region of the yellow spot and round the apertures for the choroidal nerves and blood-vessels. The sclerotic consists, generally speaking, of an interlacement of some white fibrous, with broad bands of connective tissue, interwoven with elastic fibres.

*Development.*—Before the third month, no difference of appearance is observed between cornea and sclerotic; both are almost transparent and extremely thin.

A circular prominent fold of sclerotic appears as the first indication of a boundary between cornea and sclerotic, the part encircled by the fold becoming cornea. The small round transparent globules, of which at that period the sclerotic consists microscopically, become intermixed with fibrillæ. About the middle of the third month, the cornea for a short time becomes opaque, but soon resumes its transparency; while the sclerotic becomes opaque, its inner surface presenting a silvery lustre.

About the middle of the third month, when the sclerotic protuberance becomes perceptible, a thick network of blood-vessels appears upon the outer surface of the sclerotic close behind the insertion of the recti-muscles: it forms a kind of circle round the eyeball, and gradually extends towards the cornea and towards the optic nerve, assisting in the formation of the greater portion of the fibrous structure. The sclerotic rapidly increases in thickness and density about the middle of the fifth month, at a time at which the foetal changes of shape of the eyeball, and the closure of the foetal fissure, are completed.

*Congenital Anomalies.*—A double sclerotic, the rudiments of a second one, being situated within an entire one, has been observed. Blueish spots in the sclerotic, or a general blueish (semi-transparent) tint, due to great thinness, is frequently observed in infants. Remnants of the sclerotic protuberance have occurred in microphthalmic eyes. Prominences beyond the general curvature round the insertion of the recti-muscles, or round the optic nerve, are not uncommon.

*Tumors.*—Little "dermoid tumors" are generally congenital; at their base they are adhering to the sclerotic, and at their summit to the conjunctiva. Often hairs are found projecting from their surface.

*Staphyloma*—especially in the ciliary region—"strumous deposit" in the same region, medullary and especially melanotic cancer, as often found upon the equatorial part of the sclerotic, have been mistaken for tumors of the sclerotic itself.

*Inflammation.*—The sclerotic is frequently involved in inflammation of adjoining tunics, e.g. of the conjunctiva, or of the ciliary processes, or in ophthalmitis. The inflammation is often of syphilitic origin, if it commences in the sclerotic. It appears most frequently in the ciliary region, where it occupies circumscribed patches of a purple tint, covered with larger vessels, the vascular sclerotic and the sub-conjunctival tissue being swollen. In from five to ten weeks, the inflammation subsides, leaving the sclerotic slightly discoloured, semi-transparent, and thinner. Similar circumscribed inflammation often appears successively in adjoining parts of the sclerotic all round the cornea.

*Treatment.*—The inflammation readily subsides under the use of bichloride of mercury, from

$\frac{1}{4}$  to  $\frac{1}{10}$  of a grain to be taken twice daily in some water, with the local application of atropia. A few drops of the lotion "to be dropped into the eye" twice daily. The same treatment is at once adopted if new attacks appear, which often happens at the same season of one or several of the succeeding years.

*Rheumatic Inflammation.*—In rare cases we meet with an acute diffused purple redness, and slight swelling of the sclerotic, with extreme intolerance of light and great pain brought on by exposure to cold. When minutely examining a section of such a sclerotic, we find in the inflamed portion groups of what appear to be connective tissue corpuscles. The latter are swollen, and their stellate processes anastomose with each other and with those of neighbouring groups. Their granules change into cells, and probably by subdivision increase in number. The granules appearing in the interior of the new cells, undergo similar changes. The substance intervening between the nests of corpuscles gradually disappears, but if the inflammation is very acute, it is changed into a yellowish pulpy substance, breaking up into shreds (slough), while the nuclei and cells of the connective tissue corpuscles undergo fatty degeneration.

*Treatment.*—The frequent application of pieces of lint dipped into hot *Lotio Papaveris*, and of chloroform liniment, to the skin of the eyelids, forehead, and temple, with frequent instillations of atropia, are prescribed. The eyes are kept excluded from light. The general medical treatment depends upon the constitution of the patient.

*Inflammation of Tenons Capsule* is a common occurrence in ophthalmitis where the capsule becomes adherent to the sclerotic, &c. Inflammation of circumscribed portions, has been observed in myopia, and in tumors of the orbit or eyeball, and occasionally after exposure to cold air. It is accompanied by slight ptosis, a sensation of tension in the eyeball, sometimes with severe pain in and round the orbits, with vascularity and serous chemosis of the conjunctiva, and with slight protrusion of the eye, the movements of which are slow and painful.

*Treatment.*—Cold fomentations or the local application of ice, should be tried first, with a number of leeches (proportionate to the strength of the patient) applied to the skin of the corresponding temple. Fomentations with warm or hot *Lot. Papaveris* are ordered, if the cold should feel unpleasant to the patient. If ophthalmitis or intra-ocular tumor are the cause, excision of the eye may become necessary.

*Ulceration.*—The ulcer is preceded by a yellowish grey opaque and circumscribed infiltration. The margins of the ulcer are abrupt, the base yellowish white and opaque, with much redness and swelling of the surrounding sclerotic and conjunctiva. A patient, some months ago discharged from the hospital after recovery from a syphilitic ulcer of the lower lid, lately presented himself with two deep ulcers in the lower and outer part of the sclerotic, with ulceration of the cornea and some iritis. The ulcers healed rapidly under the application of the ungt. hydrarg. nitratis; a quantity of the size of a small pea being rubbed into the ulcers twice daily.

Cancerous ulcerations may from the eyelids encroach upon the sclerotic.

*Injuries.*—Clean cuts or punctures of the sclerotic.

rotic, heal readily with a semi-transparent cicatrix. The lids of the eye thus wounded should be kept closed, wet lint being kept tied over them until the wound has healed and all undue vascularity disappeared. The fellow eye, if there be no sympathetic irritation, may be used for work.

Rupture of the sclerotic, e.g. after blows, occurs more frequently near the upper or inner margin of the cornea. The eyeball being least protected at the outer and lower border of the orbit, is by the blow driven against the opposite prominent part. The rupture is often complicated with bleeding into the anterior chamber, with separation of part or of the entire iris from its insertion, with dislocation of the lens, the latter escaping through the wound. Portions of iris, choroid, "vitreous," or retina may project from the wound. All the contents of the sclerotic may escape, the latter becoming filled with blood.

The prognosis depends upon the amount of injury inflicted upon the deeper parts of the eye.

*Treatment.*—After having cleaned the wound from extraneous substance, portions of vitreous, &c., lint dipped in fresh water is applied over the closed lids of the injured eye, upon this, some cotton wool is placed and the whole secured by a bandage. The bandage is removed three times daily. Rest of the injured eye and instillations of atropia into the fellow eye if any sympathetic irritation should exist, are prescribed. The latter, in the absence of all irritation, may be used for work. (See *Injuries of Choroid, Retina, &c.*)

C. Bader.

SCROFULA, or SCROPHULA. (from *scrofa*, a sow.) So named, as is commonly supposed, either on account of its often giving a thick appearance to the throat and neck, a character of the animal here mentioned, or, because swine were fancied to be subject to the disease; though the correctness of this last etymology is rendered questionable by the remarks of Dr. Henning; and the statement that pigs are really liable to scrofula he also pronounces to be erroneous. (See *Critical Inquiry into the Pathology of Scrofula, &c.* pp. 1, 9.) Here, however, it is to be recollected, that this author does not admit tuberculous deposits to be any proof of scrofula; a point on which the highest modern authorities would be against him. Now, according to Dupuy, all the domestic animals of France, not excepting the dog, as well as those imported from warmer countries, are subject to tuberculous deposits. (*De l'Affection Tuberculeuse, &c.*)

Celsus clearly describes the disease, as it affects the absorbent glands, under the name of struma. The other term applied to it, the *King's Evil*, commemorates the imaginary virtues of the royal touch, to which from the time of Edward the Confessor, till the reign of Queen Anne, multitudes of persons afflicted with scrofula were subjected. A similar custom prevailed in France; and miraculous powers for the cure of scrofula were likewise claimed for different Romish saints; for the heads of certain noble families; for the seventh son; and for many consecrated springs.

One of the most frequent effects of the disease is a chronic swelling of the absorbent glands, in various parts of the body, which glands generally tend more or less slowly to suppuration. Our notions of scrofula, however, would be very imperfect, were we to define the disorder to be a morbid state of the

lymphatic glandular system. The first appearances, indeed, frequently consist of spots on different parts of the body, and of eruptions and ulcerations behind the ears. The system of absorbent glands, it is true, seldom or never fails to become affected in the progress of the disease; yet scrofula frequently appears, for the first time, in parts which are not of a glandular nature. There are, perhaps, but few, if any, of the textures of the human body, or of the organs, which these textures form, that are not liable to attacks of scrofula, and to scrofula as an original idiopathic affection. (See *Thomson on Inflammation*, p. 134.) These sentiments, accurate as I believe them to be, are entirely at variance with those of Alibert and other moderns, who describe the disease as having its commencement in the conglobate glands, especially those of the neck (*Nosol. Naturelle*, t. i. p. 441. 4to. Paris, 1817); and they are equally opposite to the doctrine of Dr. Henning, who argues, that the superficial absorbent glands alone are susceptible of the original action of the cause of this disease, and that if other parts become affected by it, such affection is consequential. (*On the Pathology of Scrofula*, chap. vi.)

The absorbent glands are far from being the only parts liable to the original attack of scrofula. Sometimes, as I have stated, the disease begins in the cutaneous texture; very often in the eyes, nostrils, or lips. In other cases, we find it fixing upon organs more deeply situated, as the bones and joints; or obstructing the organs for conveyance of the chyle; or giving rise in the lungs, the spleen, the kidneys, the peritoneum, and other parts, to those tubercular diseases, which, in this climate, are one of the greatest causes of mortality. The most frequent seats of scrofulous tubercles in adults are, first, the lungs, and then the small intestines; but, in children, the bronchial glands, the mesenteric glands, the spleen, the kidneys, and the intestines, in the order here enumerated. When, therefore, tubercular phthisis is regarded as a scrofulous disease, it makes an important difference in the comparative estimate of the frequency of scrofula in children and grown up persons. The most certain evidence of the existence of scrofula seems to Dr. Cumin to be afforded by the production of a soft, brittle, unorganised matter, resembling curd, or new cheese, which is found mixed with the contents of scrofulous abscesses, or deposited in rounded masses of different degrees of firmness, varying in bulk from the size of a millet seed to that of a hen's egg. Sometimes it is contained within the natural cavities and canals of the body, sometimes it is enclosed in cysts, and occasionally it is diffused, as if by infiltration, through the natural texture of a part. To the rounded masses of this substance, the name of *tubercles* has been assigned, and the substance itself is called *tuberculous*, or tubercular matter. "We venture to assert, that the presence of tuberculous matter is a satisfactory proof of the existence of scrofula; but, we do not by any means maintain, that scrofula cannot exist without the deposition of this substance. The researches of pathological anatomy have shown, that scarcely any living texture of the human body is altogether exempted from tuberculous deposits. This morbid production has been observed on the free unbroken surfaces of mucous membranes, within mucous follicles, and forming the contents of lymphatic vessels, the



tunics of which were themselves sound. (*Andral, Anat. Pathol.* t. i. p. 419, and t. ii. p. 446.) Granules of tuberculous matter, sometimes insulated, sometimes clustered together, have also been detected within the clots of blood contained in the cells of the spleen." (*Andral, Op. cit.* t. ii. p. 431, and *Carswell's Illustrations of the Elem. Forms of Disease*, Fasc. i. p. 1, 3. *Cumin*, in *Cyclop. of Pract. Med.* art. *Scrophula*.)

Professor Carswell remarks, that the prevailing opinion among pathologists is, that the seat of tuberculous matter is the cellular tissue of organs; that it may, however, be formed on secreting surfaces, as in the mucous follicles of the intestines; perhaps, in the air-cells and bronchi; the surface of the pleura and peritoneum; and likewise in false membranes, or other accidental and new products; and in the blood itself. According to the researches of this distinguished pathologist the mucous system is the most frequent seat of tuberculous matter. "In whatever organ the formation of tuberculous matter takes place, the mucous system, if constituting a part of that organ, is, in general, either the exclusive seat of this morbid product, or is far more extensively affected with it than any of the other systems, or tissues of the same organ. Thus the mucous system of the respiratory, digestive, biliary, urinary, and generative organs, is much more frequently the seat of tuberculous matter, than any other system, or tissue, which enters into the composition of these organs. The coloured plates I. and II. furnish the clearest evidence of the formation of tuberculous matter in the mucous system of all these organs. I have shown it in the lungs, formed on the secreting surface, and collected within the air-cells and bronchi; the intestines, in the isolated and aggregated follicles; the liver, in the biliary ducts and their extremities; the kidneys, in the infundibula, pelvis, and ureters; the uterus, in the cavity of that organ, and Fallopian tubes; and the testicle, in the tubuli seminiferi, epididymis, and vas deferens.

"The formation and subsequent diffusion of tuberculous matter is also observed on the secreting surface of serous membranes, particularly the pleura and peritoneum; and in the numerous minute cavities of the cellular tissue. The accumulation in the lacteals and lymphatics, both before and after they unite to form their respective glands, is frequently very considerable." (See Pl. III. and IV.) In Pl. III. Dr. Carswell has also given representations of tuberculous matter in the substance of the brain and cerebellum, in accidental cellular tissue, and in the blood. (See *Illustrations of the Elem. Forms of Disease*, Fasc. i.)

[Rokitansky describes scrophulous tubercle as an exudate of a fibrinous or albuminous blastema in the lowest grade of development, which readily solidifies. This exudate, he says, "is for the most part distinguished by the tubercle form; that is, by its appearance as scattered or collected nodules, or where more copiously produced, by its deposition in granulations and stellate masses. It is hereby cognisable at the first glance. Still this is open to exceptions; tubercle itself occurs in extensive irregular masses. These are inflammatory products endowed with an indwelling tuberculous character, although manifesting a total absence of the external habitudes of tubercle. Tubercle has therefore sometimes a local, but, far more fre-

quently, a general import and significance. It is invariably so closely linked with dyscrasial processes, that, for a profitable consideration of tubercle, an incessant retrospect to the dyscrasial relations is imperatively demanded."

He does not hold with the opinion that the grey miliary tubercle is converted into the crude yellow tubercle of Laennec by progressive changes, but considers them as two separate exudations from the first. He thus divides scrophulous tubercle into two distinct kinds under the designations of *simple fibrinous or grey tubercle* and *fibrino croupous or yellow tubercle*, each possessing its appropriate characters of development and decay.

*Simple fibrinous or grey miliary tubercle* "appears as scattered or stellate conglomerations of granules of about the size of millet seeds. It presents, moreover, smooth pseudo-membranous exudates, as we often find exemplified upon the pleura of lungs involved in florid phthisis." "Under the microscope it reveals the following elementary composition. It consists mainly of a more or less pellucid base (blastema), which forms a sort of binding medium for certain form elements. Its components therefore are: 1. The said basement mass, for the most part a fibro-glebous, grey, fixed blastema, rendered turgescent and transparent by acetic acid. 2. Certain embryonic form elements, viz.: (a) Elementary granules of various magnitude. (b) Nucleous formations, both black-contoured, lustrous, spherical, even oblong nuclei; and more delicate, dull, granulated nuclei, under various phases. (c) Nucleated cells; commonly in such small numbers as to tempt one to doubt their occurrence altogether. Nuclei and cells are often to a great extent misshapen, disorderly, jagged, angular, bulging, dumb-bell shaped, rudimental, stunted. This tubercle, he maintains, never softens; its metamorphosis is limited to decadence. It becomes transformed with the loss of its moisture, with condensation, to a hard nodule, and shrivels into a tough, amorphous, or indistinct fibrous, horn-like mass, in a word—cornifies. This determines a complete wasting and death of the tubercle, subversive of all further change. Occasionally this process is associated with bony deposition, the tubercle becoming a partly cornified, partly ossified, nodule."

*The fibrino croupous or yellow tubercle* he describes as appearing from the first "in the shape of roundish nodules, as also, and that very frequently, of irregular gibbous branched masses of considerable diameter, or upon free surfaces as gibbo-stellate layers of various thickness. The nodules in size often equal the grey tubercle granulations, still oftener do they equal hemp-seed or peas. Usually, every variety of size coexists. The substance of this tubercle is, as we may here once for all remark, opaque from the very first; now resplendent in various degrees, yellow, of fibrous or of granular fracture, firmly elastic or friable, of a lardaceous, card-like aspect. The microscopic examination of this tubercle shows, as in the case of the foregoing one, a fixed base and the aforesaid form-elements. The former is a fibro-glebous, or else an amorphous opaque blastema. With respect to the latter much variety obtains. The number of cells, of nuclei, especially of the dull, granulated nuclei, of the elementary granules, and especially the quantity of the finest point-molecule predominate. The metamorphosis proper to this tubercle is softening, and again cre-

tefaction. The first, namely, softening, also termed supuration, consists in this: after the tubercle has tarried for a certain time in the above described condition of crudity, it loosens up, for the most part with considerable increase of volume, readily breaks asunder through compression, moistens. Hereupon it changes into a yellowish, glutinous, fatty, tenacious substance, like melted cheese, and eventually liquefies to a thin, whey-like fluid of acid reaction, wherein flocculent and fragmentary particles, the remnants of tubercle imperfectly broken up, float as tubercle pus. In the larger tubercle masses there is often observable, during the said process, a cleft formation on a large scale; or, where the tubercle is spread out in a layer, a fissuring of this latter. With regard to the elementary character of the tubercle at this stage, we would observe: the softening consists in a liquefaction and breaking up of the solidified base of the tubercle to a fluid loaded with point-molecule. This transformation results in a separation or isolation of the form elements of the tubercle, which, at the same time, undergo within the fluid a more or less marked change. Thus, the cells become turgid, corroded, dissolved; the nuclei shrivelled and misshapen, irregular, angular, punched, &c. At length free fat becomes developed in the softened tubercle. Hence, *the liquefied tubercle* consists (a) of a fluid with point molecule; (b) of the isolated nuclei and cells changed in the manner just now specified; (c) of free fat in the shape of elementary granules and larger scattered globules.

"The other metamorphosis of this tubercle is *cretification*. It never affects the tubercle blastema in its primitive condition, but only in its liquefying or liquefied state. During the softening process, or after its completion, the tubercle takes up lime-salts and fats in the shape of free discrete or aggregated elementary molecule, or else in granule cells in the form of big drops of cholesterol crystals. In this act, the softened tubercle is progressively thickened into a moist, unctuous chalk-pap, and eventually converted into a concrete mortar."

Scrofula generally first shows itself during infancy, between the ages of three and seven; sometimes rather sooner; but frequently as late as puberty, and in some instances, not till a more advanced period of life. In the latter cases, the disease is said to be rarely so complete, or well marked, as it is in young subjects. Sir A. Cooper mentions the period of growth generally, as the time of life for scrofula; and its first commencement, afterwards, he agrees with most writers in pronouncing very uncommon. "Cette maladie (says Alibert) est communément le partage de la première enfance. Il est rare qu'elle se développe chez les adultes. Je l'ai pourtant observée chez des septuagénaires; mais presque toujours ce sont les effets de la dentition qui la font éclore, et ceux de la puberté qui la font évanouir." (*Nosol. Naturelle*, p. 448.) These statements do not apply to tubercular forms of scrofula.

By some authors, it is stated, that the disease seldom attacks the glands in children under two years of age. Dr. Thomson, however, has seen the glands affected before this period, and Dr. Cullen used to mention a case, in which the disease broke out in an infant only three months old; which is uncommon. But, though glandular scrofula oc-

curs most frequently in children, it is by no means confined to that period of life. Dr. Thomson has even found the mesenteric glands affected with scrofulous inflammation in persons of very advanced age. (*Lectures on Inflammation*, p. 136.) Probably, however, such patients had laboured under scrofulous complaints in their earlier days; and it merits notice, that some authors, like Dr. Henning (p. 110), do not regard enlargements of the mesenteric glands as an unequivocal specimen of scrofula. But, how they can retain this opinion, when they see tubercular matter in those parts, I cannot understand. It is observed by Mr. Lloyd, that the susceptibility of different parts to the disease "is altered by age: thus, in children, the upper lip, eyes, glands of the neck, and those of the mesentery, are generally the parts first affected; the lungs, bones, and other parts, being subsequently attacked. It happens sometimes too in children, that small lumps form under the skin in various parts of the body, which suppurate, ulcerate, and pursue the same course with scrofulous abscesses in general." (*On Scrofula*, p. 5.) A species of warts, he says, also often forms about the face and neck of children of a scrofulous habit, but seldom in adults. "In more advanced age, the eyes, upper lip, and lymphatic glands are comparatively seldom affected; while the lungs, the other viscera, and the spongy parts of the bones are frequently attacked."

Scrofula is also as hereditary as any disease can be; that is to say, it is so inasmuch as any particular kind of temperament or constitution can descend, more or less completely, from parents to children. Mr. White, Dr. Henning, and others have strongly censured calling the disease hereditary; but their observations only lead to these conclusions, that children, born of scrofulous parents, are not invariably affected with scrofulous diseases; and that, sometimes, one child has some strumous affection, while the parents, and all the rest of the family, have no appearance of scrofulous habits. However, I still conceive, that neither Mr. White, nor any other writer, will maintain the opinion, that scrofula does not much more frequently afflict the children of scrofulous parents, than the offspring of persons who have always been perfectly free from every tendency to any form of this affliction. Too numerous are the facts, which fall under my own notice, to allow me to entertain the smallest doubt, that scrofula prevails in certain families. In this sense, I think the term *hereditary* perfectly accurate and allowable. But, at the same time, I beg the reader to understand, that I have no intention of questioning what seem to be irrefragable truths, viz. that the children of scrofulous parents often continue, as long as they live, entirely free from the disease; and that one child is sometimes afflicted, while its father, mother, brothers, sisters, and all the rest of its relations, have never had any tendency to strumous disorders. It should also be recollected, that the doctrine of a congenital tendency to the disease in particular families is one which interferes with some theories, which have been offered about the predisposing cause of the disease, as for instance with that of Dr. Henning, who declares that such cause is foreign to the body, and depends upon peculiarity of climate (*On the Pathology of Scrofula*, p. 69, &c.); an opinion, which is incorrect only in respect to its exclusion of the influence of other circumstances.



Two specimens of tuberculated lungs in the fœtus, preserved in Mr. Langstaff's museum, have been adduced by Mr. Lloyd, as positive proofs of scrofula being hereditary. (*On Scrofula*, p. 23.) The facts and arguments on this point, I think, are decidedly in favour of the doctrine; and Dr. Alison, who has treated very ably of the pathology of scrofula, has remarked, that, "in most cases, in which scrofulous diseases are fatal, the diseased action is in internal parts, and the first symptoms are obscure and equivocal. The chief and certainly the most characteristic appearances on dissection are tubercles in different stages of their progress. (See *Edin. Med. Chir. Trans.* vol. i. p. 403.) The same writer everywhere treats of phthisis as decidedly a scrofulous disease.

In the individuals, possessing the disposition to scrofula, a peculiar softness and flaccidity of fibre are remarkable; their hair is more frequently light coloured than dark, and their eyes are oftener of a blue than any other colour. The eyelashes are frequently long and the pupils large. Their skin is generally very fine, and even handsome, both in regard to its outward texture and complexion. When pinched, it feels (as Sir A. Cooper observes) thinner than that of a healthy child, and the vessels may often be seen meandering under it. Subjects with scrofulous constitutions frequently have a thickening of the upper lip; this swelling is sometimes very considerable, and occasionally extends to within the nostrils. The extremities of the fingers are broad and flat, or *clubbed*, as the phrase is, just like what is seen in phthisical persons; and the belly is large. Scrofula is sometimes complicated with rachitis, or follows the latter affection; but there is as little reason for supposing rickets to arise from scrofula, as this latter from rickets. In some subjects, however, the complexion is dark, and the skin coarse; but in these persons, at least when young, the face is generally tumid, and the look unhealthy. (*Burns on Inflammation*, vol. ii. p. 232.)

Mr. White denies that grey, or blue eyes, light hair, and a fair complexion, ought to be considered as marks of a scrofulous disposition; for the majority of children in this country have light hair and eyes while young, which become darker as they advance in life. Now, as the majority of scrofulous patients are children, and young subjects, and as most children in this country have naturally the kind of hair and eyes above described, Mr. White considers it inaccurate to lay any stress on persons affected with struma, or predisposed to this disease, having such appearances. (*On Struma or Scrofula*, p. 38, ed. 3.) However, it is to be recollected, that the greater frequency of scrofula in fair people is noticed in France, where the eyes are mostly dark. Thus, Alibert, in his description of a patient disposed to the disease, takes notice of his swelled nostrils and upper lip; his florid complexion; his fair, delicate, and glossy skin; his cheeks of a lively red colour; circumscribed, however, by a pallid bloatedness of the rest of the face; his blue eyes; dilated pupils; light hair; short neck; large head and lower jaw; flabby flesh; large, protuberant belly; strong intellectual powers, &c. (*Nosol. Naturelle*, p. 442; also *Dict. des Sciences Méd.* t. i. p. 281.)

Dr. Thomson expressly declares, that some of the worst cases of scrofula, which he has seen,

occurred in persons, whose complexion and hair were of a very dark colour. (*Lectures*, p. 134.) And every man of experience must be aware of one remarkable fact, namely, that many negroes are afflicted in this country with scrofula in its worst forms. Does not this fact indicate, at the same time, that it is climate, which is most powerfully concerned in the production of the disease? Since the African black, in his own country, is nearly exempt from scrofula. After all, however, as the disease is undoubtedly very frequent in persons of fair skin, light eyes, &c., the term *alike*, at least in the sense of *equally*, may not be altogether correct in the following inference, viz. "that persons of every variety of complexion are *alike* subject to this disease, and that it is only necessary to place them in circumstances, favourable to its development, to have it fully formed." (*Lloyd on Scrofula*, p. 7.) The truth, I believe, is, that though children of dark hair and complexion are often attacked by scrofula, those of light hair and fair complexion are still more frequently afflicted, and this even in France, where the fact cannot possibly be referred to the number of fair children exceeding that of such as naturally have dark hair and complexion.

Females are commonly believed to be rather more subject, than males, to scrofulous disease. (See *Albert, Nosol. Naturelle*, p. 449.)

Struma prevails more extensively in temperate latitudes, than in very hot or very cold climates. It is also more frequent in some parts of Europe than others; and in this country, it has been alleged to be most prevalent in the counties of Suffolk and Lancashire. At all periods, it seems to have been a very common complaint in this island. From history, we learn, that it was denominated the king's evil in the time of Edward the Confessor, who is supposed to have been the first that attempted to cure it by the royal touch. From a register kept in the royal chapel, we find that Charles the Second touched 92,107 persons in a certain number of years; and this equally bigoted and useless practice was not discontinued till a recent period, when kings were found to be, as well as their poorest subjects, totally destitute of all supernatural power.

Scrofula is not communicable from one person to another; the opinion also, that scrofulous nurses may infect children, seems quite destitute of foundation. (See *White*, p. 26, &c.)

Pinel and Alibert purposely kept scrofulous and healthy children together in the same ward, without any of the latter receiving the complaint. Hébrard could not communicate the disease to dogs by inoculation. And G. T. Kortum, whose valuable work contains every thing known about scrofula at the period when it was written, tried in vain to impart the distemper to a child, by rubbing its neck every day with the pus discharged from scrofulous ulcers. Lepelletier, desirous of ascertaining the correctness of such experiments, repeated them: he made guinea-pigs swallow scrofulous matter; and he injected it into the veins, and applied it to wounds; but in no instance was there even a temporary appearance of the disease being communicated. The same author also mixed scrofulous with vaccine matter, and inoculated with it; yet, he never found the vaccine vesicle, thus produced, deviate in the least from its regular course. Lastly, Lepelletier inocu-

lated himself with pus, discharged from scrofulous sores, as well as with the serum, collected under the cuticle of a strumous patient after the application of a blister; but remained perfectly free from every scrofulous ailment. (See *Dict. des Sciences Méd.* t. 50, p. 294.) Our countryman, Mr. Goodlad, inoculated himself several times with the discharge from scrofulous sores and abscesses, and the result was, that the disease could not be thus transmitted. (*On Diseases of the Absorbent System*, p. 113.)

[Notwithstanding the apparent conclusive nature of these experiments, we cannot with our present knowledge accept the conclusion that scrofulous matter cannot be successfully inoculated. We are indebted to Dr. Villemin, on the contrary, for establishing, as regards rabbits and guinea-pigs, that scrofula can be transferred by inoculation. (*Gaz. Hebdom.*, Dec. 1865 and Nov. 1866.) Dr. Villemin's experiments have been repeated and verified by Herard and Cornil, by Dr. Genaudet and by Dr. Lebert. *Op. cit.* Jan., 1867.) Mr. Simon, also, in the Pathological Society's last number, adduces proofs of the same facts. Dr. Marcet, in a very interesting paper published in the *Trans. of the Med. Chir. Society*, for 1867, vol. 1., relates several cases in detail, in which he succeeded in inoculating guinea-pigs with the sputa of phthisical patients. The object of his paper was to show, not only that inoculation can be effected, but that it may be used with advantage as a means of diagnosis in doubtful cases of phthisis.]

The parts most frequently affected by scrofula, next to the lymphatic and mesenteric glands, and perhaps the skin, are the spongy heads of the bones, the joints, and the eyes. The three species of porrigo, named favosa, larvalis, and furfurans, together with eczema, impetiginodes and rubrum, in their chronic forms, have been frequently considered as strumous diseases. One variety of lupus, or noli mi tangere, is decidedly a scrofulous affection: I mean that which commences with small, red, button-like prominences, which usually remain indolent for some time, and then form eroding ulcers, with pale, shining, spongy granulations, and encrusted margins. Chronic enlargement of the tonsils is another scrofulous disease; and so is one example of the well-known ulceration of the pituitary membrane called *oxæna*. The form, which the disease assumes in the bones, and serous membranes, is particularly described in the article JOINTS. The disorder of the spine, attended with a paralytic affection of the lower extremities, is frequently of scrofulous origin. (See VERTEBRÆ.) Spina bifida is a congenital disease, most frequently seen in children whose parents are scrofulous. (*Thomson's Lectures*, p. 133.) The chronic abscess, originating in caries of the vertebræ, which descends to the inguinal region, guided by the psoas muscle, is generally regarded as a strumous disease; and when its contents are found to contain flakes of a curd-like matter, a substance peculiar to scrofulous abscesses, no one can doubt, that the complaint is connected with this constitutional affection. (See LUMBAR ABSCESS.) I may here take the opportunity of remarking, that scrofula always produces in the system a predisposition to the formation of chronic abscesses, a kind of *suppurative diathesis*, as it has been called by Andral; and this, not only in the absorbent glands, and in the cellular tissue of the loins,

but in this latter texture generally. The chronic enlargement of the thyroid gland is sometimes considered as scrofulous; but, though patients, with this affliction, very often have, at the same time, other complaints, which are unequivocally strumous, though the enlargement of the thyroid gland most frequently commences at an early period of life, like scrofulous diseases, and, though, like them, it is sometimes benefited by the carbonate of soda, burnt sponge, and iodine, the opinion of its being scrofulous, I think, is rather on the decline. (See BRONCHOCELE.) Scrofula also frequently makes its appearance in the form of imperfect suppurations, in various parts of the body; the contents of such abscesses being a curd-like matter, and the skin covering them having an unhealthy red appearance, and a thickened doughy feel. The mesenteric glands are often found universally diseased, and enlarged in scrofulous subjects; and, as all nutriment has to pass through these parts, before it can arrive in the circulation, we cannot be surprised at the many ill effects which must be produced on the system when such glands are thus diseased. Scrofula frequently makes its attack on the testicle. (See TESTICLE, DISEASES OF.) The female breast is also subject to scrofulous tumors and abscesses.

According to Sir A. Cooper, scrofulous persons frequently have follicles on different parts of the body, incrustated with inspissated matter. He agrees with most other writers in considering the absorbent glands and joints as the parts most frequently attacked, especially the glands of the neck and mesentery. Various other parts of the body he enumerates as liable to it—the lungs, the brain, the eyes; but the heart, he believes, is never affected. The secreting glands, he also says, are rarely the seat of scrofula, at least, the liver and kidneys; for the breast and testicle are exceptions. However, if we take into the account tubercles and tuberculous deposits, as proofs of scrofulous disease, scrofula is common in or upon most of the viscera; yet, as puberty approaches, the disposition to most of the forms of scrofula, except those of pulmonary tubercles in the lungs, or intestines, and of lumbar abscess, diminishes.

Dr. Thomson believes, that more or less local inflammation occurs in every form and stage of scrofulous diseases. He observes, that the swellings are very often from the first attended with a sensible increase of heat and redness; and that the pain, though seldom acute, is always present in a greater or less degree. Pressure on scrofulous swellings never fails to create pain; and the temperature of the skin covering them, is usually two or three degrees higher than that of the contiguous parts. (*Lectures*, &c. p. 131.)

Scrofulous inflammation is marked by a soft swelling of the affected part, which is frequently one of the lymphatic glands. The covering, or coat of the gland, becomes slightly thickened, and its substance more porous and doughy. The swelling increases, and the doughy feel changes by degrees into that of elasticity, or fluctuation, and a firm, circumscribed, hardened margin, can be felt round the base of the tumor. The skin is slightly red. If, at this time, an incision or puncture be made, either no matter, or very little, is evacuated; the lips of the wound inflame and open, displaying a sloughy-looking substance within; and, betwixt



this and the skin, a probe can often be introduced for some way all round. If, however, the disease should have advanced further, then there is very little elasticity in the tumor; it is quite soft, rather flaccid, and fluctuates freely; the skin becomes of a light-purple colour, and small veins may be seen ramifying on its surface. Some time after these appearances, the skin becomes thinner at one particular part, and here it is also generally rendered of a darker colour. It afterwards bursts and discharges a thin fluid, like whey, mixed with a curdy matter, or thick white flocculi. The redness of the skin still continues; but the aperture enlarges as the tumor subsides, and thus a scrofulous ulcer is produced. The margins of this kind of sore are generally smooth, obtuse, and overlap the ulcer; they are of a purple colour, and rather hard and tumid. The surface of the sore is of a light-red colour; the granulations are flabby and indistinct; and the aspect is of a peculiar kind, which, as Mr. Burns states, cannot be described. The discharge is thin, slightly ropy, and copious, with curdy flakes. The pain is inconsiderable. When this ulcer has continued for some time, it either begins slowly to cicatrise, or, as more frequently happens, the discharge diminishes and becomes thicker. An elevated scab is next formed, of a dirty white or yellowish colour. This continues on the part a good while; and, when it falls off, leaves the place covered with a small purple cicatrix. Mr. Burns adds, that the preceding description corresponds to the mild scrofula, or the *struma mansueta* of the old writers. Sometimes, especially if a bone be diseased below the ulcer, the sore has a more fiery appearance; the surface is dark-coloured, the margins soft, elevated, and inflamed, and sometimes retorted. The discharge is watery, the pain very considerable, and the surrounding skin inflamed. This has been called the *struma maligna*. Such overacting scrofulous sores are most frequently met with over the smaller joints, particularly those of the toes. Sometimes a scrofulous abscess, after it has burst, forms a sinus; the mouth of which ulcerates, and assumes the specific scrofulous appearance, while the track of the sinus still continues to emit a discharge. Scrofulous swellings are often disposed to subside in winter, and recur on the approach of summer; but this is not an invariable law. Glandular enlargements are very apt to become smaller, in a short time, in one place, while other glandular swellings originate with equal suddenness, somewhere in the vicinity of the former ones. Ulcers, also, very often heal, upon the appearance of the disease in other parts. (*Burns on Inflammation*, vol. ii. 1800.)

Professor Carswell notices the opinion sometimes entertained, that scrofulous swellings are only simple chronic inflammatory enlargements of the lymphatic glands. This view, he conceives, is incorrect, "for (says he), among the great number of cases, which I have examined, I have never found these glands, when generally affected, exempt from the presence of tuberculous matter; and even when the cutis is pale (if they are situated under this tissue), I have sometimes found them almost completely filled with this morbid product. When therefore enlarged glands in a scrofulous patient ultimately disappear, we may conclude, almost with certainty, that we have witnessed the cure of a tubercular disease." (See *Illustrations of the Elementary Forms of Disease*, fasc. 1.)

According to Dr. Carswell, tabes mesenteric has been known to terminate favourably. In one case of this kind, he had an opportunity of examining the mesenteric glands, and thereby of determining the certainty of the cure. The patient (who, when a child, had been affected with this disease, and also with swellings of the cervical glands, some of which ulcerated) died at the age of 21, of metritis, the seventh day after delivery. Several of the mesenteric glands contained a dry, cheesy matter, mixed with a chalky-looking substance; others were composed of a firm cretaceous substance; and a tumor, as large as a hen's egg, included within the folds of the peritoneum, and which appeared to be the remains of a large agglomerated mass of glands, was filled with a substance resembling a mixture of putty and dried mortar, with a small quantity of turbid serosity. In the neck, and immediately beneath an old cicatrix, there were two glands, which contained in several points of their substance, which was healthy, small masses of hard cretaceous matter. Dr. Carswell has also been able to trace the same steps of the curative process in the bronchial glands. (*Op. cit.* fasc. 1.)

The glandular swellings which occur in syphilis, are of a more acute character than those which proceed from scrofula; and they arise from the absorption of a specific poison. Chronic swellings of the absorbent glands occur also in carcinoma; but these manifest little or no disposition to suppuration: they succeed most frequently to carcinomatous indurations, or ulcers existing in the neighbourhood of the glands affected; and they are accompanied in their progress and growth by a peculiar lancinating pain. (See *Thomson on Inflammation*, p. 135.)

With regard to the proximate cause of scrofula, medical men may be said to remain, even at the present day, in entire ignorance of it. After the ridiculous theory, referring scrofula to certain humours in the constitution, or chemical changes in the blood, had been exploded, the opinion gradually arose, that it was a disease of the lymphatic system; and, indeed, that the absorbent glands are often visibly the seat of its attack, when no changes are distinguishable in other textures, is a fact that admits of no dispute. I believe, at the same time, that whoever supposes scrofula to be exclusively confined to the lymphatic system, must have a very imperfect conception of what is really the case. On the contrary, I fully participate in the sentiments of Professor Thomson, already adduced upon this point, and in the belief of another modern writer, that strumous complaints "are not to be considered as dependent on disease of any particular system, as the lymphatic." (*Lloyd*, p. 10.) Such writers as have fixed upon the absorbent vessels, as the particular seat of scrofula, can throw no useful light upon its origin, by following up the theory, whether they imagine the cause to be obstruction of the vessels and glands, or take up the wild speculation of Cabani, that, in scrofula, the mouths of the lymphatics are in a state of increased activity, while the vessels themselves are in a state of atony; or the doctrine of Soemmerring, that scrofula depends upon a passive relaxation and dilatation of the absorbents; or the hypothesis of Girtanner, that these vessels are in a state of increased irritability. The idea of obstruction being the cause has, of late years, been

much on the decline; and that the convolutions of lymphatic vessels, forming the glands, are quite pervious, and may readily be injected, even when diseased, a fact, first demonstrated by Soemmering, is one that must weigh heavily against this opinion. Sir A. Cooper describes the disease as proceeding from congenital debility, which attends its whole course, and imparts to it a peculiar character, rendering the various processes of inflammation in it slow and imperfect. With respect to the exciting causes, Mr. John Hunter remarks that, "in this country, the tendency to scrofula arises from the climate, which is in many a predisposing cause, and only requires some derangement to become an immediate cause, and produce the whole disease. (*On the Venereal Disease*, p. 26.) The disease is remarked to be most common in females; in cold, damp, marshy countries, and in all places near high mountains, where the temperature is subject to great vicissitudes. "Nous voyons presque toujours (says Alibert) que les tumeurs et les ulcères se rouvrent au printemps pour se fermer ensuite vers la canicule." (*Nosol. Naturelle*, p. 449.)

Mr. Hunter notices slight fevers, colds, small-pox, and measles, as exciting scrofulous diseases. He observes, that in particular countries, and in young people, there will sometimes be a predisposition to scrofula; and that, in such subjects, buboes will more readily become scrofulous. (P. 37.) In short, it was one of Mr. Hunter's opinions, that the venereal disease is capable of calling into action such susceptibilities as are remarkably strong, and peculiar to certain constitutions and countries; and that, as scrofula is predominant in this country, some effects of other diseases may partake of a scrofulous nature. (P. 96.) Mr. Hunter, in speaking of venereal buboes, mentions his having long suspected a mixed case, and adds, "I am now certain that such exists. I have seen cases where the venereal matter, like a cold, or fever, has only irritated the glands to disease, producing in them scrofula, to which they were predisposed. In such cases the swellings commonly arise slowly, give but little pain, and seem to be rather hastened in their progress, if mercury is given to destroy the venereal disposition. Some come to suppuration while under this resolving course; and others, which probably had a venereal taint at first, become so indolent that mercury has no effect upon them; and, in the end, they get well of themselves, or by other means." (P. 269.) For such buboes, Mr. Hunter used to recommend sea-bathing; and, in case of suppuration, poultices made of sea-water.

Sir A. Cooper observes, that the predisposing cause of scrofula is congenital, or original fault of constitution. The exciting causes, he says, are whatever tends to produce or increase debility, such as fever from diseases of a specific kind, like measles, scarlet fever, and small-pox. He notices the greater frequency on this account of scrofulous cases some years ago, when the advantages of vaccination were not known; and the importance of this practice to society, if it had no other recommendation.

In the words of a well-informed Professor, scrofula readily forms an alliance with almost every morbid affection, occurring either from external injury or from internal disease: it modifies the appearance of other diseases, and seems to convert them gradually into its own nature. Indeed, there

are few of the local inflammatory affections which occur in this country, in which the symptoms and effects of these affections, and the operation of the food and remedies employed for their cure, are not more or less modified by the degree of scrofulous diathesis, which prevails in the constitution of those who are affected by them. The scrofulous diathesis, wherever it exists, usually gives more or less of a chronic character to local inflammatory affections. (*Thomson's Lectures*, p. 131.)

Sentiments, corresponding to some of those already quoted, are delivered by Dr. Alison: "The facts," says he, "which seem most decisive, as to the connection of the scrofulous habit with general debilitating causes, may be recapitulated as follows:—1. The differences in the symptoms and progress of inflammation, when scrofulous, and when healthy, appear manifestly to indicate in the former case a languid state of the circulation, particularly in the capillary vessels of the diseased part. 2. The hereditary disposition to scrofula is chiefly transmitted from parents, and is mostly observed in children, who show evident marks of constitutional debility in other respects. 3. There is no state of the body, as every practitioner knows, in which scrofulous action is so easily excited, as the state of great and often permanent debility which remains after severe febrile disease, continued fever, small-pox, measles, scarlatina, or which follows the long-continued use of mercury, or accompanies amenorrhœa. 4. The season, at which scrofulous diseases have been observed to prevail most in this climate, is not that when cold weather has recently set in, and is most productive of disease in general, but the end of the winter and the spring; and they are then chiefly observed in those young persons, who have manifestly lost strength during the continuance of the cold weather." (*Alison, in Edin. Med. Chir. Trans.* vol. i. p. 381.)

It has been the fashion of late years to ascribe the origin of a vast number of diseases to disorder of the digestive organs, little trouble being generally taken to consider, with any impartiality, whether the derangement of those organs may not be rather the common effect, than the common cause, of so many various diseases. Numerous circumstances tend to perpetuate the delusion, into which young practitioners are falling upon this topic. They see various diseases, attended with dyspepsia, flatulence, loss of appetite, costiveness, and a torpid state of the bowels; they observe that such diseases and the latter complaints of the alimentary canal generally diminish together; that, when the functions of the stomach and bowels are deranged, any other diseases, which the patient may be labouring under, either grow worse, or are retarded in their amendment; and, lastly, the treatment, to which the theory leads, improves the health, by rectifying the state of the alimentary canal, and the sore, tumor, or other complaint, in the end, with the additional aid of time, nature, and other favourable circumstances, gets well. But, however simple, safe, and beneficial the practice may be, and plain as the facts are, which lead to it, there is no proof that the other disease was truly a consequence of the disorder of the digestive organs. The latter symptom, I believe, is very frequently an effect mistaken for a cause, and perhaps, always so, in relation to scrofula. Besides, if it were to be assumed (as



indeed it actually is), that, in scrofula, "there *always* is more or less disorder of the digestive organs, and *primarily of no other important function*," I do not see that we advance one step nearer the truth; because, as the same cause is generally assigned, by gentlemen attached to this theory, for a vast number of other cases, we still remain in the dark, as to the circumstances, which make so many complaints of different kinds spring from one and the same cause. These circumstances, though buried in silence, are still the mystery—still the secret, which is desired; and, if it be answered, that the effect will only happen in particular constitutions, when we are brought back at once to the point, from which we first started, viz. that scrofula is a disease depending upon some unknown peculiarity of constitution, congenital or acquired, and capable of being excited into action by various causes, as climate, mode of living, &c. However, lest I may not have attached sufficient importance to the doctrine of gastric disorder being the cause of scrofula, I feel pleasure in referring for the arguments in its support, to the writings of Mr. Abernethy, Dr. Carmichael, and Mr. Lloyd, whose sentiments appear highly commendable, so far as they tend to teach surgeons, rather to place confidence in means calculated to improve the health in general, as the most likely mode of benefiting scrofulous patients, than to encourage foolish dreams about new specifics for the distemper. Thus far, I can follow these gentlemen safely; but no farther. However, perhaps, none of the believers in the effect of disorder of the digestive organs mean to say, that such disorder is any thing more than one of the many exciting causes of scrofula; and, with this qualification, their theory may, or may not be correct. It is the doctrine of Alibert; and indeed of nearly all writers: "ce sont les vices de la puissance digestive, qui préparent de loin les scrofules. Rien n'influe davantage sur leur développement que la mauvaise qualité des alimens," &c. (*Nosol. Naturelle*, p. 449.)—"Ajoutez à cette cause le séjour dans les habitations malsaines." But, every explanation, even of exciting causes, remains unsatisfactory, so long as we find children living in the same air, under the same roof, and feeding and sleeping together, and clothed also exactly alike, yet only one or two of them become scrofulous, while all the rest continue perfectly free of the disease. Here, then, we are again compelled to return to predisposition, constitution, diathesis, and a congenital tendency to the complaint, as a solution of the difficulty. In short, then, respecting the etiology of scrofula, little is known, except that certain constitutions probably have a congenital disposition to the disease; that such disposition may be increased, or diminished, by the operation of climate, mode of life, age, &c.; and that irritations of a thousand kinds may excite the disease into action, when the system is predisposed to it, by inexplicable causes. That climate has great influence cannot be doubted, when it is reflected, that the inhabitants of certain countries, in which the temperature is invariably warm, never suffer from scrofula. It is noticed by Sir A. Cooper, that the occurrence of scrofula is much promoted by climates, in which the change from cold to heat, and from heat to moisture, is particularly frequent, as is the case in this island. But though cold and moist climates have this effect, he re-

marks, that persons living in the extremes of heat, or cold, are not affected. The disease, he says, is even arrested by cold and heat, uncombined with a damp atmosphere. On the other hand, numerous children who come from the East or West Indies to this country, fall a prey to scrofula. He has also known some individuals from the South-Sea Islands die here of the same disease. The fact of the great influence of the climate on scrofula is equally proved by the effect of the weather and seasons, for, it is a common and a true remark, that in a mild dry atmosphere, and in summer-time, the health of scrofulous persons generally improves, and, whatever local complaints they may have, get better, while on the contrary their disorder in winter is more difficult of relief, and either continues stationary, or becomes worse again. Hence, as Sir A. Cooper has justly remarked, the exact value of any proposed remedy for scrofula cannot be estimated, without reference to the time of year when it is tried. There can also be no doubt, that, with age, the disposition to scrofula diminishes; for, children, much afflicted while young, frequently get quite well when they approach the adult state; and, if a person remain perfectly free from every mark of a scrofulous constitution, till the age of twenty-five, he may be considered as nearly out of all danger of the disease.

According to the calculations of Dr. Alison, scrofulous diseases are much more frequent in the inhabitants of great towns, than in the agricultural population of any climate. This seems to him an unquestionable fact, and one that confirms the truth of the connection of scrofula with debilitating causes. (*See Edinb. Med. Chir. Trans.* vol. i. p. 383.)

It seems to M. Lepelletier, that the privation of solar light creates a tendency to scrofula; but, though it occasions a pale complexion, a flaccidity of fibre, and a bloated look, these states may not exactly constitute the conditions implied by the term scrofula. Independently of the redundancy of white tissues and colourless fluids, conjectured by Stokes, Jolly, and others, to form one of the chief characters of a scrofulous constitution, and at the same time one of the chief anatomical circumstances of scrofula, there is no doubt, that the composition of the fluids of scrofulous individuals is more or less a deviation from what it ought to be; and especially that some of them contain an extraordinary proportion of the phosphate and carbonate of lime, and chloruret of soda; and that these same principles frequently enter copiously into the matter of scrofulous tubercles. M. Labillardiere ascertained that the milk of a cow, affected with tubercles, contains seven times as much phosphate of lime as the milk of a healthy cow.

#### TREATMENT OF SCROFULA.

As the nature and treatment of particular forms of scrofulous disease are described in other articles of this work, I shall here limit my observations to the general treatment of the disorder.

From the remarks delivered in the foregoing columns, it is evident, that many children are born with a constitution and organisation predisposing to the attack of scrofula; nay, that some pass into the world with tubercles, or the germs of them already formed; but all children are liable to become scrofulous under the influence of various conditions

detrimental to the general health. The following is Dr. Cumin's advice respecting the mode of rearing a child, in which circumstances justify the opinion of a tendency to the disease:—"When the child of a scrofulous father is born, the infant, unless the mother is free from all traces of the disease, ought to be consigned to a wet-nurse, of sound and robust constitution, having an abundant supply of milk. This alone ought, for some months, to be sufficient for the nourishment of the child; but, after a time, should it appear delicate, a little isinglass jelly may be allowed in addition, or liquid yolk of egg, or beef-tea, together with some preparation of wheaten meal, or flour, or pure starch. Daily immersion in cold water, and gentle friction of the whole body, will be found of great utility. The child ought to be warmly clothed; to be carried about in the open air as much as possible; and the apartment in which it sleeps ought to be kept at a steady moderate temperature, and perfectly well ventilated. All rooms, occupied as nurseries for children, ought to be spacious and lofty, never situated in a sunk floor, nor in an attic, and, if possible, considerably above the level of the ground." (*Cumin, in Cyclop. of Pract. Med.*, art. *Scrofula*.)

To all individuals, in whom a scrofulous diathesis is manifest, or even probable, and whose circumstances enable them to remove to a mild climate, and to localities judiciously selected, such change affords one of the best chances of preventing or checking the disease. (See *Sir James Clark on the Influence of Climate*.) The facts of scrofula being so prevalent in cold damp countries, noted for extremely variable temperature, like this kingdom, and of its comparative rarity in, or total absence from, some other parts of the world, prove sufficiently, that climate is of all the exciting causes of scrofula the most powerful one. Climate and local circumstances also determine very much what form of scrofula predominates in any particular country where the disease exists; for, in some places, we find the tubercular varieties of it are particularly common, though the disease in its other shapes is infinitely less frequent.

"For the cure of scrofula (says Cullen), we have not yet learned any practice that is certainly, or even generally, successful." With respect to mineral waters, he was not satisfied that they shortened the duration of the disease, whether they were chalybeate, sulphureous, or saline. Neither did he think more favourably of sea-water. (*First Lines of Physic*, vol. iv.) On the subject of mineral waters, Dr. Thomson remarks, that they are now usually employed as purgative and tonic remedies, and not as specifics. In employing them, it is often difficult to distinguish between the effects which they in reality produce, and those which are to be attributed to the slow operation of time, the season of the year, change of situation, alteration in the mode of life, or exercise in the open air. (*Lectures on Inflammation, &c.* p. 195.)

In scrofulous diseases, Dr. Fordyce had a high opinion of bark; and he endeavoured to prove, that, in cases of tumefied glands, attended with a feeble habit, and a weak circulation, it is a most efficacious medicine, and acts as a resolvent and discutient. He also brings forward a case, in support of bark being a means of cure for ophthalmia strumosa. (See *Med. Obs. and Inq.* vol. i. p. 184.) Dr. Fothergill, in the same work (p. 303), writes

in favour of the good effects of bark in similar cases; small doses of calomel being sometimes given with it. On the other hand, Cullen pronounces the efficacy of bark in scrofula to be dubious and trivial. (*First Lines, &c.* vol. iv.)

According to Mr. Burns, bark has been frequently found useful in the cure of scrofulous inflammation, but more often of ulceration than tumefaction of the glands. But, it does not appear to him to possess, by any means, that certain power of curing scrofulous affections, which is attributed to it by Dr. Fothergill and several other authors. He observes, that we are not to suppose it will infallibly cure scrofulous inflammation, or ulceration of parts, which, even when affected with simple inflammation, are very difficult of cure. If it be difficult to cure a simple inflammation, or ulceration, of a tendon, cartilage, or bone, we must not be disappointed if even a specific remedy for scrofula (were such ever discovered) should prove ineffectual in procuring a speedy restoration to health. Mr. Burns contends, that bark is often ineffectual, because improperly administered. Given in small quantities, once or twice a day, it may prove a stomachic, and increase, like other tonic bitters, the power of the stomach, or the functions dependent on it; but, in order to obtain the benefits of the specific action of bark, he maintains, that it should be given in large quantities, for several weeks, with a good diet, air, and proper exercise. (*On Inflammation*, vol. ii. p. 371.) Dr. Thomson does not believe that bark, or iron, has any specific virtue in curing scrofula; but, he admits that either of these medicines may sometimes prove useful in amending the tone of the digestive organs, when given after, or occasionally along with, a course of purgative mineral waters. (*Lectures*, p. 197.) When bark is prescribed, the sulphate of quinine is one of the best formulæ, as least likely to disagree with the stomach.

So far as I can judge, Mr. White has with much reason recommended paying attention to such circumstances as may have effect in preventing the disease, viz., pure air, cleanliness, exercise, and diet. He mentions cold bathing among the preventives of struma, and speaks of sea-bathing as being the best. He advises attention also to be paid to the manner of clothing children, keeping them more covered in winter than summer. He thought a great deal of sleep prejudicial; but this seems only conjecture.

In noticing the treatment of the disease, Mr. White states, that "The general idea of struma is, that it is a disease of debility (a doctrine also inculcated by Sir A. Cooper) and therefore the great object is, to invigorate the habit by every possible means; the chief of which are tonic medicines, and sea-bathing. Some are of opinion that, in the case of young patients, this should be continued, during the summer months, every year, to the age of fourteen or sixteen. Many recommend it, not only in the summer, but throughout the year; whilst others are for administering alteratives, principally the alkaline salts, with or without antimonials, and the different tonics, during the winter; and the sea-water, and sea-bathing, or cold-bathing, during the summer, for a continuance of two or three years from the commencement of the disease; with this general observation, that they will outgrow the complaint." Mr. White mentions, as the chief external means,



fomentations and poultices of sea-water. With respect to regimen, some recommend a milk and vegetable diet; others animal food and fermented liquors. Sir A. Cooper, in particular, who regards the disease as connected with congenital debility, strongly recommends a nutritious diet of animal food, in preference to one of vegetables.

Mr. White maintains, that the preceding plans of treatment are not, in general, efficacious, though, in some instances, they may prove useful. "In early affections of the lymphatic glands, and from the want of a pure air, and proper exercise, where children are delicate and irritable, a change of situation to the sea-side, together with bathing, when they have acquired some strength, must be exceedingly proper; and, in gross plethoric subjects, who have diseased lymphatics, from improper feeding, and want of necessary exercise, a journey to the sea-coast may be very useful, particularly if the salt-water is drank often, and in a sufficient quantity to become purgative. This, with the novelty of their situation, which may naturally produce an increase of exercise, might answer every expectation; but these are the kind of cases that, with a very little attention, are easily cured." (*White on the Struma*, ed. 3, p. 104.)

The conclusion, to which Mr. White's remarks upon this part of the subject tend, is, that sea-bathing only deserves praise as a preventive, and in the early stages of the disease. He particularly condemns cold-bathing, for poor, weakly, debilitated children, whose thin visages, enlarged bellies, and frequent tickling cough, sufficiently indicate diseased viscera: such do not recover their natural warmth, after cold-bathing, for hours; and their subsequent head-ache, livid lips, and pale countenance, are sufficient marks of its impropriety. (P. 107.)

Dr. Cullen entertained a very favourable opinion of cold-bathing, since he affirms, that he had seen scrofulous diseases more benefited by it than any other remedy. (*First Lines of Physic*, vol. iv.)

"Cold-bathing, especially cold sea-bathing (says Mr. Russell), is a remedy universally employed in scrofula, and I believe with great advantage in many cases; for it not only appears to improve the patient's general health and strength, but likewise to promote the detumescence of enlarged glands, and the resolution of indolent swellings in the joints, even after they have attained a considerable size, and have existed for a great length of time. But, in order that cold-bathing may be practised with safety and advantage, the constitution must have vigour to sustain the shock of immersion without inconvenience. If the immersion be succeeded by a general glow over the surface of the body, and the patient feels cheerful, and has a keen appetite, we may conclude that the cold-bath agrees with him; but if he shivers on coming out of the water, continues chill, and becomes drowsy, we may be assured that the practice of cold-bathing does no good, and had better be omitted.

"In estimating the comparative merit of cold-bathing and warm-bathing, in the cure of scrofulous complaints, my own experience, together with the result of different conversations on the subject with some of the most judicious practitioners of my acquaintance, would lead me to bestow much more commendation on the effects

of warm-bathing. I should not even be inclined to circumscribe the practice to cases of emaciation and debility, since, from observation, I am fully satisfied with regard to the beneficial effects of the warm-bath to patients of plethoric constitutions, who were much affected with swelled scrofulous glands. Several of those instances occurred in young women, about the prime of life, who were in all respects healthy and vigorous, abating the swellings of the glands, and those symptoms of distress which were connected with fullness of blood.

"The sensation of the warm-bath is exceedingly grateful to most patients, and the practice is universally safe. It may be employed at all seasons of the year, and in all weather, without danger or inconvenience; the risk of suffering from exposure to cold, immediately after immersion in the warm-bath, having been much magnified by prejudice. There is not even any good reason to believe in the existence of such a risk. The precautions, however, which are employed to avert it, are perfectly innocent; and provided they do not impose any unnecessary and incommoding restraints upon the practice, may be encouraged, so far as to relieve the patient's mind from uneasiness and groundless apprehensions.

"It requires many weeks, and sometimes several months, to ascertain the full effects of warm-bathing in relieving scrofulous complaints; but, as the practice is not attended with any inconvenience, nor followed by any bad consequence, there can be no reason to intermit the course, till the trial is completely satisfactory; and I am convinced, that the practice of warm-bathing, in cases of scrofula, will be more universally adopted, after the knowledge of its beneficial effects is more widely diffused." (See *Russell on Scrofula*.)

Nothing can be more satisfactory (says Professor Thomson) than the evidence, which is on record, of the efficacy of the muriate of soda, as it exists in sea-water. In reading this, one only wonders how so efficacious a remedy should ever have fallen into neglect. (P. 196.) In a subsequent passage, however, the same gentleman evinces only a limited confidence in this means of relief. "Local sea-bathing, both cold and warm, has often appeared to be of use in procuring the resolution of scrofulous swellings. The temperature of the bath must always be varied according to circumstances, according to the season of the year, the strength and habits of the patient, and the particular effect which the bath seems to produce. It is at all times difficult to distinguish between the effects immediately arising from the application of salt-water to the body, and those which arise from the increased warmth of temperature in the bathing seasons of the year; from the exercise which patients going to sea-bathing generally take in the open air; from the change of situation and amusements; and, among the poorer classes, from the more nourishing diet and exemption from labour, in which they are usually permitted to indulge, during their residing at sea-bathing quarters. It is not improbable that those living on the sea-coast, who become affected with scrofula, would, for similar reasons, derive equal benefit by going from the sea-coast to reside for a time in the interior of the country." (See *Thomson's Lectures*, &c. pp. 203, 204.) A still later writer declares his belief, that cold sea-bathing has no specific power over the disease. (*Lloyd on*

*Scrofula*, p. 43.) Yet the plain surgeon, in search of practical truths, will not care whether any plan has a *specific power* or not over a complaint, if that disorder is sometimes relieved by it. And, that this is the fact, is admitted by Mr. Lloyd, when he says, "cold sea-bathing, however, is certainly useful when judiciously applied," &c. &c. (P. 44.)

Mr. White, after enjoining attention to air, exercise, and diet, as promotive of a recovery, as well as a preventive of the disease, proceeds to explain his own practice. The first external symptoms, such as swellings of the lips, sides of the face, and of glands under the chin, and round the neck; also other symptoms, usually considered as strumous, viz. roughness of the skin, eruptions on the back of the hand, and different parts of the body, redness, and swelling of the eyelids and eyes; are accompanied, according to Mr. White's conceptions, with an inflammatory diathesis, though seldom such as to require bleeding. Calomel is the medicine which this gentleman recommends for the removal of the foregoing complaints. It is not to be given in such quantities, as to render it a powerful evacuant, either by the intestines, or any other way; but, in small doses, at bedtime. For chronic swellings of the breast, suspected to be scrofulous, I would here particularly recommend a trial of iodine, which should be used both externally and internally. (See IODINE and MAMMA.)

When the glands of the neck, or other parts of the body, tend to a state of suppuration, it is very slowly, the skin appearing uniformly thin, and of a deep red colour, and the tumor seeming flaccid. In such cases, Mr. White recommends the use of the lancet or caustic; for if no artificial opening is made, it will be a long time before the skin gives way; and, when it does, the aperture will not only be very small but often unfavourable in its situation. Mr. White adds, that the contents will often be more like mucus, than pus, or like a mixture of both; and the discharge will continue for a great length of time, if no remedy is applied. He found a solution of gum myrrhæ in aqua calcis, used as a lotion, and the ceratum saponis, or some similar outward application, the best method of treating this symptom.

We need not describe Mr. White's practice in the treatment of scrofulous joints, as the subject is fully considered in the article JOINTS. It appears, however, that he confirms the efficacy of stimulating applications, and pressure with bandages, when the fingers and toes are affected with strumous diseases. (P. 143.)

Whoever compares the practice of Mr. White in administering calomel, occasional purgatives, the deductum Lusitanicum, sarsaparilla, &c., with the blue pill, sarsaparilla, and laxative treatment of the present day, will perceive no very material difference between them, especially when the stress which Mr. White laid upon attention to diet, clothing, &c. is taken into the account. Mr. Lloyd, who has detailed Mr. Abernethy's practice in scrofula, lays it down as an axiom, that "the disease is only to be cured by avoiding all sources of irritation, and restoring the natural and healthy functions of the digestive organs." (P. 48.) By sources of irritation, Mr. Lloyd means exciting causes; the advice is therefore excellent, so far as it can be followed, or such causes are decidedly

known. The restoration of the functions of the digestive organs is also a thing worth aiming at; and the only difference in my views from those of Mr. Lloyd is, that, as I look upon the disorder of the digestive organs to be in general only a complication, or effect of the scrofulous disease, ulcer, abscess, diseased joint, &c., and not the exciting cause, the treatment, when beneficial, becomes so only on the principle of improving the general health, by the removal or diminution of one of the most hurtful consequences of the original disease. The treatment, described by Mr. Lloyd, in addition to the usual advice about diet, clothing, the avoidance of damp and cold, and the utility of good air, exercise, &c. consists in giving the patient five grains of the pil. hydrarg. every night, and half a pint of decoct. sarsap. c. twice a day. And if, at a certain hour of the day, there has been no motion, recourse is had to opening medicines. This plan is pursued till the bowels become regular; and then, with the view of preventing a relapse of the bowels into their former state, Mr. Lloyd continues the exhibition of alterative doses of mercury for an indefinite time, the preference being given to the compound calomel pill, in doses of five grains every night. In children, the practice is exactly like that of Mr. White, viz. small doses of calomel with purgatives. When acidity prevails in the stomach, small doses of soda are recommended; and when the stomach is weak, with loss of appetite, cinchona, steel, and mineral acids. A full diet, with porter and wine, is disapproved of, and, as already stated, not much confidence is placed in sea-bathing. (*Lloyd on Scrofula*, p. 38.)

Crawford, Pinel, and others tried the muriate of barytes in scrofulous cases (*Med. Communications*, vol. ii.; *Nosogr. Philosophique*, vol. ii. p. 238); and it had the recommendation of the celebrated Hufeland. Mr. Burns says, that the muriate of barytes has no effect on diseased glands; but, that it is occasionally serviceable in scrofulous ulceration, though, he adds, that it deserves little dependence. (*Diss. on Inflam.* vol. ii. p. 372.)

Several narcotics have been tried, such as opium, hyoscyamus, the solanum dulcamara, &c.; but, though their virtues against scrofula have been sometimes cried up very highly, the moderns have lost all faith in them. The attention of the public to the effects of cicuta, in cancer and scrofula, was first particularly excited by the accounts of its virtues published by Baron Stork.

Fothergill also praises cicuta, and perhaps, next to iodine, and soda, joined with rhubarb and columba, it is as good an internal medicine as can be tried; but it is far from being generally efficacious. It is highly deserving of recommendation for irritable scrofulous ulcers. There is now not the least doubt, that the statements of Baron Stork were greatly exaggerated. He considered cicuta indicated, whenever obstructions and tumors existed; and, under this treatment, he says that he found the swellings melt away like ice. What is extraordinary, every sort of tumor yielded to cicuta. But (as Dr. Thomson judiciously remarks), universal success is always one of the most suspicious circumstances which can be mentioned in the history of the effects produced by any new remedy. (*Lectures*, &c. p. 199.) Dr. Cullen frequently employed hemlock, and sometimes found it useful



in discussing obstinate swellings; but, he says, it also frequently disappointed him, and he never saw it dispose scrofulous ulcers to heal.

With regard to mercury, we have already noticed, that calomel was much employed by Mr. White. Some have exhibited the bichloride, some the chloride, others the acetate of mercury. All these preparations have been at times conjoined with cicuta, antimony, &c. Calomel or the chloride is, perhaps, the best mercurial preparation in scrofulous cases; but mercury, given internally with any view of exciting salivation, is justly deemed hurtful. As an alterative, and an occasional purgative, it is undoubtedly a good medicine for strumous patients. Mercury was disapproved of by Cullen, as a medicine for scrofula. As a distinguished Professor observes: "From the great apparent similarity of the symptoms, progress, and seats of scrofula, to those of syphilis, and from the well-known effects of mercury in curing syphilis, it need not seem strange, that medical men should have been a little obstinate in their attempts to obtain benefit from the use of mercury in scrofula. These expectations are in general abandoned, and mercury is now given for the cure of scrofula as a purgative only. A long-continued, or improperly administered course of this medicine, has often been known to aggravate all the symptoms of scrofula; and, in many instances, to excite these symptoms in persons in whom they did not previously exist." (See *Thomson on Inflammation*, pp. 194, 195.)

Mr. Burns thinks the nitrous acid has some effect in promoting the suppuration of scrofulous glands and tumors, and disposing ulcers to heal. He says, two or three drams may be given every day, for a fortnight; but if, in this time, it should do no good, its employment ought to be discontinued. The mineral acids, diluted with water (says Professor Thomson), are often used with views similar to those which guide us in the employment of tonic remedies. Their medicinal powers appear to be nearly the same; but the nitric acid has of late been preferred, particularly in the scrofulous affections, which are sometimes induced by the action of mercury. (*Lectures*, &c. p. 197.)

The carbonate of soda and potassa are useful in the treatment of scrofula, but not to be regarded as specifics. They may be given with rhubarb, and, if the alvine discharges be of bad colour, with a few grains of hydrargyrum cum cretâ.

A spirituous infusion of gentian, into six ounces of which are put thirty six grains of the carbonate of soda, or the same quantity of the carbonate of ammonia, is a medicine highly spoken of by Richerand for scrofulous cases. (*Nosogr. Chir.* t. i. p. 184, ed. 4.)

Potassa, in large doses, with mercurial frictions, is the practice extolled by Mr. Farr. (See *Farr on Scrofula*, 8vo. Lond. 1820.)

According to Mr. Burns, eight or ten drops of hydrosulphuret of ammonia, given thrice a day, are useful, in irritable strumous ulcers. The breathing of oxygen gas has been proposed; but, of this plan I know nothing from experience; and as it now makes less noise in the world than formerly, I conclude that either its usefulness has been exaggerated, or the difficulty of the practice is too great to permit its extensive adoption.

The sentiments of Dr. Cullen are decidedly against antimony. As a modern writer observes,

no great dependence seems ever to have been placed in the use of diaphoretic medicines for the cure of scrofula. The different preparations of antimony, indeed, have been occasionally administered; but, chiefly in cutaneous affections, supposed to be of a scrofulous nature. Guaiacum, sarsaparilla, sassafras, and mezereon, singly, and in combination, have all been supposed to be useful in the cure of scrofula; but they are now seldom given with this view, except in cases of scrofula combined with syphilis, or excited by the too free and injurious use of mercury. (*Thomson's Lectures*, &c. p. 199.)

With respect to Alibert's practice, amongst the vegetable bitters, he prefers the hop, burdock, gentian, and bark. He seems to have no confidence in specifics, like hemlock, belladonna, acornitum, &c. Neither does he express himself favourably of alkaline medicines, or the muriates of ammonia and barytes. However, he praises the good effects of steel medicines on enlarged glands. He affirms, that he has seen most good derived from external means; aromatic fumigations in an apparatus prepared by the chemist Darcet. What he calls scrofulous eruptions, he covers with a strong solution of the nitrate of silver. Swelled glands he rubs with the antimonial ointment. He commends also change of air, and the avoidance of low damp places; and speaks favourably of sea-bathing, sea voyages, sulphureous mineral waters, and particularly of the good effects derived from the solar warmth. (See *Nosol. Nat.* p. 449.)

Sir A. Cooper, in his account of the treatment of scrofula, dwells more upon the good effects of air, exercise, and nourishment, than upon the virtues of physic. He asserts, that there is no specific for the disease. Medicines, occasionally given for the improvement of the digestive organs, and regulation of the secretions, he admits, are useful; but attention to air, exercise, and diet, he considers far more important. Sometimes, he prescribes, once a week, or every ten days, two grains of calomel, and eight of rhubarb, in order to restore the visceral secretions. A good tonic medicine, for a short time, he observes, is two grains of rhubarb, and from three to five of the carbonate of iron. Another, he says, is two of rhubarb, six of dried subcarbonate of soda, and ten of columba, taken mixed with sugar. He recommends also a few grains of hydrargyrum cum cretâ, to be taken in the infusion of camomile flowers, at bedtime; or the bichloride of mercury, in the proportion of a grain to two ounces of tincture of bark, of which a tea-spoonful may be taken twice a day in a glass of camomile infusion; or when costiveness prevails, the tincture of rhubarb may be substituted for that of bark. The liquor potassæ is also enumerated. But the medicines preferred by him are steel, with rhubarb and calomel, or the subcarbonate of soda, with rhubarb and columba.

The local treatment, preferred by Mr. White, has been already described. I have only a few words to add concerning this part of the subject. Dr. Cullen states, that, in his practice, he had very little success in dispersing incipient scrofulous tumors by topical applications; and that a solution of acetate of lead, though sometimes useful, more frequently failed. Dr. Cullen found the liquor ammoniæ acet. not more successful. "Fomentations of every kind (says he) have been frequently found to do harm; and poultices seem only to

hurry on a suppuration. I am doubtful if this last be ever practised with advantage; for scrofulous tumors sometimes spontaneously disappear, but never after any degree of inflammation has come upon them; and, therefore, poultices, which commonly induce inflammation, prevent that discussion of tumors, which might otherwise have happened." Even when scrofulous tumors had advanced towards suppuration, Dr. Cullen thought, that hastening the spontaneous opening, or making one with a lancet, was hurtful.

Formerly, the extirpation of scrofulous tumors was advised; but this method is now considered as being for the most part injudicious, and unnecessary, with the exception of diseased joints, and a few other parts, which frequently require amputation or excision of the heads of the bones for the sake of saving the patient's life. Certainly, no particular danger (generally speaking) would attend cutting out scrofulous glands, and tumors: the objections to the plan are founded on the pain of the operation; on the number of such glands frequently diseased; on their often subsiding, either spontaneously, or by surgical treatment; on the operation doing no good to the general affection of the system, &c. Wiseman relates, that he was in the habit of cutting out scrofulous glands, and tumors, with great success; but, for reasons already alleged, most of the moderns think such operations in general unadvisable.

Caustics have been employed for the same purpose, instead of the knife; but as they effect the object in view less certainly, more painfully and tediously, and cause extensive ulcers, they are disused by all the best surgeons of the present day.

Some authors advise making issues, and keeping them open, in order to prevent any ill effects from the healing of scrofulous ulcers. Issues may, perhaps, be unnecessary for any purpose of this kind: but they are eminently useful as a part of the local treatment of scrofulous joints and abscesses, as we have more particularly explained in the articles *JOINTS*, *LUMBAR ABSCESS*, and *VERTEBRÆ*.

The good effects of iodine upon scrofulous tumors and ulcers, both as an internal medicine and local application, seem to be exciting considerable attention. Certain indolent swellings of the testicle and breast, in particular, yield to this powerful medicine.

Iodine, as prescribed by Lugol, is at present in considerable repute. He recommends it to be given in small doses, varying from half a grain to two grains in the 24 hours, dissolved in distilled water, with double its proportion of hydriodate of potash. Lugol also employs iodine in baths and lotions to a much greater extent than is done in this country. His baths contain about two grains of iodine in each pint of water, and his lotions for scrofulous ulcers, &c., about one grain and a half, dissolved with hydriodate of potash. Hydriodate of potash, with sarsaparilla, is frequently given by British surgeons to scrofulous patients, and with decided benefit. From three to five grains of the hydriodate, in from two to four ounces of the decoction twice or thrice a day, may be safely tried in a variety of cases. (See *IODINE*.)

Preparations of lead; cold water; sea water; weak vegetable acids; æther; linimentum camphoræ; a mixture of æther and laudanum; and hemlock poultices; the unguent. potassæ hydri-

dati; form a long list of applications which have been employed for scrofulous tumors.

According to Mr. Burns, moderate pressure, by means of adhesive plaster, conjoined with the application of cold water, is one of the best plans of treating mild scrofulous ulcers, when their situation admits of it. In other cases, he recommends applying a powder, five parts of which consist of cerussa acetata, and the sixth of burnt alum. A piece of dry lint is next to be applied, and a compress, with such pressure as can be borne. Benefit occasionally results from dipping the compress in cold water. Water dressing, or ung. zinci, is an eligible application, when it is wished not to interfere much with the progress of the ulcer. Ung. hydrarg. nitrat. rub. and the ung. hydrarg. nitrat. are amongst the best stimulating ointments. Poultices of bread and sea water; lotions of alum, sulphate of copper, and the bichloride of mercury; solutions of the nitrates of copper, bismuth, and silver; the recent leaves of the wood-sorrel bruised; lint dipped in lemon-juice, or vinegar and water; a mixture of mercurial ointment and ceratum saponis (*Scott on Chronic Inflammation, &c.*), are among the applications to common scrofulous ulcers.

For irritable sores, diluted hydrosulphuret of ammonia; ointments containing opium; carrot and hemlock poultices; a solution of opium; and carbonic acid gas, have all been recommended.

The following are Mr. Russell's sentiments respecting the treatment of scrofulous ulcers: "Scrofulous complaints in general do not do well with stimulant applications. In the treatment of scrofulous ulcers under the ordinary circumstances of the complaint, the simplest and mildest dressings answer best. When the patients are using a course of sea bathing, it is usual to wash the sores with sea water over and above the momentary application of the sea water during the immersion of the whole body. Cold spring water is likewise a favourite application with many practitioners; and, from much observation, it appears that the operation of cold is well suited to counteract the state of inflammation, which accompanies scrofulous sores. Preparations of lead are, upon the whole, very convenient and useful applications, provided the solutions be used in a state of sufficient dilution to prevent irritation. Liquid applications are applied by means of wet linen, which is renewed whenever it dries, so that the surface of the sore may be kept constantly moist, when under this course of management. Upon the same principle, simple ointment and Goulard's cerate furnish the best dressing in ordinary cases.

"Scrofulous congestions, of a solid nature, in the more external parts of the body, are little adapted to the practice of local bleeding, unless they be attended with symptoms of inflammation; but as some degree of inflammation is, in general, present during the incipient stage, it may be prudent to employ local bleeding in moderation at the commencement of the attack, although there may be no indication to persist in the practice, after the complaint has advanced farther in its progress. If, however, these congestions are more of an indolent nature, unaccompanied with heat or pain, there is no benefit to be expected from the local detraction of blood; warm fomentations, together with the use of stimulants, and a repetition of blisters, are the most serviceable class of remedies:



such cases, too, are the best adapted to the use of friction as a discutient. Friction, indeed, has long been employed for this purpose; but of late years, it has been introduced to an extent, and with an effect, far beyond the experience of all former practice. As yet, it has been circumscribed to the practice of a few individuals, with whom it is said to have performed very great cures; and if, upon the test of more extensive experience, it is found to answer its present high character, I shall consider the use of repeated frictions to be one of the most valuable improvements which have been introduced into practice in modern times. The safety and simplicity of the practice recommend it strongly to favour, though I am afraid they are the very circumstances which retard its adoption by the public in general. I only regret that I do not feel myself entitled to give a decided opinion upon the subject from my own experience, though I have known some instances of successful cures; but the reports of success are so numerous and so well supported, that I am inclined to think very favourably of the practice.

"There is no substance, interposed between the surface of the swelling and the hand of the person who administers the friction, excepting a little flour, to prevent the abrasion of the skin. The friction is applied regularly two or three hours every day, with great celerity, the hand being made to move to and fro one hundred and twenty times in a minute, and the course may require to be continued, without interruption, for some months." (See *Russell on Scrofula*.) Here I would again recommend to the notice of surgeons, the external use of iodine, as perhaps possessing more efficacy than simple friction. (See *IODINE*.)

Scrofulous affections of the joints are elsewhere explained. (See *JOINTS*.) *Bronchocele*, *Iodine*, *Lumbar Abscess*, *Lupus*, and *Vertebra*, are other articles, containing matter connected with the preceding observations.

The reader may consult *Wiseman's Chirurgical Treatises*, fol. 1676. *J. Brown*, *Adenochoiradologia*, or an Anatomick-Chirurgical Treatise of Glandules and Strumals, or King's Evil Swellings, together with the Royal Gift of Healing, or Cure thereof by Contact, or Imposition of Hands, &c. 8vo. Lond. 1684. *Wm. Clowes*, A right frutefull and approved Treatise, for the Artificial Cure of the Struma, or Evil, cured by Kings and Queens of England, 4to. Lond. 1602. *Th. Fern*, On the King's Evil. *Cheyne*, On the King's Evil, 8vo. 1709. *R. Russell*, On the Use of Sea Water in the Diseases of the Glands, &c. 8vo. Lond. 1769. *B. Bell's Surgery*, vol. v. *B. Bell*, on Ulcers. Tumor Strumous Colli post vomitorium imminutus, 8vo. (Weikard, Collect, 88.) *Kirkland's Medical Surgery*, vol. ii. Lond. 8vo. 1783. *J. Morley*, Essay on the Nature and Cure of Scrofulous Disorders, &c. ed. 27. 8vo. Lond. 1790. *White*, On Struma, ed. ii. 1794. *P. Lalouette*, *Traité des Scrofules*, &c. Paris, 1780. *A. G. Kortum*, *Comment. de Vitio Scrofuloso*, in 2 vols. 4to. Lemgoviae, 1789. *R. Hamilton*, On Scrofulous Affections, &c. 8vo. Lond. 1791. *S. T. Soemmering*, *De Morbis Vasorum Absorbentium Corporis Humani*, 8vo. Traj. 1795. *C. W. Hufeland*, *Ueber die Natur, &c. der Skrophelkrankheit*, 8vo. Jena, 1795. *John Burns*, On Inflammation, vol. ii. *M. Underwood*, On Ulcers, &c. with Hints on Scrofulous Tumours, &c. 8vo. Lond. 1785. *Crother's* Obs. on the Disease of the Joints, commonly called White Swelling; with Remarks on Caries, Necrosis, and Scrofulous Abscesses, &c. ed. 2. 1808. *James Russell*, On Scrofula, 8vo. Edinburgh, 1808. *J. Thomson*, On Inflammation, p. 130, et seq. p. 155—191. &c. Edinb. 1813. *W. Goodlad*, Essay on the Dis. of the Vessels and Glands of the Absorbent System, 8vo. Lond. 1814. *G. Henning*, A Critical Inquiry into the Pathology of Scrofula, 8vo. Lond. 1815. *Richerand*,

*Nosographie Chir. t. i. p. 165, et seq. edit. 4. Boyer*, *Traité des Maladies. Chir. t. ii. p. 414, &c. Paris, 1814. Ch. Brown*, On Scrofulous Diseases, showing the good Effects of factitious Aërs, 8vo. Lond. 1798. *J. Brandish*, Obs. on the Use of Caustic Alkali in Scrofula, and other Chronic Diseases, 8vo. Lond. 1811. *C. Armstrong*, On Scrofula, in which an Account of the Effects of the Carbonas Ammoniacæ is submitted to the Profession, 8vo. London, 1812. *W. Lambe*, Inquiry into the Origin, &c. of Constitutional Disorders, particularly Scrofula, Consumption, Cancer, &c. 8vo. Lond. 1815: also Additional Reports on the Effects of a peculiar Regimen in Cases of Cancer, Scrofula, &c. 8vo. Lond. 1815. *R. Carmichael*, Essay on the Nature and Cure of Scrofula, and a Demonstration of its Origin from Disorder of the Digestive Organs, 8vo. Dub. 1810. *J. Rabben*, De præcipuis Causis Mali Scrofulosi ejusque Remediis efficacissimis Commentatio, 12mo. Gott. 1817. *Alibert*, *Nosologie Naturelle*, p. 448. fol. Paris, 1820. *Dict. des Sciences Méd. t. 1. art. Scrofules*, 8vo. Paris, 1821. *E. A. Lloyd*, On the Nature and Treatment of Scrofula, 8vo. Lond. 1821. *Dr. Coindet's* Letter on the Administration of Iodine in Scrofula, in *Journ. of Science*, &c. vol. xii. Jan. 1822: also his Obs. on the Remarkable Effects of Iodine in Bronchocele and Scrofula; transl. by *J. R. Johnson, M.D.* Lond. 1821. *Brera*, *Saggio Clinico sull' Iodio*, &c. 8vo. Padova, 1822. *W. Gibson*, *Institutes, &c. of Surgery*, vol. i. p. 249, &c. 8vo. Philadelphia, 1824. By the kindness of the author, I have just received a fifth edition of this work. *W. P. Alison*, in *Edinb. Med. Chir. Trans.* vol. i. Edinb. 1824. *A. Manson*, On the Effects of Iodine, 8vo. Lond. 1825. *J. Scott*, On Chronic Inflammation, 8vo. Lond. 1828. *T. Buchanan*, On a new mode of Treatment for Diseased Joints, 8vo. Lond. 1828. *J. G. A. Lugol*, *Trois Mém. sur l'Emploi de l'Iode dans les Maladies Scrofulieuses*, 8vo. Paris, 1829, 1830, 1832. *Cumin*, in *Cyclop. of Pract. Med.*; art. Scrophula. *Lepelletier*, Sur la Maladie Scrophuleuse, 8vo. Paris, 1830. *A. C. Baudelocque*, *Etudes sur la Maladie Scrophuleuse*, 8vo. Paris, 1834. *Robert Carswell, M.D.* Illustrations of the Elementary Forms of Disease, 4to. Lond. fasc. i. [*Peter*, De la Tuberculisation générale, 1866. *M. Hérard et M. V. Cornil*, De la Phthisie Pulmonaire, 1867. *J. A. Villemin*, *Etudes sur la Tuberculose*, 1868.]

SCROTOCE'LE. (From *scrotum*, and *κῆλη*, a tumor.) A rupture, or hernia in the scrotum.

SCROTUM, CANCER OF. (*Chimney-sweepers' Cancer. The Soot-wart*.) This peculiar disorder, which commences as a wart-like excrescence, is described by Mr. Pott, as always making its first attack on, and its first appearance in, the inferior part of the scrotum; where it produces a superficial, painful, ragged, ill-looking sore, with hard and rising edges. He never saw it in persons under the age of puberty. According to Mr. Earle's observations, it very rarely attacks persons under the age of thirty. Most of the cases, seen by him, were in individuals between the ages of thirty and forty. He has seen three instances in subjects between twenty and thirty; but only one at or before the age of puberty. A single case is mentioned by Sir J. Earle, which happened in a child under eight years of age. I have seen one case in a boy not more than sixteen. (*Med. Chir. Trans.* vol. xii. p. 299.) Sir Astley Cooper has known the disease occur at various ages from twenty to eighty.

In no great length of time, the disease pervades the skin and membranes of the scrotum, and seizes the testicle, which it enlarges, hardens, and renders truly and thoroughly distempered; from whence it makes its way up the spermatic chord into the abdomen, where it affects some of the viscera, or glands, and then soon becomes painfully destructive. (*Pott*.) Not only is the discharge from the sore very fetid, but the perspiration from the whole body has a peculiar and an ammoniacal smell. (*Earle*, in *Med. Chir. Trans.* vol. xii. p. 298.)

"Other people, besides chimney-sweepers (says Pott), have cancers of the same part; and so have others, besides lead-workers, the Poitou colic, and the consequent paralysis: but it is nevertheless a disease to which they are peculiarly liable; and so are chimney-sweepers to the cancer of the scrotum and testicles."

Workmen, exposed to the fumes of arsenic, are said to be liable to a cancerous disease of the scrotum, resembling that which infests chimney-sweepers. This is particularly the case with the smelters in Cornwall. (See *Paris's Pharmacologia*, p. 89, vol. ii. ed. 5.) If the two diseases are precisely similar, the fact is particularly interesting with regard to the cause of the complaint, which has been referred to the irritation of soot, and this alone, in a supposed peculiar condition of constitution, not defined, nor indeed at all understood.

From the great number of persons who pursue the occupation of sweeping chimneys, and the comparatively few affected by the application of soot, "it would appear, that there is something either in the constitution, or the parts of some individuals, which disposes to its production. I am inclined to believe (Sir Astley Cooper adds), that it depends more upon local circumstances, than upon the constitution, because the subjects of it appear to be very healthy at the dawn of the disease, although they lose that health in the progress of the complaint." (*On Dis. of the Testis*, p. 229.)

Mr. Pott describes the disease as always beginning at the lower part of the scrotum: but there are exceptions. Sir James Earle has recorded an instance of its occurrence on the wrist of a gardener, who had been employed in distributing soot for the destruction of slugs; and some cases have taken place on the face. (*H. Earle*, in *Med. Chir. Trans.* vol. xii. p. 297.) Sir Astley Cooper has seen it on the face of an old person, whose cheeks were full of wrinkles, calculated to afford a lodgment for soot. Mr. Keate met with a similar case. One circumstance is noticed by Mr. Earle, which, if it prove generally correct, materially influences the prognosis and treatment: he says, "The inguinal glands are often enlarged, but they will generally subside on the removal of the diseased scrotum; clearly proving that the disease is not commonly communicated in the course of the absorbents." (P. 298.) He knows only one exception to this statement; a case, where a bubo formed, suppurated, and assumed the same characters, as the primary affection in the scrotum. According to Mr. Travers, the lymphatic glands are seldom specifically affected. (*Med. Chir. Trans.* vol. xvii. p. 345.)

If there be any chance of putting a stop to, or preventing this mischief, says Mr. Pott, it must be by the immediate removal of the part affected; namely, that part of the scrotum where the sore is; for, if it be suffered to remain until the testicle is affected, it is generally too late even for castration. "I have many times made the experiment; but though the sores, after such operation, have, in some instances, healed kindly, and the patients have gone from the hospital seemingly well, yet, in the space of a few months, it has generally happened, that they have returned either with the same disease in the other testicle, or in the glands of the groin, or with such wan complexions, such pale leaden countenances, such a total loss of strength, and such frequent and acute internal pains,

as have sufficiently proved a diseased state of some of the viscera, and which have soon been followed by a painful death." (*Pott*.)

Mr. Travers's prognosis is less encouraging, for, says he, "The disease returns after extensive removal." That it does so sometimes is unquestionable; but that it does so always, is not what my experience teaches me. Some of Mr. Travers's patients appear to have fallen victims, not to a return of the disease itself, but to scrofulous tubercles of the lungs, or peritoneum. (See *Med. Chir. Trans.* vol. xvii. pp. 345, 346.)

Mr. Earle concurs with Sir Astley Cooper, that no topical applications, nor internal medicines, have the slightest influence over the disease. The scalpel, he says, is the only resource; and it may be employed with confidence, provided the whole of the diseased mass can be removed. Even when the inguinal glands are enlarged, he inculcates the same practice. Also, when the testicle is affected, provided the spermatic chord is sound, he conceives, that it is right to give the patient the chance of recovering; and, notwithstanding the discouraging results of Mr. Pott's operations in this stage of the disease, he has known the attempt succeed in two cases, in which no relapse had happened several years afterwards.

Sir Astley Cooper does not consider enlarged glands in the groin a positive prohibition of the operation, "as they are sometimes increased from simple irritation only; and, as the removal of a portion of the scrotum is little painful, soon performed, and unattended with danger, the patient should have this chance of recovery given him. If the tunica vaginalis participate in the disease, it will require great care in its removal to prevent injuring of the testis." (*Op. cit.* p. 230.)

The following case, which was under my care in University College Hospital, is replete with instruction. Frederick Leith, admitted September 26, 1837; a married chimney-sweeper, aged twenty-three, and of very intemperate habits. About five years prior to this date, he noticed a small pimple, or wart, on the anterior part of the scrotum, accompanied by intense itching, which obliged him frequently to scratch the part. The little wart-like induration increased considerably in size, and in two years ulcerated. The ulceration proceeded slowly, till about nine months before his admission into the hospital, when, happening to place himself under the care of a practitioner, who suspected the disease to be syphilitic, he was severely salivated, and the ulcer then began to enlarge, and continued to do so down to the time of his coming under my notice. At this period, the following circumstances were remarked. A large irregular ulcer was seen at the lower and anterior part of the scrotum, with elevated, hard, and red margins, which were in some parts very thick. The centre of it was occupied by a foul adherent greenish slough. The ulcer discharged copiously a thin, purulent, offensive fluid. The rest of the scrotum was hot, red, and somewhat swollen, and at several points little fleshy excrescences were seen, which the patient said resembled that which had changed into this foul, ill-conditioned ulcer. There was much itching and burning felt, and occasionally an acute lancinating pain was experienced, which however did not extend to the groin. The spermatic chords were free from induration, and the testes were sound; and, though some



enlargement of one or two of the inguinal glands might be perceived, they were not at all painful, and, according to the patient's account, they sometimes entirely subsided. The general health was moderately good—the pulse 104—tongue clean—appetite good, and the bowels were regular. The diluted solution of the chloride of soda was applied, and aperient medicine prescribed.

Oct. 3. Hoping that the disease had not yet seriously implicated the inguinal glands, and that the swelling of them was merely from irritation, and a manual examination of the abdomen, joined with a consideration of the man's general health, having convinced me that the lumbar glands were sound, I decided to remove the ulcerated part of the scrotum, and indeed the greater portion of it; for there were several warty indurations at various points of it, more or less distant from the ulcer. The testes having been held up by Mr. Quain, and a catheter introduced to inform us of the precise situation of the urethra in the performance of the deeper incisions, two semilunar incisions were made, which joining together circumscribed the disease, which was then carefully dissected out. Owing to an adhesion and induration of the left tunica vaginalis, a part of it was necessarily removed, and the testis exposed. No vessels required ligature. As the loss of substance was too great to admit of the edges of the wound being brought together, the part was simply covered with water dressing, and the patient conveyed back to his bed, with directions that he should take an anodyne, if he suffered much pain.

Oct. 22. Went on without any untoward event till this day, when some tenderness was experienced in the right groin, followed by an erysipelatous blush of the skin, which, however, subsided under the beneficial influence of purgatives and cold applications. The case then advanced favourably for three or four days; at the end of which I found that the patient had suffered great pain in the right groin, where the skin had become reddened, and the glands swollen and indurated; whether from mere irritation, or a commencement of the disease, seemed now doubtful. By means of the repeated applications of leeches, and the use of calomel aperients, and other antiphlogistic means, however, the inflammation was soon reduced, and an abscess which formed healed up without difficulty, and the patient left the hospital cured. This case exemplifies several well ascertained facts relative to chimney-sweeper's cancer, or cancer scroti.

1. The usual commencement of the disease, about or a little before puberty; its occurrence in younger subjects being so rare, that Pott never noticed it but in one instance shown to him by the late Sir James Earle.

2. The usual beginning of the disease at the anterior, or inferior part of the scrotum, in the form of a small lump, or induration.

3. The painful, ragged, ill-looking nature of the ulcer, surrounded by hard rising edges.

4. The occasional presence of one or more indurations, fleshy growths, or soot warts, on other points of the scrotum. When these are very small and superficial, with a narrow base, I believe that they are sometimes picked off, and that the parts may then heal. In other instances, they reach more deeply, and advance to cancerous ulceration.

5. The absolute localisation of the disease, until

it has so implicated the spermatic chord, the inguinal, or lumbar glands, or viscera, that the same kind of disease has been extended to them. That is to say, it is not dependent upon, or originally connected with, that unfavourable kind of constitution which attends ordinary cancer; and therefore if the whole of the disease admits of being cut away, the patient will not suffer a relapse. This is so true, that patients have recovered permanently, although it has been necessary to remove a part of, or the whole of the testis. Sir Astley Cooper informed me, that he has in some instances taken away a portion of the testicle together with the diseased part of the scrotum. In my case, a portion of the tunica vaginalis was removed. [In the present day, the chimney-sweepers' cancer is considered by most surgeons in every respect analogous to epithelioma in other parts.] (See CANCER.)

See Pott's Works, vol. iii, edit. by Earle. Also W. Simmons's Obs. on Lithotomy, to which are added Obs. on Chimney-sweepers' Cancer. 8vo. Manchester, 1808. H. Earle, On Chimney-sweepers' Cancer, in Med. Chir. Trans. vol. xii. p. 296, &c. Benj. Travers, Op. cit. vol. xii. p. 344. Sir Astley Cooper, On the Structure and Diseases of the Testis, 4to. Lond. 1830.

**SCROTUM, Sarcomatous Thickening and Enlargement of.** The investigations of Baron Larrey lead him to believe, that cases of enormous growth of the scrotum are endemic in warm countries, or, at least, that they are seldom observed in cold climates; since most of the examples, which have been seen in Europe, came from Asia and Africa. With the exception of the case, on which Mr. Liston operated, the scrotal tumor of Delacroix, formerly minister of external relations, is considered by Larrey as perhaps the only well authenticated instance of the origin of such a disease in our own climate; and it was also much smaller than the instances related in the Ephemerides German. for the year 1692, in the surgical writings of Dionis, in the 9th vol. of the Bibliothèque de Médecine, and those which Larrey met with in Egypt. The smallest of these latter, after they had attained their full size, weighed more than 25 kilograms (between 60 and 70 pounds). Many instances of this curious disease are recorded, particularly by Dr. Cheston, Dr. Titley, and the celebrated Sandifort. I remember in Mr. Abernethy's museum a considerable fleshy substance, which was a portion of hypertrophied scrotum.

The tumor, removed by Mr. Liston, is believed by him to be the only case which ever occurred in a resident native of these islands. (See Liston's *Practical Surgery*, p. 289.)

In the cases which Larrey had an opportunity of seeing in Egypt, the fleshy mass, into which the scrotum was converted, was broad below, and suspended from the pubes by a sort of pedicle. "Externally the tumor presents rugosities of different sizes, separated by particular lines, or sinuses, to which the mucous cryptæ and roots of the hairs correspond. Upon a large portion of its surface, especially when the case is of long standing, yellowish scaly crusts are always seen, the detachment of which constantly leaves so many small herpetic ulcers, emitting an ichorous discharge. The tumor is indolent, and hard at some points, but softish at others. It may be handled and pressed in different directions, without the least pain. The patient is only incommoded by its

weight, and the impediment which it causes to his walking well. Hence he is necessitated to employ a suspensory bandage. In consequence of the situation of the urethra, the urine dribbles over the swelling; but without causing any excoriation." In most of the cases, seen by Larrey, the spermatic chord and testicles were in the natural state, situated at the sides and at the root of the swelling. The spermatic vessels, however, were somewhat enlarged and elongated. All the patients were likewise more or less affected with elephantiasis.

Baron Larrey attempts to explain the causes of the complaint in Egypt, but, as I think, without any degree of success. As the affection is seldom seen in cold countries, climate has certainly a chief effect. Employments which keep persons a good deal in a sitting posture; the loose breeches worn by the Egyptians, and the consequently pendulous state of the scrotum; diseases of the humours, and particularly itchy pustules on the part, an ordinary consequence of syphilis in that country; bad regimen; abuse of venery; and the immoderate use of the warm bath; are merely conjectures, which will not bear the test of reasoning.

The enormous magnitude, which this sort of disease may attain, is almost incredible. The case recorded in the Ephemerides German. weighed about a hundred kilograms, or more than two hundred weight. Another, described by Larrey, was calculated to weigh about one hundred and twenty pounds; and this surgeon likewise saw in Egypt ten or twelve more instances, nearly as large, and all of the same character.

A curious example, in which a similar disease affected the labia pudendi in a surprising degree, is also detailed by Larrey. The woman was a native of Cairo.

In the early stage of the disorder, we may try preparations of antimony combined with sudorifics; drinks acidulated with sulphuric acid; lotions containing the same acid, or the bichloride of mercury, the oxyde of copper, or the chloride of ammonia. These means are to be assisted by a gradual, uniform compression of the whole tumor. In one case, incisions, and the application of caustic, proved of no service, and Larrey very properly condemns all such experiments.

When the disease resists every plan tried for its relief, and its increase renders the patient's life irksome and wretched, the extirpation of the tumor with a knife becomes proper. In this proceeding, the chief skill consists in doing no injury to the spermatic chords and testicles, which are in general perfectly sound. Care must also be taken not to injure the corpora cavernosa penis, and the urethra. After the operation, the skin is to be brought over the exposed testicles, as much as possible, by suture, adhesive plaster and a bandage.

M. Delonnes successfully removed the diseased mass in the celebrated case of the French minister Delacroix, and Larrey performed the same operation with success when he was in Egypt. Dr. Titley, of the island of St. Christopher, also cut away such a tumor, which weighed seventy lbs., and the patient, who was a negro, and also affected with elephantiasis, speedily recovered. (See *Med. Chir. Trans.* vol. vi. p. 73, &c.) The case of the Chinese operated upon by Mr. Aston Key, in Guy's Hospital, had a quickly fatal result, the patient not having had stamina sufficient to endure the requisite proceeding.

In Mr. Liston's example, the tumor had been growing for twelve years, in a patient about twenty-two or twenty-three years of age. The operation was performed many years ago, and the patient now enjoys perfect health. "It was impossible (Mr. Liston observes) to say where the organs of generation were placed in the mass; if they could have been found and saved, I should not have been able to cover them; they would thus have been totally unserviceable." I think, however, that nature would soon have formed a new investment for them, as she often does where the scrotum sloughs away from effusion of urine. The mass was detached from the perineum and pubes, together with the testes, and two inches of the penis. About sixteen arteries were tied. The tumor weighed nearly fifty pounds, and is preserved in Mr. Liston's collection. (*Op. cit.* p. 290.)

Probably some of the cases, which occur in warm countries, are analogous to elephantiasis; one weighing one hundred and ten pounds, and successfully removed by Clot-Bey, is stated to have been of this nature (see *Travaux de l'Ecole de Méd. d'Abou Zabel, Egypte*, p. 131, 8vo. Paris, 1833); but I do not believe that the scaly incrustations, which are represented by this distinguished individual, and also by Baron Larrey, as having occurred in the cases which they saw in Egypt, have always been noticed in the instances which have taken place in colder countries. Nor, indeed, did they take place in the instance recorded by Dr. Titley.

Delpach gives an account of a patient, aged thirty-five, a native of Perpignan, whose scrotum was converted into an enormous mass, weighing sixty French pounds, in which the penis, the spermatic chords, and the testicles were completely buried. The swelling was nearly pyriform, flattened transversely, divided at its lower front part into three principal lobes, and reached downwards below the calf of the leg. Behind, it formed a vast projection; and it was attached to the perineum and hypogastric region by a neck, or pedicle, that occupied the whole space comprised between the pubes, the two groins, and the anus. The circumference of the pedicle, at its narrowest part, was eighteen French inches. The patient could neither walk nor stand, without much difficulty. Although the organs of generation were buried in the manner thus specified, erections and seminal emissions occasionally took place. Some parts of the integuments were tuberculated; and in the interior lobe of the swelling, which was like a cauliflower excrescence, there was a transverse fissure, at the bottom of which was a deep sinus, running upwards and rather to the left: such was the state of the prepuce and passage, through which the urine was discharged. For the particulars of the operation, by which this enormous mass was removed, so as to leave two lateral flaps of sound skin for covering the testicles, I must refer to *Chir. Clinique de Montpellier*, t. ii. 4to. 1828. The extent of the wound may be conceived, when it is stated, that the external pudendal artery, the artery of the septum scroti, the dorsal arteries of the penis, the transverse artery of the perineum, the right and left arteries of the bulb, and several branches of the inferior hemorrhoidal, required ligatures, the ends of which M. Delpach cut off, in order that the extraneous matter in the wound might be lessened. Owing to the prodigious elon-



gation of the spermatic chords, it was necessary to arrange them after the operation in a tortuous form, and some difficulty was experienced in fixing the testicles in their proper situation. The wound was completely cured in about two months; and the patient returned to Perpignan, where, in the course of a few weeks, he became indisposed, and died. On opening the body, a very large abscess was detected in the liver. Must this be regarded as a consequence of the extensive wound, inflicted in the operation, or as the result of the patient's excesses after the wound had healed? If the former view be adopted, it is another confirmation of the frequency of visceral inflammations and suppurations after severe local injuries, or great operations; a subject on which much interesting matter may be collected from the Memoirs of the Royal Academy of Surgery; the papers of Messrs. Rose and Arnott in the *Medico-Chir. Trans.* of London; and the great work of Cruveilhier, on *Pathological Anatomy*.

With regard to the nature of the tumor, Delpech contends, that it presented an example of true elephantiasis of the scrotum; a point on which many practitioners will disagree with him. The following circumstance relative to the structure and composition of the swelling, is noticed. The skin of its anterior part was not less than three inches thick; and the inequalities, observable upon every portion of it, were here greatest. Notwithstanding the discolorations, which the skin exhibited in places, where it was most deeply affected, the incisions in it bled very little; few vessels of considerable size were met with; and not a single varicose vein. The cellular tissue was manifestly every where distended; its lamellæ were lengthened, and included very large cells; most of them were semi-opaque, and of a white pearl colour, which change is ascribed to an inflammatory process that had thickened them. The areolæ of this tissue, besides being very dense, contained a serosity, a part of which flowed out in the operation, while the rest, in consequence of its greater consistence, did not escape from the cells, though they were opened. Both contained a large proportion of albumen, and were coagulated by heat or acids. Blood-vessels were seen ramifying in this tissue; but they were not numerous, and only of small size. The lymphatics were plainly discernible in great numbers, and of considerable diameter. In front of the spermatic chord, some fat was found, the only situation in which it presented itself; and here its accumulation made Delpech suspect, for a little while, that there was an omental hernia, with a very thin transparent sac. The cremaster seemed to have preserved the spermatic chord completely from the disease.

To the preceding history, Professor Delpech has annexed the case of, what he terms, an elephantiasis of the female sexual organs, removed by Dr. Talrich, of Perpignan. The disease, which originated just below the mons veneris, hung down as low as three inches above her knees, and unless it was pushed towards the naval, rendered the evacuation of the urine difficult. It involved the labia, especially the right one; and the clitoris, which was considerably elongated by the weight of the swelling, was concealed under its root. I do not adopt the view taken by Delpech of this swelling, which he contends was that of elephantiasis. Whoever will compare the description of the

disease with the history of elephantiasis (see *Good's Study of Medicine*, vol. ii. p. 626, ed. 4) will see few points of resemblance between them.

[For the best and more recent information on this subject, the reader should consult the writings of surgeons who have practised in warm climates, where this disease is of frequent occurrence. Mr. F. H. Brett, of the Bombay military service, published an account of this hypertrophy of the scrotum, and relates seven cases on which he had operated, saving in each case both the penis and the testicles. (*A Practical Essay on some of the Principal Surgical Diseases of India*, by F. H. Brett, 1840, p. 94.) The operative procedure recommended by him, consists in making an upper, lower, and two lateral flaps, which may be thus briefly described. The patient being placed on a table in the position for lithotomy, the legs well separated by assistants, the tumor is raised with the intention of facilitating the return of the venous blood. The posterior flap is now formed, while the tumor is in this position, by making a curved incision several inches in extent on the neck of the tumor in the perineal region, the convexity forwards, and dissecting it backwards towards the anus—the tumor being brought down, the anterior flap is next formed by cutting two slightly converging incisions over the neck of the tumor in the inguinal regions; these are to be joined by a transverse one a few inches below the supposed site of the root of the penis, for which it is to assist in forming a covering. The lateral flaps are rapidly made by inserting a long catling or double-edged amputating knife under the skin, and cutting from within outwards. The point of the knife enters where the upper flap terminates, and makes its exit at the level of the lower flap at its outer margin. A flap is now cut of sufficient size, on each side, to cover the testicles and meet in the median line without tension. The next step of the operation is to incise the tumor boldly, in order to find the testicles and chords, which are deeply buried in the diseased mass. These are to be separated carefully from the rest of the tumor, reflected upwards, and entrusted to the hands of an assistant. The penis and prepuce now claim the careful attention of the operator. An incision is to be made around the orifice of the prepuce, and from this another longitudinal one backwards towards the pubes through the tumor, in the supposed line of the concealed penis, till it reaches the centre of the anterior flap. The outer layer of the prepuce and the skin of the penis, together with the hypertrophied areolar tissue, are now to be dissected away. Great care must be taken to save the inner layer of the elongated prepuce, which is afterwards to be drawn back over the penis to form a covering to that organ. The prepuce will be found sufficiently long and wide to form, when reflected, a complete integument for the penis, for which purpose it answers admirably. The mass of the tumor may now be rapidly detached from the lateral and posterior flaps and from the perineal region. In adjusting the flaps by suture and adhesive plaster, it will be readily understood that the lateral flaps should contain and cover the testicles, and be joined to each other in the median line—that their upper margins should be adapted to the upper flap and to the root of the penis—their lower margins are to be adjusted to the posterior flap. The con-

verging incisions of the upper flap in the inguinal regions are to be united together—its lower margin in the centre is to be connected at the root of the penis, with the reflected prepuce and the rest of its lower edge as already stated, will be joined to the upper margins of the lateral flaps. Mr. Brett lays great stress on the advantage of emptying the veins by position before commencing the operation, and of rapidity in its performance in order to save as much as possible the loss of blood. In Mr. Brett's work will be found plates of the disease and of the steps of the operation. Also in the *Lancet*, Feb. 1846, p. 242. He operated on seven cases in India, of which two died from mortification; the remaining five recovered.

In the year 1846 the present Editor assisted Mr. Brett in an operation of this kind for a tumor weighing 9 lbs. The operation as above described was somewhat modified, on account of the comparative small size of the tumor. A full description of the case by Mr. Brett will be found in the *Lancet* for July, 1846, p. 36. The man made an excellent recovery.

Dr. Fayrer, Professor of Surgery in the Medical College, Calcutta, in his work entitled *Clinical Surgery in India*, publishes as many as 28 cases of this malady occurring in his own practice, all of which were operated upon; of these 6 died and 22 recovered. Of the 6 deaths, 5 were from pyæmia, and 1 from exhaustion. Dr. Fayrer's mode of performing the operation differs considerably from that recommended by Mr. Brett. He advocates the raising the tumor for half-an-hour or longer before commencing the operation, in order to drain it of blood as much as possible; also rapidity in removing the tumor, which should be accomplished in from three to five minutes, in order to save loss of blood. With the same object of preventing hæmorrhage during the operation, he recommends the application of a hand-clamp to the neck of the tumor, or a sort of tourniquet, consisting of a strong chord, the ends of which are passed through a brass ring, and armed with handles. He does not think it of importance to save skin either to cover the penis or testicles, but trusts to healing by granulation and cicatrization. The description of his operation performed for the removal of a scrotal tumor weighing 75 lbs., with a short history of the case, is here added.

"Nobo Koomar Dass, 32 years of age, native of Calcutta, was admitted into the Medical College Hospital, on December 9th, 1861, with a scrotal tumor of great size. His health was very poor; he was suffering at the time from sloughing ulceration of the tumor. He was much emaciated, and subject to repeated attacks of fever.

"It was not till April 12, 1862, that it was deemed safe to attempt the operation. During the interval, under the combined influence of rest, good food, quinine, and iron, he had improved in health, and gained flesh, strength, and spirits. The tumor was of enormous size, slightly tuberculated at the lower part of it. It was 17 inches in circumference at the neck, 44 inches transverse, 46 inches vertical, and 57 inches lateral circumference. Its growth, extending over a period of eight years, commenced in the scrotum, and was accompanied by the usual paroxysms of fever, recurring several times in the month. No elephantiasis in any other part of the body. On April 12, I removed it with the aid of my colleague Mr.

Partridge, the house surgeon Mr. Hayes, and the dressers.

"A vertical incision was made with a long amputating knife on a steel director down to the penis, which lay deeply embedded in the mass. Three deep incisions were required to expose the glans. The penis was then dissected out and held back. The left testicle was exposed by a series of bold incisions, dissected out, and reflected. The right testicle was next sought for, but being deeply embedded and difficult to detach from the surrounding mass the attempt was discontinued and the cord cut across. The incisions were then connected by a transverse cut at the base, and the mass removed by a series of rapid sweeps with the scalpel. The arterial hæmorrhage was partially controlled by a clamp placed on the neck of the tumor, which had been elevated with pulleys for an hour before the operation to empty it as much as possible of blood. About thirty-one ligatures were required, every bleeding point being carefully secured.

"He became very low on the table, but soon rallied. The removal of the tumor occupied a little over three minutes. It was not considered safe to prolong the operation in searching for the right testicle, as the hæmorrhage was profuse, and the patient had naturally a weak pulse and feeble action of the heart, with a tendency to fatty degeneration, which made us rather doubtful in the outset as to the propriety of giving chloroform; but having preserved the penis and one testicle, the other was sacrificed rather than run any risk of sinking from exhaustion. I should add that, in addition to the elephantiasis, there was a large hydrocele containing several pounds of fluid.

"The tumor was weighed some time after its removal, when the blood and serum had drained away, and was found to weigh 75½ lbs.; so that the weight removed, including fluids, must have been over 80 lbs. The patient was under the influence of chloroform and felt nothing.

"I saw him five hours after the operation; the pulse had risen to nearly its natural standard; the body was warm, and the effect of the shock had evidently passed away.

"The wound was dressed for the first time on the 15th (the third day), after the dressings applied on the operating table, and they have been changed daily since. Oiled lint and pressure with a bandage to aid contraction was all that was required.

"He has not had a bad symptom, and the wound rapidly closed in.

"He was able to sit up and even walk about a little on April 28 (the sixteenth day), and by May 27 (the forty-fifth day) was quite well."

"The largest growths of this nature that have been removed in England are, so far as I know, those operated on by the late Messrs. Liston and Aston Key, one tumor being nearly 50 lbs. and the other nearly 57 lbs. in weight. Mr. Liston's case did well, the entire tumor, including the testes and penis, being removed. Mr. Key's case died very shortly after the operation, which lasted one hour and three-quarters; the delay, no doubt, being caused by the attempts to preserve and cover the genital organs.

"It is therefore interesting to know that even larger growths may be removed, the genital organs be preserved, and no such fatal result occur. It is not necessary to attempt to preserve flaps to cover in the exposed penis and testes; this is perfectly



well effected by the subsequent granulation and cicatrization. The neighbouring integument is generally unsound, and it preserved is liable to be the seat of a recurrence of the disease. To attempt, therefore, to preserve it is as useless as dangerous; and an operation which, in the experienced hands of Mr. Key, occupied an hour and three-quarters (vide *Chelius*, by South), may be performed more satisfactorily, and with greater safety to the patient, in a few minutes. In the removal of the largest of these growths, I may add that should the effort to preserve the testes be found to prolong the operation beyond from three to five minutes, the attempt should be desisted from, and the whole remaining mass swept away as quickly as possible.

"It is remarkable how little deformity results. The genital organs, after the operation, differ but little in appearance from the normal condition of the parts, slight retraction of the penis, and a contracted state of the scrotum, being the only changes perceptible."]

*Larrey*, Mém. de Chir. Militaire, t. ii. p. 110, et seq. *Ri-herand*, Nosographie, Chir. t. ii. p. 314, &c. ed. 4. *Delonnes'* Mém. &c. *Cheston's* Case, &c. Med. Chir. Trans. vol. vi. *Delpech*, Chirurgie Clinique, t. ii. 4to. 1828; p. 289. *R. Liston's* Practical Surgery, 8vo. Lond. 1837. [*Brett*, a practical Essay on Surgical Diseases in India, 1840. *Fayrer*, On Surgical Diseases of India, 1867.]

[SCURVY or SCORBUTUS. German, scharbock; Saxon, scorbie; Dutch, scheubuck; Swedish, skörbjugg; Danish, skörburg; a Latinised variety of the last three words, or the Slavonic word Scorb with a Latin termination.

A result of prolonged abstinence from vegetable food, accelerated by bad diet; moisture, and any other depressing circumstances that tend to lower the average standard of health, inducing swollen and spongy gums, discolorations more or less extensive, resembling bruises, about the legs and thighs, a brawny hardness about the hamstring muscles and those of the calf, with contraction of the lower limbs, and an invariable condition of great physical debility. The disease is very vaguely described by the early writers, and it is uncertain whether or not Hippocrates recognised it. There is no doubt that scorbutus, or scurvy, was endemic in many countries prior to the advancement of civilisation, and the increased cultivation of fruits and vegetables gradually caused its disappearance. The most distinct descriptions of scurvy are found in the annals of medico-military historians, and we may read of its ravages in the army of Louis XI. in Egypt in 1260, among the besieged at Breda, North Brabant, in 1625, at Thom in Prussia in 1703, among the Austrians and Turks in Hungary in 1720, among the garrison at Quebec in 1760, at the siege of Alexandria in 1801, at the Cape of Good Hope in 1836, and lastly in Bulgaria and the Crimea during the conflict between Russia and the allied armies of England, France and Turkey. Ireland also suffered severely from the presence of this disease among her people during the potato famine of 1847. The evidence of all historians who relate particulars of scurvy as it existed during the campaigns above-mentioned, goes to prove that this disease killed more men than any other malady, or than the engines of war. Scurvy has been, from the earliest times, a loathsome enemy to sailors, and from the beginning of the fifteenth century to the present time, detailed accounts have

been written of its direful and fatal effects. The primary and exciting cause of scurvy is most undoubtedly prolonged abstinence from vegetable diet; and Parkes says that, though a want of fresh vegetables is not invariably followed by scurvy, this want is the only invariable antecedent of the disease. Trotter says that scurvy can come on under an exclusively vegetable diet, if the vegetables be not fresh. Authors disagree as to predisposing causes of the disease, but it appears that insufficient ventilation of dwelling-places, wet clothes, dirty habits, an inactive life and temperament, and most atonic diseases, predispose to scurvy. Garrod says that solitary cases of scurvy are occasionally found in the upper classes, the subjects thereof having, with some definite object, carefully avoided all fruits and vegetables.

The precursory signs somewhat resemble those of simple sub-acute rheumatism. The feet and legs are sometimes cedematous, and, according to Blane, suppression of perspiration and paucity of urine are among the earliest indications of scurvy. But the distinctive symptoms above mentioned are all-sufficient to diagnose this disease. There is also a great tendency to syncope in assuming even the semi-recumbent position, and patients received into hospital when suffering from severe attacks of scurvy, have occasionally, in the absence of the nurse, sat upright in bed, and so induced fatal fainting. Hæmorrhage, properly so called, exists as a concomitant of the malady much less frequently than is generally supposed, and severe epistaxis or hæmatemesis is, as a rule, very unusual. But the gums are sometimes so much swollen as to conceal the teeth, and large portions now and then become detached. A case occurred in the practice of Mr. Busk, now honorary surgeon, and formerly surgeon, to the Dreadnought Hospital Ship, in which the gums of the upper jaw had met in the centre of the mouth, and grown together, forming a kind of bridge or false membrane below the hard palate. The skin seldom suffers solution of continuity, but old wounds and ulcers will reopen, and the latter soon become occupied with foul fungous-looking excrescences, that have not unfrequently been diagnosed as the results of malignant disease. The appetite is unusually good, and in uncomplicated scurvy, severe diarrhœa is the exception rather than the rule. Node-like swellings frequently appear on the tibia, and more rarely over the other long bones; these nodes are exquisitely tender, and indicate seats of effusion between the periosteum and the bone. According to Parkes, the temperature of the body in scurvy is lower than usual, and there is great disorder of the respiratory functions; but general clinical observations of about 300 cases on board the Dreadnought, does not tend to confirm the latter of these opinions. Pericarditis and hemeralopia are of occasional but by no means frequent occurrence in scurvy, and many other concomitant symptoms are described as more or less constant, for scurvy so frequently complicates, that it has been often confounded with other diseases. The nervous system remains unchanged. All processes of repair appear to be perverted. Fractures occurring in scorbutic patients unite very slowly, no healthy process of reparation appearing to commence until the symptoms of scurvy have disappeared. The tendency in old fractures to become disunited when scurvy supervenes is mentioned by Budd, Lind, and others, but evidence on this point

is by no means decisive. A boy who entered the *Dreadnought* in December, 1867, suffering severely from scurvy, was the possessor of a leg broken at Calcutta twelve months previously; it appeared to have been well set, and showed no disposition to disunion. The post-mortem indications found in cases of genuine and uncomplicated scurvy are in a great degree negative. A blanched condition of all the tissues, more or less sponginess of the gums, occasional ecchymoses about the thoracic and abdominal aortæ, and scattered indifferently about the coats of the intestinal canal. No structural changes are found in any organ except the spleen, which is usually large, and sometimes friable, pulpy, or almost rotten. The brawny state of the calves and hams is caused by fibrinous effusions between the striæ of the muscles. (A preparation, illustrating this condition, may be seen in the Museum of the *Dreadnought*, and was prepared by Mr. Busk.) Effusions of semi-fibrinous coagula are also found between the periosteum and the bone; these being most marked immediately beneath the node-like swellings above-mentioned (see a preparation by Busk in the *Dreadnought* Museum), and sometimes, according to Lind and Budd, about the lower jaw. But the persistence of the vascular connection between the periosteum and the bone through the clot, renders it probable that this effusion takes place very gradually, and serves also to explain the fact specially noticed by Lind, that, although scorbutic nodes continue on the tibia for a long time, they never give rise to exfoliation of bone (*Budd*). The body of a patient who had died from scurvy and dysentery, was examined in the *Dreadnought* in 1866, and the periosteum was found detached from two or three of the upper ribs at their sternal ends, and, in several instances, the cartilages were partially dislocated.

All researches as to scurvy tend to show that it is eminently a blood disease, that, according to Parkes, it is a distinct and exclusive disease, and that the direct cause producing scurvy as a consequence is the absence of some, or the superabundance of other, constituents of the blood that are necessary to preserve the system in a healthy condition. Various analyses of blood taken from scorbutic patients have been made by Busk, Chaten and Bouvier, Becquey and Roden, Andral, Ritchie, and Frisk, but the results are somewhat conflicting, and the total number of examinations is too small from which to deduce any very positive conclusions. But it appears that, in all, the red corpuscles and water were found in increased quantities, and the balance of evidence goes to prove the special result of Busk's observations, that the proportion of fibrine is definitely increased. For in anæmia "the density of the blood is diminished, and the proportion of fibrine, albumen, fatty matter, and salts remains unaltered; in the hæmorrhagic diathesis, the blood contains too little fibrine," and it is highly probable (though not yet sufficiently proved) that, in the scorbutic diathesis, the blood contains too much fibrine. True hæmorrhages in scurvy are rare, and the swollen and spongy gums, if carefully examined, will be found to contain, not blood, nor simple coagula, but a semi-organisable fibrinous material, and the effusions between the periosteum and the bone do not occur on account of the brittleness of the neighbouring vessels, but on account of the watery condition of the blood itself. Aldridge ascribes the cause of scurvy to a

deficiency of sulphur and soda, Garrod to a want of potash, and John Morgan, of Dublin, to a deficiency of phosphorus; but the results of treatment hitherto obtained do not confirm satisfactorily any one of these opinions (*Parkes*). Lehmann remarks that the alkaline salts are often doubled in scurvy, and M. Verdeit says that a vegetable diet causes an increase in the alkaline carbonates of the blood, the phosphates existing in very small quantity. The diagnostic characters of scurvy are well marked, inasmuch as the brawny calves and thighs, the spongy gums and bruised-like appearance of the skin, are all sufficient to distinguish this disease from purpura or any other malady.

The prophylactic and curative agents that may be usefully employed in this disease have been generally indicated in the foregoing remarks. It may be confidently asserted that the use of fresh vegetables and fruits (particularly unripe fruits) will both prevent and cure scurvy, and that those classed under the natural orders Cruciferae and Aurantiaceae, are most potent in antiscorbutic properties. But the very useful properties of lime and lemonjuice as a prophylactic agent have long been known, and to its employment may be attributed the practical extinction of scurvy from the Royal Navy. The special virtues of these juices were first recorded by Woodall in 1600, but very little use was made of this discovery until the close of the last century, when the exertions of Lind and Blane caused their regular adoption in the British fleets. The use of lime and lemonjuice in the mercantile marine was made compulsory by The Merchant Shipping Act 1854, and the continued existence of scurvy in ocean-going ships has been proved to arise from the gross adulterations to which these juices were subject, thereby rendering them utterly useless as antiscorbutics. But The Merchant Shipping Act 1867, compels an official examination of all juice taken to sea for the use of ships' crews, and also ensures preservability by securing its mixture with a certain proportion of spirit. Our chemists have not yet discovered the special antiscorbutic element in lime and lemonjuice. Morgan maintains that it is phosphorus, Garrod that it is potash, and many others that it is citric acid. No confirmatory evidence exists as to phosphorus, the potash theory has produced conflicting results, and, though the antiscorbutic virtues of citric acid in large doses are undeniable, a large balance of facts now exists that show its great comparative inferiority to lime and lemonjuice. Graham has, however, advanced an important step in the right direction, by separating the colloid from the crystalloid principles of the juice. This very ingenious idea was carried out in 1867, and it is proposed to test the antiscorbutic properties of both principles as opportunities occur. Parkes remarks, with reference to this subject, that "the *Materia Medica* gives many analogous examples of the superior efficacy of a medicine in its natural combinations." The antiscorbutic properties of raw walrus meat have been extolled by Kane, who writes of its usefulness in Arctic voyages, but the data are limited. Cooked ox liver was lately prescribed for scorbutic hemerolopia by the surgeon of the Austrian Imperial ship "Novara," and its further use in cases of scurvy is recommended by German writers. Morgan of Dublin adopts a system of curing meat by an arterial injection of a solution containing a certain propor-



tion of phosphates, and considers that the use of this meat would prevent all tendency to scurvy. Its antiscorbutic virtues have yet to be satisfactorily tested, and there is no doubt that, up to the present time, in the absence of a sufficiently varied scale of diet, good lime or lemonjuice is by far the most efficient antiscorbutic about which positive evidence has been obtained. The internal administration of drugs in scurvy is unnecessary, for, if fresh vegetable diet can be procured, and due care be taken as to warmth and cleanliness, the patient recovers rapidly. In the absence of fresh fruits and vegetables, preserved and dried fruits, sugar, treacle, pickles, wine, and beer should be given. If the gums be very foul and swollen, some benefit may be derived from the use of a disinfecting lotion. All antiphlogistic treatment is dangerous; Lind records the specially bad effects produced by mercury, and we cannot endorse the opinion of Opitz, who recommends vesication of the affected parts. There is, indeed, no malady the treatment of which is so simple, and the success of that treatment so certain and rapid. Uncomplicated scurvy is now seldom a mortal disease, for the causes of its intensity are diminishing annually, and it is probable that, if the hygienic measures indicated in The Merchant Shipping Act 1867, be faithfully carried out, scurvy will, except as one of the many evils of war, soon be an unknown disease.

The surgical aspects of scurvy are important, and it may at once be stated that the presence of this disease should, unless under very exceptional circumstances, always contra-indicate any sort of operation. All processes of repair appear to be perverted, ulcers have a foul malignant appearance, somewhat simulating fungus, and, if tissues be destroyed, numerous granulations form, fill up the wound, and project beyond the surface (*Parkes*). Experiences gleaned during the Crimean war abundantly proved the unfavourable influence exercised by scurvy over all operations performed during the first winter in the camp before Sebastopol. McLeod says that "scurvy was the destructive agent against which it was most difficult to cope. Hæmorrhages of frequent repetition and difficult of suppression; fractures refusing to unite; sores unaccountably hard to heal. The sloughing buboes which they (*i.e.* the French) had to contend against were amongst its worst complications." "It is somewhat remarkable that the regulations require the issue of limejuice to troops on board of ship, when salt meat is issued for a certain number of days, but that there is not any similar provision for the protection of troops on shore, though the necessity may be equally urgent, as it has been in the Crimea, and would be in a fortress that was invested or blockaded." (*Army Reports*.) Milroy says that the almost entire disappearance of scurvy from our army during the last twelve months of the occupation, while it continued to exist in other parts of the allied camp, affords a convincing proof how much some forms of disease, which have often been most destructive to armies, may be prevented by attention to one set of hygienic requirements. The total number of admissions into hospital for this disease during the Crimean war was 2,096, of which 1,836 were noted between 1st of July 1854 and the same day of the following year. Dr. Marlin (28th Regiment) remarks that, during the first six months of the siege, nearly every admission

into hospital exhibited unequivocal signs of the scorbutic taint. The Medical Director-General of the Army, in his report on the surgical history of the Crimean war, says, in speaking of scurvy, "Even in cases where recovery did take place, its influence was largely and banefully felt; not only were wounds slow to heal and supuration profuse, but many uncomplicated flesh wounds remained in a state of chronic ulceration, with little tendency to heal or to spread, and the fact that limejuice and other means remedial against scurvy are reported to have been of great and marked utility in a large number of cases, sufficiently shows their nature." Scurvy does not appear to have exhibited, during this war, the very marked symptoms observed at sea, but it is probable that this was in a great measure owing to the presence of dysentery or some other intestinal complication in those who were the subjects of scurvy. The medical history of the American war furnishes similar records as to the unfavourable circumstances under which all operations performed on scorbutic patients must be conducted. The surgical deck of the Dreadnought Hospital Ship is seldom without cases that have been brought from the medical department in a semi-convalescent state as to scurvy, but with a fracture slowly uniting, a bubo still retaining the dull blueish discoloration round its edges, or a wound filled with unhealthy and excrescent granulations. Cases of this kind remain in hospital from three to twelve months, and seldom appear to regain at the end of that time a reasonable standard of health. It is likely that even, in future years, the exigencies of war will still tend to the production of scurvy, inasmuch as large bodies of men are suddenly collected in a comparatively confined area, under unfavourable hygienic conditions, and furnished with a very scanty supply of vegetables or fruits of any kind. But, as it is now practicable to provide the crews of ships with a proper scale of diet, and, as moreover, marine passages now seldom exceed five months, this disease should be unknown in the mercantile, as it has been for some years, in the Royal Navy. It cannot be denied that all other asthenic diseases predispose to scurvy, and that if men are the subjects of venereal or other maladies afloat, the occurrence of scurvy in such cases is probable. But it is not, on that account, excusable, nor, with the vast variety of portable prandial material now at command, can we allow that scurvy should ever complicate other diseases at sea.] (*Harry Leach*.)

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SEARCHING. The operation of introducing a metallic instrument, through the urethra, into the

bladder, for the purpose of ascertaining whether the patient has a stone or not. (See SOUNDING.)

**SETON.** A kind of issue, usually made by means of a flat needle, from half an inch to nearly an inch in breadth. The needle is commonly a little curved. From the point, to its broadest part, it is double-edged, and, behind, it has a transverse eye, through which a skein of thread or silk is placed. A fold of skin is pinched up, at the part where the seton is designed to be made, and the needle is pushed through it, together with the skein of thread, which is first dipped in sweet oil. The instrument is not to be introduced too low into the base of the fold, nor too high, near its edge. In the first case, the muscles, and parts, which ought to be avoided, might be wounded; in the second, the interspace between the two wounds would be narrow, and the seton soon make its way through it.

When no seton-needle is at hand, the fold of the skin may be punctured with a lancet, and the skein of thread introduced by means of an eye-probe. A seton may be applied almost to any part of the surface of the body, when circumstances require it; but, one of its openings should always be made lower than the other, that the matter may readily flow out. The skein of thread is to remain untouched, for a few days after the operation, until the suppuration loosens it. Afterwards, the part of the thread, nearest the wound, is to be smeared with oil, white cerate, or any common ointment, and drawn under the interspace between the two wounds, and what was there before is to be cut off. The seton is to be drawn in this manner once or twice a day, according as the quantity of matter may require. A new skein of silk, or thread, is to be attached to the preceding one, as often as necessary. Care is to be taken to keep the thread on the outside of the wound well covered, and free from the discharge, which would make it stiff and hard, and apt to occasion pain and bleeding on being drawn into the wound. If the discharge should be deficient in quantity, powdered cantharides or savine may be mixed with the ointment. A neater, and less troublesome kind of seton, is that in which a thin, smooth slip of elastic gum is employed, instead of silk. The elastic gum tape is generally about four inches long, and half an inch wide; the needle for conveying it through the integuments has no eye, but takes hold of it in the manner of a pair of forceps. This kind of seton has the recommendation of being less painful than the common one, more cleanly, and does not require the repetition of the disagreeable operation of changing the silk. When it is wished to render it more irritating, the elastic gum slip may be drawn a little out of either opening, and smeared with savine ointment.

**SHINGLES.** See SKIN, DISEASES OF.

**SILVER, NITRATE OF.** (*Lunar Caustic.*)

One of the best of the milder caustics. Its utility in stimulating indolent ulcers, and keeping granulations from rising too much, is well known to every surgeon. Mr. Hunter sanctions its application in the early stage of a chancre, while absorption of the syphilitic virus may not yet have taken place. He directs the caustic to be scraped to a point, like a black-lead pencil; every part of the chancre to be touched with it, and the repetition of this process till the last slough thrown off leaves the sore florid and healthy. The plan has

been advocated by many other surgeons, in the hope that it may lessen the chance of the constitution becoming affected; and it is occasionally resorted to by those who use mercury, as well as by others who trust to other means for the cure of the venereal disease.

The important use of the nitrate of silver in the cure of numerous diseases, which fall under the care of surgeons, I have noticed in various articles of this work. The late professor Delpech believed that it had greater power than any other escharotic or stimulant in expediting the process of cicatrization. I entertain the same belief. Its efficacy in the relief and cure of many diseases of the eye, may be learned from the explanations given in the articles CORNEA, IRIS, CONJUNCTIVITIS, &c. As an application to this organ, it is used either in substance, or in the form of a lotion, or of the black ointment, containing from ten to twenty grains of the nitrate to each drachm of lard. Some examples of lupus, or *noli me tangere*, are benefited by the nitrate of silver, and a strong solution of it agrees well with certain obstinate ulcerations, which occur round the roots of the nails of the fingers and toes. The lotion is sometimes applied by means of a camel-hair brush; sometimes by means of lint; sometimes with a syringe; and occasionally by dropping it on the part, as for instance the eye.

In an interesting "*Essay on the Use of Nitrate of Silver*, ed. 2, 8vo. London, 1829," Mr. Higginbottom notices its influence in subduing inflammatory action. That it "should subdue the inflammation of phlegmon, or of a line of inflamed absorbents, arrest the spreading of erysipelas, prevent and modify the formation of pus (says he), are facts I believe totally new." In some cases of external inflammation, he finds it sufficient merely to blacken the cuticle; in others, it is necessary to produce a degree of vesication. In some instances, the application has appeared to prevent suppuration; in others, a plainly fluctuating fluid has been absorbed. Mr. Higginbottom throws out a suggestion, that the application may prove useful also in internal inflammation, by inducing prompt vesication over the inflamed part, or even without it. But, for a particular account of its use in phlegmonous inflammation, whitlow, erysipelas, inflammation of the absorbents, wounds, ulcers, burns, and cases of hard painful cicatrix from the latter injuries, I must refer to this gentleman's publication, in which will also be found observations on its employment, in examples of diseased joints, inflammation of the urethra, neuralgia, contracted rectum, ulceration of the tongue, eye, and navel of infants, and corns. In University College Hospital, I often employ it as a means of checking the extension of erysipelas, which sometimes will not pass beyond a black line made with it. Its use in strictures, and many of the cases here specified, are further explained in other parts of this **DICTIONARY**.

**SINUS.** A long, narrow passage, or canal, discharging from time to time purulent matter, and leading from some abscess, diseased bone, &c.

[**SKIN, DISEASES OF.** Diseases of the skin are morbid affections of the external surface-membrane of the body; sometimes involving the general structure of the skin; sometimes special elements of its structure, as its vessels, nerves, papillae, hairs, and glands; and sometimes causing derange-



ment of its functions, namely, sensation and secretion, the secreted products of the skin being the epidermis, nails, sebaceous matter, and perspiration.

A classification of diseases of the skin, founded on a view of the structures involved in the morbid phenomena, would constitute a *physiological* classification, and might be detailed as follows:—

1. Diseases of general structure, including inflammation and its consequences.

2. Diseases of special structure; namely, of *vessels*, for example, *nævus*; of *nerves*, for example, *hyperæsthesia* and *anæsthesia*; of *papillæ*, for example, *verruca* and *clavus*; of *hairs*, for example, *tinea tonsurans*; of *glands*, for example, *acne* and *molluscum adenosum*.

3. Disorders of function; namely, *sensation*, which might be referred back to diseases of nerves; and *secretion*, for example, secretion of epidermis, of nails, of sebaceous matter, of perspiration.

Diseases of the general structure of the skin present special and characteristic signs, such as redness, papulation, lymph-effusion, suppuration or pustulation, and desquamation; and these five signs of disease, or lesions, are the groundwork of the classification which is in common use in this country, a pathological classification, the so-called classification of Willan. This classification, which is purely artificial, may be called the classification of pathological signs or appearances, and its application is as follows:—*Redness* is the type of one of the eight orders of diseases of the skin of Willan, the order *Exanthemata*; *papulation* supplies him with two orders, *Papulæ*, or small pimples, and *Tubercula*, or large pimples; *lymph-effusion* also constitutes two of his orders, namely, *Vesiculæ*, or small vesicles, and *Bullæ*, or large vesicles or blisters; *pustulation* suggests a sixth order, *Pustulæ*; and *desquamation* a seventh, *Squamæ*; the eighth, and remaining Willanean order, namely, *Maculæ*, includes stains or marks of the skin and discolorations not due to simple vascular congestion or inflammation.

The pathological classification, in other words, the classification founded on the elementary pathological lesions of the skin, dates back to an early period of systematic medicine. Riolanus, an author of the sixteenth century, informs us that some physicians include all diseases of the skin under three genera, namely, alterations of *smoothness*, of *colour*, and of *magnitude*; but, as this arrangement affords no place for disorders of the hair, others prefer to distinguish the groups under the three heads of *Pustules*, *Deformities*, and *Tubercles*; *Pustules*, comprehending all eruptions attended with roughness of the skin, whether pimples, vesicles, pustules, or scales; *Deformities*, marks of all kinds, morbid coloration, and diseases of the hair; and *Tubercles*, warts and condylomata. At a later period, 1776, Plenck amplified this simple grouping into fourteen classes, which he then subdivided into one hundred and fifteen genera. His fourteen classes are as follows:—*Maculæ*, *Pustulæ*, *Vesiculæ*, *Bullæ*, *Papulæ*, *Crustæ*, *Squamæ*, *Callositates*, *Excrecentiæ*, *Ulcera*, *Vulnera*, *Insecta*, *Morbi unguium*, and *Morbi pilorum*. And Willan, in 1798, reduced this number of groups to the eight orders already enumerated, discarding, with more or less reason, *crustæ*, *callositates*, *excrecentiæ*, *ulcera*, *vulnera*, *insecta*, *morbi unguium*, and *morbi pilorum*.

The Willanean system of classification, or, as the French writers term it, the Teutonic-Anglican classification, resembles, in most respects, the Linnæan classification of plants; it gives a speedy help to the discovery of the name of the disease, but it affords no further information; it neither assists the learner to a knowledge of the natural affinities, nor of the cause of the complaint, and it is therefore of no value as an aid to medical treatment. Its peculiar adaptation to diagnosis, however, is a great temptation to retaining it, and to this its popularity and universality are consequently due; it is essentially the classification of diagnosis; a merit of no mean significance.

The mode of application of the Willanean classification is as follows:—The student has exhibited to him an eruption, the leading character of which is *redness*, without perceptible elevation of surface; a redness which is clearly due to hyperæmia, or congestion of the vascular system of the skin; he perceives at once that he has to deal with a disease which belongs to the order *Exanthemata*. Or, the predominant character of the eruption may be *pimples*, raised above the general level of the skin; the pimples are of small size, probably minute, there is more or less redness of the ground from which they spring, and the pimples themselves are more or less red; the case is one, obviously, belonging to the order *Papulæ*. Or, instead of being small, the pimples are large and broad, probably the size of a split pea, may be some are smaller and some larger; these are no longer pimples, they are *tubercles*, and their specific designation will be found in the order *Tubercula*. Or, perchance, instead of little hard pimples, we find minute *vesicles*, rising from a red, and, possibly, somewhat swollen ground; they are minute bladders of lymph or serum, and, where they are broken, there is a watery-looking fluid exuding from the skin; here, then, is a member of the order *Vesiculæ*. But if the vesicles, instead of being small and usually congregated, are large, forming *blisters*, varying in size from the hemisphere of a pea to that of an egg, they are termed *bullæ*, that is, bubbles, and the disease to which they belong will be found under the order *Bullæ*. Or, the vesicles and smaller *bullæ*, instead of containing serum or lymph, may be filled with pus; then they are *pustules*, and are grouped in the order *Pustulæ*. Seventhly, instead of simple redness, or *papulæ*, or *vesiculæ*, or *bullæ*, or *pustulæ*, the morbid skin may exhibit, as a principal character, whitish *scales*, of a certain thickness, but variable in size and shape; the eruption distinguished by scales is therefore to be looked for under the head of *Squamæ*; or, eighthly, and lastly, the predominant character may be *discoloration* of the skin; it may be brown or red, purple or blue, yellow or black, or even white; this is a case belonging to the order *Maculæ*. So that with the most moderate study of this classification the learner may be in a position to distinguish, in other words, to determine the diagnosis of diseases belonging to the eight Willanean orders of diseases of the skin; he has only to assure himself as to the eruption before him being simple redness, a crop of pimples, vesicles of smaller or larger growth, pustules, scales, or mere stains or marks. Let us now examine these orders more closely, with the view to distinguish their component diseases.

The eight orders of Willan are treated by him-

self and by Bateman as independent entities, as though they had no mutual relation with each other, and are arranged as follows:—1. Papulæ; 2. Squamæ; 3. Exanthemata; 4. Bullæ; 5. Pustulæ; 6. Vesiculæ; 7. Tubercula; 8. Maculæ. But these groups have in reality an important relation with each other, and that relation is made apparent when they are arranged somewhat differently, for example:—1. Exanthemata; 2. Papulæ; 3. Vesiculæ; 4. Bullæ; 5. Pustulæ; 6. Squamæ; 7. Tubercula; 8. Maculæ. And it is according to the latter arrangement, which rests on a physiological as well as on a pathological basis, that we shall proceed to examine them.

1. *Exanthemata*, derived from ἐξανθεῖν, to blossom, is intended to signify those appearances of the skin which are known as an efflorescence or rash (rush). They are “superficial red patches variously figured, and diffused irregularly over the body, leaving interstices of a natural colour and terminating,” for the most part, “in cuticular exfoliation.” In other words, exanthemata are characterised by vascular congestion of the skin, the consequence of inflammation, and unattended with elevation of the surface. The diseases included by Willan under this head, are—Rubeola, Scarlatina, Urticaria, Roseola, Purpura, and Erythema. In Rubeola or Measles the redness presents a raspberry hue, and is disposed in small patches which correspond with the natural healthy mottling of the skin; in Scarlatina, the redness is brighter, has a vermilion tint, the skin is less mottled and the redness more diffused; that is, distributed in large patches, or is uniform; in Urticaria, the redness has a bright vermilion tint, occurs in patches of irregular size, is studded over with whitish elevations termed *wheals*; or, in its more chronic forms, the redness is dull, and the wheals of a mingled red and white colour; in Roseola, the redness is a dull crimson or rose colour, and the form of the patches either mottled like rubeola, or circular, or annular; in Purpura, the redness is due, not to vascular congestion of the skin, but to the extravasation of blood into the tissues of the skin, and the tint of redness corresponds with the known hues of blood effused from its vessels; being, at first, brightly red, and becoming, after a time, crimson, then purple, and then black, fading as it disappears into brownish and yellowish stains; the redness of purpura may always be distinguished from the redness of hyperæmia or vascular congestion, by remaining permanent under pressure with the finger, whereas, under a similar pressure, in vascular congestion, the redness disappears and the skin becomes white; in Erythema, the redness may be bright or dull: and the term is applicable to every morbid redness of the skin not included in the preceding forms, and obeying the general definition of redness without perceptible, or with but slight and uniform, elevation of surface.

2. *Papulæ*. Papula (pimple) “a very small and acuminate elevation of the skin, with an inflamed base, and commonly terminating in scurf.” The diseases belonging to this group are three in number—namely, Strophulus, Lichen, and Prurigo. Strophulus is a papular or pimply eruption common to infants; Lichen is an eruption of small pimples common to every period of life from childhood to old age; and Prurigo is more particularly met with in elderly

persons, or in those in whom the skin has fallen into the wasted condition which is so frequent in advanced life. All these eruptions are remarkable for the pruritus with which they are accompanied, and which from its severity has suggested the especial designation, “prurigo.”

3. *Vesiculæ*. A vesicle is an elevation of the cuticle of small size, arising upon a more or less inflamed cutis, and distended with serum or lymph. Vesicles are sometimes semiglobular, and sometimes conical or acuminate in form; and their contents, which are at first transparent and colourless, become milky and sometimes purulent as they advance to maturity. They terminate, by the desiccation of their fluid contents, into a scab or thin crust; or as happens commonly in eczema, in rupture, and concretion of the discharged fluid into spongy crusts of considerable thickness. The diseases comprehended in this group by Willan, are:—Eczema, Miliaria, Herpes, Varicella, Vaccinia, Rupia and Aphtha. Eczema is the type of vesicular eruptions (so that the term eczematous eruption may be taken as synonymous with vesicular eruption), and is, at the same time, among the most frequent of the diseases of the skin. The vesicles in eczema are very small, rarely distinct, but commonly aggregated, and not unfrequently blended together in clusters so as to form a multilocular and slightly elevated vesicle of considerable extent. Miliaria is an eczema in which the vesicles are somewhat larger than those of true eczema, distinct, filled with a serous fluid, and dispersed over a surface unaltered by inflammation. In Herpes the vesicles are of larger size, hemispherical in shape, developed on an inflamed ground of circumscribed extent, distended with lymph which passes through the various stages of transparent, opalescent, yellow and purplish, and terminate in thick brownish or black crusts. Varicella or chicken-pox is a semiglobular vesicle of small size, remarkable for its crystal-like transparency, becoming opalescent in the course of a day; it is dispersed over the general surface of the body; appears in successive crops during four or five days; terminates in thin friable and brownish crusts; is a disorder of children, and is accompanied with some slight febrile disturbance. Vaccinia is the vesicle cow-pox. Rupia is a venereal ulcer in its vesicular stage, and can only be recognised by its association with other symptoms of constitutional syphilis. And, Aphtha is a vesicle of the mucous membrane, usually met with in the mouths of infants, and rarely seen in the vesicular stage, being commonly indicated by a white opacity with thickening and softening, or by abrasion of the epithelium.

4. *Bullæ*. Bulla, a bubble, bleb, or blister—that is, an elevation of the cuticle, ranging in size from a large pea to a hen’s-egg, and distended with serum, is the typical character of this order. There is very little redness surrounding the base of the bullæ, and their contents are colourless or yellowish, sometimes as deep as amber, and sometimes tinged with blood. The diseases comprehended by the order *Bullæ*, are—Erysipelas, Pemphigus, and Pompholyx. The bullæ of Erysipelas vary in size from that of a split pea to a hazel nut; they are oval or circular in figure, and developed upon a portion of skin which is tumefied and brightly red; moreover, erysipelas is an acute affection, and is accompanied with febrile symptoms



of greater or less severity. The bullæ of Pemphigus and Pompholyx are sometimes solitary and sometimes developed in clusters; both are chronic affections, and so closely allied, as to be regarded by dermatopathologists as the same disease, differing only in degree of chronicity, pemphigus being somewhat more general in its attack than pompholyx, and accompanied with more heat and redness; and pompholyx being remarkable for the absence of heat and redness, for a larger development of bulla, and for its more solitary character.

5. *Pustulæ*. A pustule is an elevation of the cuticle, otherwise, a vesicle distended with pus; it is commonly hemispheroidal, but is sometimes conoidal, and is developed on a more or less inflamed base, which forms a halo around its circumference. It varies in size from a mere point to one or two lines in diameter. Several kinds of pustules are distinguished by authors, for example:—Phlyzaciun, a large pustule with a hard and inflamed base; Psyraciun, a small pustule occurring in clusters, frequently confluent; the psyraciun at first contains lymph, which gradually becomes purulent. Achor,\* a small pustule developed on the scalp, around the mouth of the hair-follicle; and Favus, a deep pustule, also developed around the mouth of a hair-follicle. The diseases included by Willan, in the order *Pustulæ*, are—Impetigo, Ecthyma, Porrigo, Variola, and Scabies. Impetigo is a rash of small psyracious pustules, unattended with a deep or severe inflammation of the skin; it may be regarded as a purulent eczema, and is commonly associated with the latter eruption. Ecthyma is an eruption of phlyzacious pustules; they are generally solitary, and scantily dispersed over the affected region. Porrigo is used by Willan as the generic appellation of all pustular affections of the scalp, whether of the nature of Achores or Favi; but, according to its original and proper signification, it should be applied only to a state of scurfiness of the skin, and especially to pityriasis and chronic eczema. Variola is the pustule of smallpox. And Scabies, the large, superficial and well-defined pustule which is met with in the purulent variety of itch.

6. *Squamæ*. A scale is “a lamina of morbid cuticle, hard, thickened, whitish, and opaque. Scales, when they increase into irregular layers, are denominated *crusts*.” Such is the definition of the morbid appearance of the skin, which includes *Lepra vulgaris* (Alphos), Psoriasis, Pityriasis, and Ichthyosis. In *Lepra vulgaris* or Alphos the scales are laminated, whitish, and silvery, of moderate thickness, and either isolated or confluent. When isolated, they are circular, free around the edges, and vary in size from the eighth of an inch to one or two inches in diameter, often resembling wafers adherent to the skin. When confluent, the scales are more apt to assume the character of crusts, and are of unlimited extent, sometimes embracing the convexity of a joint, such as the elbow or knee, and sometimes an entire limb. The slight degree of redness which occupies the base of the patches of *lepra vulgaris* is due to a specific inflammation, and the inflamed base is somewhat elevated. Psoriasis (*eczema squamosum*) is distin-

guished by small, thin, and irregular scales, developed on patches of skin thickened by common chronic inflammation, the sequel of chronic lichen or chronic eczema. Patches of psoriasis have no regularity of figure; they are often of considerable extent, and are frequently accompanied with cracks and excoriations. Pityriasis is an erythema of a slight and superficial degree, accompanied with thin and very minute scales, which have been compared to bran, furfures; there is no thickening of the skin as in *lepra vulgaris* (alphos) and psoriasis, and no cracking or excoriation, as in psoriasis. Its common seat is the face and scalp, and in the latter situation, it is commonly called dandruff or dandruff. Ichthyosis is the result of a congenital malformation of the epidermis, the scales not being the product of an inflamed skin, but of an ill-developed and ill-nourished skin. The cutaneous surface is hard, dry, rough, and discoloured; and the scales present considerable variety of thickness and form; being, in some parts, thin laminæ of shining cuticle; in others, variously shaped crusts; in another place dry, crumbling granules; and, again, elongated and rigid spines.

7. *Tubercula*. A tubercle is “a hard, superficial tumor, circumscribed and permanent, or proceeding very slowly to suppuration.” This order embraces a considerable number of very dissimilar affections, having, as a sole uniting link, the above comprehensive definition. For example: Phyma, Acne, Sycosis, Molluscum, Lupus, Vitiligo, Elephantiasis, Frambæsia, and Verruca. Phyma is a suppurating tumor or cutaneous abscess, and the term has been applied generically to the group of furuncular affections: for example, furunculus, terminthus, hordeolum, and anthrax. Acne is the small papular tubercle which is so frequent on the forehead, face, and back of young persons, and sometimes met with in the adult. Sycosis is a pustular affection attacking the hair-follicles of the beard and whiskers, sometimes simply pustular, and sometimes tubercular. Molluscum is a small, prominent tumor, sometimes pedunculated, arising from hypertrophy of a sebiparous gland, and occurring upon the face or neck, and sometimes on the eyelids of children. The term is also used in a wider signification, so as to include all simple tegumentary growths, of a pouch-like form, soft to the touch, and innocent in their nature. Lupus is a tubercle arising from a specific disorganisation of the skin and terminating either in absorption or ulceration. Its common seat is the cheek, the nose, the scalp, and the back of the hand. The term Vitiligo is applied, very correctly, by Willan and Bateman, to a pathological form of disease that appears to correspond with the leuce of Celsus. Elephantiasis, the lepra of the Greeks, is a specific disease, remarkable for the development of tubercles of a deep red or bronze colour, on the forehead, along the eyebrows, on the nose and cheeks, and on other parts of the body. Frambæsia is an eruption of tubercles, resembling a raspberry in figure, epidemic among the negroes both in Africa and in the West Indies; while Verruca is the cuticular growth which is popularly termed a wart.

8. *Maculæ*. Macula, a mark, or stain, or spot, is a “permanent discoloration of some portion of the skin, often with a change of its texture;” and the examples of macula, are:—Ephelis, Spilus, and Nævus. Ephelis includes all discolorations of the

\* The term *achor* signifies *scurf*, being derived from *achuron*, chaff or bran; and is therefore applicable more correctly to the desiccated and desquamating product of the pustule than to the pustule itself.

skin unattended with thickening; the seat of the discoloration is the rete mucosum; and freckles are a common illustration. Spilus and Nævus comprise the group of mothers' marks; the spili being those marks which are characterised by pigmentary discoloration; and the nævi such as are due to an abnormal development of the vessels of the skin, whether of its arterial or its venous structure.

Having, with the aid of the Willanean classification, succeeded in finding the order to which a particular disease belongs, and having also determined its genus, we have, in the next place, with the view to establish a correct diagnosis, to ascertain its species or variety; and having settled the species, there remains the still graver duty of prescribing an appropriate treatment. But a knowledge of the proper treatment of a disease must be preceded by a knowledge of its *cause*; and, for the discovery of the cause of cutaneous diseases, the Willanean classification is no longer serviceable. We will, therefore, while our attention is still engaged with the genera, and before we proceed to investigate further its species and varieties, take into consideration the nature of the *cause* of cutaneous disease.

A classification founded on the *cause* of disease, in other words, an *Etiological classification*, is especially valuable to the physician or surgeon, inasmuch as it supplies him with the key to the proper treatment, without a knowledge of which all classification, however scientific or refined, must be of little practical worth. The Willanean classification will still be employed for the purposes of diagnosis, and will be of great use to the student of these diseases; but the practitioner will find his best help in a properly constituted etiological classification. Acting upon this idea we some years ago proposed a classification, founded on the cause of these complaints, of which the following is a summary:—

The diseases affecting the general structure of the skin admit of arrangement into five groups, according as they arise: 1, from general causes; 2, from special external causes; 3, from special internal causes; 4, from the syphilitic poison; and 5, from organic poisons of unknown origin.

1. The general cause principally concerned in the production of cutaneous diseases is lowered vital power, however induced, and giving rise to derangements of innervation, of assimilation, of hæmotosis, and of nutrition; and the groups or genera included under this head are:—Erythema, the type of the exanthemata; lichen, the type of papulæ; eczema, the type of vesiculæ; impetigo and ecthyma, the type of pustulæ; herpes and pemphigus, the type of bullæ; phyma, the type of the furuncular eruptions; and purpura. Erythema as the type of exanthematic eruptions is associated with erysipelas, urticaria, and roseola. Lichen stands at the head of a group of which gutta rosacea, strophulus, and prurigo, are members; and eczema, the psora of the Greeks, brings with it its chronic or squamous form Psoriasis, and Miliaria. 2. The special external causes of disorders of the skin are, parasitic animals,\* and extremes of heat

and cold:—for example, Scabies; Malis, or cutaneous vermination; Combustio or burn; and Gelatio or frost bite. 3. The special internal causes are such as give rise to lepra vulgaris or alphas, lupus, scrofuloderma, cheloides, and elephantiasis Græcorum. 4. The cutaneous disorders proceeding from the syphilitic poison assume the principal typical forms of cutaneous eruption in general, for example, erythema and roseola, lichen, tubercula, and rupia; to which may be added onychia and alopecia. 5. The diseases arising from organic poisons of unknown origin, and inducing eruptive fevers, are: rubeola, scarlatina, variola, varicella, vaccinia, and equinia.

Before, however, we leave the subject of classification, it may be well to take a brief survey of the chief classifications and arrangements under which cutaneous diseases have been heretofore grouped. In studying these diseases, our first object is *diagnosis*; hence we have already drawn attention to that form of classification which may be regarded as essentially a classification of diagnosis, namely the classification of elementary pathological lesions; the classification which originated with the German nosologist Plenck, and has been subsequently pruned and improved by Willan. But the time has now arrived when the student of cutaneous medicine seeks for another kind of information; he desires to discover the *cause* of these diseases, in order that, knowing the cause, he may be guided to a rational and appropriate *treatment*. Out of this want has arisen the idea of another kind of classification, a classification which, in contradiction to the *artificial* method of Plenck and Willan, and in imitation of the botanical system of Jussieu, as compared with that of Linnaeus, has been denominated the *natural classification*. A natural classification must, therefore, lead us to the treatment of the disease through a knowledge of the cause; hence it is also named an *Etiological* or a *Therapeutical* classification.

The earliest natural classification of cutaneous diseases, with which we are acquainted, is that of Celsus; who divides them into—1, such as should be treated with diet; 2, such as should be treated with medicines; and 3, such as should be treated by surgical means. This is obviously a *therapeutical classification*; but he further introduces into it a topographical element, when he subdivides the diseases to be treated by medicines into a group of general, and a group of topical affections. Another natural classification of more recent times, is that of Alibert, first published in 1810; and remodelled in 1832. Alibert's classification, the "Arbre des Dermatoses," is founded on certain affinities or analogies which are supposed to exist between certain diseases, and to lead consequently to a method of treatment which is similar for each separate group. His groups or families of cutaneous eruptions, twelve in number, the twelve branches of the "Arbre des Dermatoses," are as follows:—Eczematous; exanthematous; teigneous; dartrous; cancerous; leprous; verolous (syphilitic); strumous; scabious; hæmatous; dyschromatous; and heteromorphous.

Devergie rejects the imputation of invention in the method of grouping which he has adopted in his excellent work, and which he modestly distinguishes by the name of "arrangement." As the basis of this arrangement, he endeavours to

\* Some dermo-pathologists admit another cause of external origin in a parasitic vegetable fungus, developed in the skin. The diseases attributed to this cause will be found in a group by themselves, under the name of Phytodermata, among the "Diseases of the hair-follicles and hairs."



assemble together, in separate groups, diseases which are allied in their amenability to treatment; such as resemble each other in the form of the disease; such as have resemblances in pathological products or accidental conditions; and such as are of foreign origin: and he has succeeded in establishing fourteen groups, seven of which correspond with Willanese orders, the remaining seven being:—affections dependent on vegetable parasites, affections dependent on animal parasites, scrofulous affections, syphilitic affections, diseases of foreign origin, diseases of nails, and infantile diseases, especially of the hairs.

Hardy, the most recent author of a natural classification, revives the views and some of the groups of Alibert; for example, the darts. In other respects, his classification takes for its groundwork an etiological or therapeutical basis. Of his ten classes, seven are founded on the cause of the disease; for example, two, the special poisons of the eruptive fevers and syphilis; three, diathesis, namely, dartrous, scrofulous, and cancerous; one, parasites; and one, symptomatic of internal disease. The three remaining classes are—one, topical, namely, local inflammations; one, elementary lesion, maculæ and deformities; and, one, diseases of foreign origin. Viewed more in detail, his ten classes are as follows:—1. *Maculæ and Deformities*, including alterations of colour, maculæ, red stains, epheles, vitiligo, lentigo, warts, molluscum, ichthyosis, and cheloides, diseases requiring no medical treatment in general, but in the event of a cure being sought for, to be removed by the knife or by caustics. 2. *Local Inflammations*, independent of any constitutional disturbance; or if any constitutional symptoms appear at the outset of the disease, they are limited to feverishness of the slightest and most transient kind. The members of this group are—erythema, urticaria, herpes, ecthyma, pemphigus, &c. The treatment required is very simple, mildly antiphlogistic, local and general. 3. *Parasitic Diseases*, purely local, and due to the presence of a parasite, animal or vegetable; for example, scabies, sycosis, herpes circinatus, and favus. The treatment is obvious—destruction of the parasite. 4. *Eruptive Fevers*, dependent on a general cause, the admission into the system of a virus distinct for each variety of disease; for example, scarlatina, rubeola, variola, &c. The eruption on the skin is preceded and accompanied by symptoms of constitutional disturbance of greater or less intensity. In conducting the treatment, the natural course of the disease is to be respected, and complications only attacked. 5. *Symptomatic Eruptions*: the eruption is secondary; the treatment must therefore be directed against the primary disease. The diseases belonging to this group are herpes labialis, the roseolous spots of typhoid fever, sudamina, and purpura. 6. *Darts*; eruptions due to a particular state, a general disposition of the economy, called diathesis. The members of this group are eczema, psoriasis (alphos), lichen, and pityriasis. These diseases are constitutional, the treatment consequently must be general as well as special. 7. *Scrofulides*, an important group, dependent on the scrofulous diathesis. The treatment must be constitutional to control the diathesis, as well as locally alterative. 8. *Syphilides*, resulting from the syphilitic diathesis, a tendency not necessarily innate or hereditary, but ordinarily

accidental. The treatment must be the same as that which is adopted for syphilis. 9. *Cancers*: the most common form of cancer affecting the skin is that which is termed cancroide. The treatment is the removal of the disease by the knife, or, by preference, through the means of caustics. 10. *Exotic Diseases*, the produce of other countries; for example, lepra tuberculosa, pian, &c.

The plan of classification of cutaneous diseases will be rendered sufficiently obvious by the examples which we have already given; and we repeat, that for the purpose of diagnosis, the artificial classification of Plenck and Willan stands pre-eminent. How far the natural classifications may fulfil the objects for which they were framed, we are unable to say. The artificial classification rests upon positive data—real pathological lesions, about which there cannot be a doubt; not so, however, the etiological and therapeutical classification. Differently organised minds may take different views of the nature of a supposed cause, and derive from those views very different conclusions; and there is always the great danger, in matters which rest more upon opinion than fact, of methods, or systems, or classifications, taking the form of theories of the individual who proposes them. Thus, if we were inclined to survey with a critical eye the classification of Hardy, we might ask, How are we to distinguish between local inflammations pure, and local inflammations symptomatic? Are erythema, urticaria, herpes, and pemphigus, really local inflammations with so little constitutional disturbance as to render internal treatment almost needless? Are herpes labialis, the roseolous spots of typhoid fever, sudamina, and purpura, deserving of being constituted a group of cutaneous diseases, even if they were the only examples that could be selected to illustrate symptomatic eruption? Is not urticaria ab ingestis a symptomatic eruption? Again, is it not an extreme of courtesy to admit the roseolous spots of typhoid fever and the stains of purpura to the distinction of being eruptions at all?

We say that these are questions that might be asked, and they may be taken as an evidence, simply, of the great difficulties that stand in the way of a perfect natural classification.

Of a more scientific character is the classification of Hebra, who advocates the homogeneity of the skin with the rest of the economy, and takes as the groundwork of his arrangement the pathology of the general system, adapting this pathological framework to the special organ, the skin. His classes, twelve in number, are as follows:—*Hyperæmiæ*, *anæmiæ*, *anomalix secretionum et organorum secermentum*, *exsudationes*, *hæmorrhagiæ*, *hypertrophix*, *atrophix*, *neoplasmata*, *pseudoplasmata*, *ulcerationes*, *neuroses*, and *parasitæ*. The *hyperæmiæ* are active and passive, and each division idiopathic and symptomatic; the active idiopathic diseases being erythema traumaticum, caloricum, et ab acerbis seu venenatum; the symptomatic, erythema seu roseola infantilis, variolosa et vaccina; the passive, idiopathic, livedo mechanica et calorica; and the symptomatic, cyanosis. The *anæmiæ* are, *anæmia ex jacturâ sanguinis*, and *ex inervatione anomalâ*. *Anomalix secretionum et organorum secermentum*, comprehend anomalies of quantity and quality of the sebaceous and sudatory secretion, together with comedo,

miliun seu grutum, and molluscum contagiosum. The *exsudata* are acute and chronic, the former being contagious and non-contagious. The acute contagious exsudata are, morbilli, scarlatina, variola, and vaccinia; the acute non-contagious, erythemata polymorpha, roseola, urticaria, dermatitis including erysipelas, furunculus, anthrax, and farcinoma; and phlyctænosen, for example, herpes, miliaria, sudamina, and pemphigus acutus. The chronic exsudata comprehend the squamous, pruriginous, acneform, pustulous, and pemphigous affections. *Hæmorrhagicæ* is devoted to purpura. *Hypertrophicæ* embraces excessive production of the epidermis, pigment, corium, follicles, and appendages; *Atrophicæ*, diminished production of the same structures. *Neoplasmata* includes abnormal growths of normal structures, for example, condyloma, molluscum simplex, acne rosacea, lupus, cicatrices, cheloid, callus, fatty tissue, vascular tissue, cholesteatomatous substance, osseous tissue, and melanotic substance. The *pseudo-plasmata* include the abnormal tissues of cancer and tubercle. *Ulcerationes* are idiopathic and symptomatic; *Neuroses*, hyperæsthesia, anæsthesia, and dermatospasmus; while the *Parasiticæ* are divided into two groups, dermatophyta, comprehending favus, alopecia, and sycosis; and dermatozoa, pediculi, acarus folliculorum, and sarcoptes hominis.

Having in view the wants of the practitioner as well as those of the student, we have thought it desirable to make another effort in the direction of a natural classification. We have taken as our groundwork the *clinical* history of cutaneous diseases, and selected as our governing idea the most striking features of the individual diseases, whether in their nature, pathological, etiological, or physiological; and upon this plan, we have collected all the known diseases of the skin into *twenty-two* groups of morbid affections, as follows:—1, *eczematous*; 2, *erythematosus*; 3, *bullous*; 4, *furuncular*; 5, *nervous*; 6, *vascular*; 7, *hæmic*; 8, *developmental* and *nutritive*; 9, *hypertrophic* and *atrophic*; 10, *alphous*; 11, *strumous*; 12, *carcinomatous*; 13, *zymotic*; 14, *syphilitic*; 15, *leprous*; 16, *pigmentary*; 17, *phytodermic*; 18, *ungual*; 19, *hair-system*; 20, *sebiparous* system; 21, *sudoriparous* system; and 22, *traumatic*.

Investigated with attention, it will be found that these twenty-two groups may be naturally reduced to the eight following heads, namely: diseases of, 1, the general structure of the derma; 2, special structure of the derma; 3, development, nutrition, and growth; 4, diathesis; 5, blood-poison; 6, epidermis; 7, follicular apparatus; and 8, injury. Thus, under the head of diseases of the *general* structure of the derma, may be ranged the first four groups: *eczematous*, *erythematosus*, *bullous*, and *furuncular*. Under the head of diseases of the *special* structure of the derma, including nerves, vessels, and the contents of the vessels, we should place: *nervous*, *vascular* and *hæmic* affections; the head of development, nutrition, and growth, embraces the two groups, *developmental* and *nutritive*, and *hypertrophic* and *atrophic* affections; the diseases of diathesis include the three groups, *alphous*, *strumous*, and *carcinomatous*; the diseases of blood-poisoning, also three groups, namely, *zymotic*, *syphilitic*, and *leprous*; then follow, as diseases of the epidermis: *pigmentary*, *phytodermic* and *ungual* affections; diseases of the follicles of the skin, the

three groups comprising the hair system, *sebiparous* system, and *sudoriparous* system; and eighthly and lastly, diseases induced by injury or traumatic affections.

In the first group, namely, *eczematous* affections, the individual diseases are: *eczema*, *psoriasis*, *pityriasis*, *lichen*, *strophulus*, *impetigo*, *scabies*, and *gutta rosacea*. In the second group, *erythematosus* affections, are comprised: *erythema*, *erysipelas*, *urticaria*, and *roseola*. The third group, *bullous* affections, consists of *herpes*, *miliaria*, and *pemphigus*. The fourth, *furuncular* affections, contains, *ecthyma*, *furunculus*, *hordeolum*, *anthrax*, *pustula maligna*, and *pustula aleppensis*. The fifth, *nervous* affections, is devoted to *hyperæsthesia*, *anæsthesia*, *pruritus*, and *prurigo*. The sixth group, *vascular* affections, includes *nævus*, and *hypertrophia venarum*. The seventh group, *hæmic* affections, has only one representative, *purpura*. The eighth group, *developmental* and *nutritive* affections, consists of *xeroderma*, *ichthyosis*, *sauriosis*, and *cachexia cutis*. The ninth, *hypertrophic* and *atrophic* affections, contains, *nævus hypertrophicus*, *ecphyoma*, *verruca*, *clavus*, *dermatolysis*, *pachylosis*, *cheloides*, *sclerosis*, *boucnemia*, and *atrophia cutis*. In the tenth group, *alphous* affections, *alphos* stands alone. The eleventh group, *strumous* affections, is devoted to *scrofuloderma* and *lupus*. The twelfth group, *carcinomatous* affections, has a solitary member, *carcinoma cutis*. The thirteenth group, *zymotic* affections, includes *rubeola*, *scarlatina*, *variola*, *varicella*, *vaccinia*, *equinia*, and *frambæsia*. The fourteenth group, *syphilitic* affections, is devoted to *syphiloderma*. The fifteenth, *leprous* affections, to *elephantiasis Græcorum*, and *morphœa*. The sixteenth group, *pigmentary* affections, contains *melanopathia*, *xanthopathia*, *lentigo*, *chloasma*, *cyanopathia* and *leucopathia*. The seventeenth group, *phytodermic* affections, embraces the *nosophyta*, or plant-parasitic diseases. The eighteenth group, *ungual* affections, contains the diseases of nutrition of the nails and *onychia*. The nineteenth group, affections of the *hair-system*, exhibits a goodly list, namely, *hirsuties*, *alopecia*, *calvities*, *canities*, *fragilitas crinium*, *tinea*, *morbi sebacei*, *favus*, *kerion*, and *sycosis*. The twentieth group, *sebiparous* affections, is also large, for example: *hypertrophy epidermic* and *epithelial*, *carcinoma folliculi*, *steorrhœa*, *asteatodes*, *alloseatodes*, *comedones*, *tumores sebipari*, *tumores encystici*, *tubercula sebacea*, and *acne*. The twenty-first group, *sudoriparous* affections, includes *idrosis*, *anidrosis*, *osmidrosis*, *chromidrosis*, and *hæmidrosis*. And the twenty-second group, *traumatic* affections, contains animal parasitic diseases, *combustio* and *gelatio*.

In this order we proceed to delineate the separate affections which constitute the great body of cutaneous diseases, beginning with *eczema*, as at once the most common of diseases of the skin, and as representing typically the first of our family groups.

1. ECZEMATOUS AFFECTIONS.—ECZEMA is the type of the *vesiculæ* of Willan, the vesicles being minute, generally confluent, arising on a more or less inflamed and swollen base, covering a greater or less extent of surface, from a mere local patch to an entire limb, and giving issue, when broken, to a copious exudation of viscous and colourless lymph, which dries up into a brownish-yellow and uneven scab. But, accord-



ing to the natural system, eczema is an inflammation of the skin, accompanied with alteration of structure and derangement of function, its characteristic signs being redness, itchiness, interstitial and sometimes subcutaneous thickening, exudation, papulation, vesiculation, and desquamation. Hence arises a division of eczema into varieties representing its pathological forms, for example: *e. erythematosum*, *papulosum*, *vesiculosum*, *ichorosum*, *pustulosum*, *squamosum*, and certain irregular forms, namely, *fissum*, *sclerosum*, *verrucosum*, *oedematosum*, *mucosum*, *bullosum*, and *neurosum*; and a further division into varieties of distribution and locality, the former being: *e. universale*, *figuratum*, *diffusum*, *nummulare*, and *marginatum*; and the local varieties: *e. capitis*, *faciei*, *aurium*, *axillarum*, *mamillarum*, *umbilicale*, *inguinum*, *puendi*, *articularum*, *manuum*, *pedum*, &c.

*Eczema erythematosum* is distinguished by redness, thickening, and hardening of the skin from serous infiltration into its tissues, itching, and successive desquamation of the cuticle in laminæ or scales.

*Eczema papulosum* represents the eruption of papulæ resembling those of lichen, hence, *e. lichenosum*, in association with the other signs of eczema.

*Eczema vesiculosum* is the type of the eczema of Willan, an eruption of small, semiglobular vesicles, without much redness, but generally associated with oedema. When occurring in exposed parts of the skin, and excited by the stimulus of the sun's rays, it constitutes *e. solare*.

*Eczema ichorosum* especially distinguishes the exudative phenomenon of the disease; exudation of a viscous lymph, often in great abundance, being its characteristic feature; this form is the *e. rubrum* of Willan, the *e. madidans* of Hebra.

*Eczema pustulosum* marks the complication of eczema with a pustular eruption, having the characters of impetigo, hence the term introduced by Willan, *e. impetiginodes*.

*Eczema squamosum* is a later form or stage of eczema, in which the redness, the thickening, and the induration of the skin remain, with a more or less extensive desquamation of the cuticle.

The irregular forms represent certain of the phenomena of eczema when they occur alone, or in an exaggerated degree; thus the dry, indurated corium is apt to crack into chaps and rhagades, *e. fissum*; or, its induration and density may be so great as to suggest the term *sclerosum*; occasionally, chronic eczema presents the appearance of warts, and may be only distinguishable from morbid papillary growths by its previous history and intense itching, *e. verrucosum*; sometimes the eruption is accompanied with considerable effusion into the subcutaneous areolar tissue, *e. oedematosum*; sometimes it is remarkable for a muco-purulent discharge, with little further lesion of the skin, *e. mucosum*; such a discharge is apt to be formed between folds of the skin in infants and fat persons, and is termed *intertrigo*. Again, eczema occasionally produces bullæ in place of vesicles, *e. bullosum*; and is sometimes remarkable for its association with neuralgia of the cutaneous nerves, *e. neurosum*.

In manner of distribution on the surface of the skin eczema may be general (*e. universale*), or dispersed in circumscribed patches (*e. figuratum*); it may be variously spread out upon the body or limbs (*e. diffusum*), or concentrated in small discs suggestive of coin (*e. nummulare*); or, it may pre-

sent a centrifugal form (*e. marginatum*), and subside in the centre, while it retains all its activity at the extreme border. Its local forms bring to our knowledge the fact of its selection by preference of certain regions, and its greater intensity in some parts of the body than in others; for example, it is common in the flexures of the joints, and between folds of the skin; behind and on the ears; in the hollows of the umbilicus, axillæ, and pudendum; on the face, the head, the legs, and forearms, the hands, and the fingers. Eczema also presents some peculiarities in its attack on infants and children (*e. infantile*); it is more frequently universal than in the adult; it is apt to exude to a greater degree, the exudation being more frequently puriform; and, it gives rise to more extensive, more varied, and thicker crusts; hence the *crusta lactea* of the face and head, the *eczema larvale*, or *porrigo larvalis* of Willan, which covers the features like a mask, and the yellow and honey-like crust produced by a purulent discharge, and termed *melitagra*.

PSORIASIS is a term applicable to the most chronic stage of eczema (the *psora* of the Greeks); when exudation has ceased, but admits of being revived by friction or scratching, and when the skin is thickened, condensed, hard, and itchy, and throws off a copious exfoliation of small scales; this latter character has been the means of confounding psoriasis with the *lepra vulgaris* of Willan, or, more correctly, *alpos*.

PITYRIASIS is also, in some instances, an exhausted eczema, and sometimes a chronic erythema; there is less thickening of the skin than in psoriasis, and sometimes an absence of thickening; but there is always a considerable amount of itching, and the production of an abundance of extremely fine scales, which have been compared to *πίτυρον*, or bran, and have been termed *furfures*. An exhausted eczema *squamosum* of the scalp is, by common consent, termed *pityriasis*. Willan and Bateman distinguish four varieties, namely, *p. capitis*, *p. rubra*, *p. versicolor*, and *p. nigra*. *Pityriasis capitis* is the typical form of the disease; *p. rubra* is a chronic eczema; *p. versicolor* is the *phytosis versicolor*; and *p. nigra* a variety of doubtful existence. By Hebra, the term *pityriasis rubra* has been applied to a rare and very remarkable disease, in which the cuticle exfoliates in flakes from the whole surface of the body, the derma beneath presenting a vermilion or bright crimson colour—a state of universal dermatitis with cuticular exfoliation.

LICHEN is an eruption of pimples and the type of the "papulæ" of Willan. The pimples are the mouths of the follicles of the skin elevated by congestion and infiltration; they are hard and solid, are accompanied by more or less erythematous redness, by heat, and by a prickling and tingling itching more or less severe. The eruption terminates in furfuraceous desquamation. The chief varieties of lichen are:—*L. simplex*, *dispersus*, *circumscriptus*, *strophulosus*, *urticatus*, *tropicus*, and *planus*; certain secondary varieties being *L. pilaris*, *lividus*, *circinatus* and *gyratus*. *L. simplex* may be developed in patches of some extent, of irregular figure, or distributed more or less extensively over the surface; the pimples are brightly red; but, in elderly persons, and when developed on the lower extremities, they are sometimes purplish (*L. lividus*); and sometimes their perforation

by a hair is a prominent feature of their appearance (*l. pilaris*). When developed under the influence of the sun's rays, as on the back of the hands, the eruption is termed *l. solaris*. *L. dispersus*, is a scattered form of the eruption, the papulæ being pale in colour, isolated, and remarkable for their pruritic tendencies, hence, *l. pruriginosus*; this variety of the eruption corresponds with the *prurigo mitis* of Willan. *L. circumscriptus* indicates the development of the eruption in circular patches, the whole surface of the area being occupied by pimples. *L. strophulosus*, the *strophulus* of Willan, is a papular eruption common to infants; the pimples are larger and softer than those of common lichen, and they present several degrees of redness, some being paler than the surrounding skin. The eruption is popularly known as the gum-rash or tooth-rash, and its varieties are as follows:—*S. interinctus* consists of clusters of pimples, developed on patches of diffused redness and distributed on various parts of the body. *S. confertus* indicates a confluence of patches, giving rise to a more severe form of local inflammation of the skin. *S. volaticus* is a transient and less severe form of eruption. The pimples of *S. albidus* are paler than the surrounding skin; and those of *S. candidus*, smooth and shining. *L. urticatus* is an eruption of large solitary pimples attended with considerable itching and commonly met with in children. The angry nature of the pimples, the rapidity of their course, their successive eruption, the intense pruritus, and the frequent evidence of muscular spasm, have suggested a comparison with urticaria. *L. tropicus*, or prickly heat, is the itching eruption induced by the high temperature of hot climates. *L. planus* is a papular eruption remarkable for the large size, flatness and glassy smoothness of the pimples, without much pruritus; it is described by Hebra under the name of lichen ruber, and presents two forms, an isolated and a confluent form; the latter throws off an abundance of small scales, and very closely resembles eczema squamosum in its dry or psoriatic stage. *L. pilaris* is a crop of papulæ arising from the hair follicles, each pimple being traversed by a hair. *L. lividus* differs from lichen simplex only in the venous colour of the pimples, and is commonly met with on the lower limbs. *L. circinatus* represents the circular and annulate form of the eruption; it may occur as a single line of pimples or as a band of moderate breadth; the ring may be solitary (*l. circinatus solitarius*) and stationary; or the eruption may consist of numerous rings which spread rapidly by their circumference and become confusedly intermingled (*l. circinatus serpiginosus*). Sometimes the annulate character is lost and a ridge of red pimples is all that remains (*l. marginatus*); or, several such ridges trace out serpentine lines (*l. gyratus*). Under the name of *L. agrius*, Willan describes an eruption which presents the highest degree of severity that lichen can assume; it is a local affection, the pimples are aggregated into circular clusters of greater or less extent, they give rise to intense prickling and itching, there is a copious exudation of an ichorous lymph, and the surface is broken up into fissures and excoriations (lichen eczematousus). It is lichen agrius, developed on the back of the hands, the wrists, and flexure of the arms, that has received the names of bricklayer's, grocer's, baker's and washerwoman's itch. The presence of discharge carries lichen agrius within the region of eczema

or psora; while, in its thickened, dry, and squamous stage, it is psoriasis.

IMPETIGO is an eruption of minute superficial pustules on a patch of inflamed skin, and its varieties are two in number, *I. figurata* and *sparsa*. *I. figurata* is distinguished by the grouping of the pustules in clusters, while in *I. sparsa* they are dispersed separately and more or less extensively over the surface of the body. Sometimes the patches of *I. figurata* enlarge by the circumference, while the skin returns to its healthy state in the middle, forming rings of pustules; at other times the eruption pours out an excessive quantity of purulent discharge which hardens into a crust of remarkable thickness, *I. scabida*. Occasionally impetigo is accompanied with considerable redness and inflammation of the skin, *I. erythematica*. Impetigo also presents peculiar features when it appears upon the head, *I. capitis*. It is the purulent secretion of impetigo that gives to one form of eczema its title to the name, eczema impetiginodes; and impetigo is combined with eczema in the production of melitagra and crusta lactea or porrigo larvalis. Impetigo may, very properly, be regarded as a pustular eczema; or, as an eczema occurring in a pyogenic constitution.

GUTTA ROSACEA, the rosy drop, is an eruption of the face occurring at the mid-period of life, and consisting of erythematous blotches, papulæ, pustulæ and tubercles; hence the distinction of *g. r. erythematosæ*, *punctatæ*, *papulosa*, *pustulosa*, and *tuberculosa*. It is commonly associated with the eczematous diathesis, and is accompanied with more or less infiltration of the skin; its papular form and its development on the face have led to its consideration as an acne under the name of acne rosacea; but a more correct pathology distinguishes between the papules of acne arising from torpid function of the hair follicles and a simple disorder of nutrition, and the inflammatory congestion of gutta rosacea.

SCABIES was once held to be the type of all affections of the skin accompanied with pruritus. Pruritus, says Riolanus, "est scabendi desiderium," or rather, "est laceratio cutis—quod scabendi cupiditatem inducit;—inde scabies." But pruritus being a symptom common to most diseases of the skin, it became necessary to define scabies more exactly. Willan includes it in his order Pustulæ, because pustules are occasionally found united with the eruption; but the greater number of authors regard it as a vesicular eruption. The vesicles are small and acuminate, and contain a colourless or opaline lymph; they are chiefly found between the fingers and in the flexures of the wrists; while a crop of lichenous pimples is dispersed more or less abundantly over the limbs and trunk of the body. In fact, the dry papulæ of lichen, the moist vesicles of eczema, and, sometimes, pustules, are intermingled in this disease, and are associated with excoriations made by the nails in the act of scratching. But there is one other character which especially distinguishes scabies, namely, a minute animal, the *acarus scabiei*, which burrows in the cuticle, chiefly of the hands, but also in other parts of the body, as the feet and podex of infants; and the axillæ, the penis, the podex, and the mammæ of adults. In true scabies, the *acarus* is the sole cause of the eruption; and if it be destroyed by the friction of sulphur into the affected parts, the eruption, dispersed over the rest of the body, ceases



more or less quickly. On the other hand, it not unfrequently happens that the eruption continues on the body, maintained by nervous irritation and perpetuated by habit even when the acarus is destroyed, and takes on the semblance of lichen; this latter must be regarded as a secondary eruption. The peculiarities already noted will explain the terms, dry itch, lymphatic itch, and pustular itch.

2. ERYTHEMATOUS AFFECTIONS.—ERYTHEMA or inflammatory blush is a superficial inflammation, accompanied with little or no swelling of the skin, occurring in patches of variable extent; more or less diffused or circumscribed, and often terminating in desquamation of the cuticle; it may present itself as an acute or chronic affection, and in one or other of the seven following forms, which represent its chief varieties:—*E. fugax*, *læve*, *intertrigo*, *circinatum*, *marginatum*, *tuberculatum* and *nodosum*. *E. fugax* is an eruption of one or more red patches on any part of the skin, but more commonly on the face and neck than elsewhere; the patches or blotches are produced under the stimulus of mental emotion or meals; they last for a few hours and then disappear. Sometimes the rash is remarkable for sudden swelling of the skin, *e. tumescens*; and to the same category belongs the transient hyperæmia of vicarious menstruation, *e. menstruale*. *E. læve seu œdematosum* is the hyperæmia which accompanies œdematous distension of the lower extremities. *E. intertrigo* is the inflammatory redness which results from chafing the skin as by friction from pressure, and from the contact of irritant substances (*e. ab acribus*); it is met with in the plaits and folds of the skin of infants and fat persons, as also at the apertures of the body. The hyperæmia following a blow, is termed *e. ab ictu*; that occasioned by riding on horseback is *e. in equitantibus*; and that which results from the pressure of the weight of the body in bed-ridden persons is the *e. a decubitu*, or, *e. paratrimma*; a scorch by the fire is *e. ab igne*; and the hyperæmia following exposure to cold, *e. ab gelu*. When intertrigo is attended with a mucopurulent discharge it must be regarded as an *eczema mucosum*. *E. circinatum* consists of circular patches, which, enlarging by the circumference and fading in the centre form rings of various dimensions. *E. marginatum* is an erythematous streak, with an abrupt border, representing a segment of one of the larger rings of *E. circinatum*; the rest of the ring having disappeared. *E. tuberculatum* is a raised form of erythema occurring in spots varying in size from a papula of lichen, *e. papulatum*, to a diameter of half an inch or more; they are developed for the most part around the joints, are attended with tingling and itching on their eruption, are tender to the touch, and leave behind them the purple and yellow stains of a bruise at their decline. *E. nodosum* is a more prominent and deeper seated form of the disorder; it is generally oval in figure, situated on the lower limbs, occurs in small number, and is not unfrequently solitary. It is tender to the touch, and at its decline leaves behind it the stain of a bruise, hence a name given to it by Hebra, *dermatitis contusiformis*.

ERYSIPELAS is a diffused inflammation of the skin and subcutaneous cellular tissue, attended with more or less swelling, peculiarly disposed to change its place and spread, and often accompanied

with vesications containing serum. It presents two principal varieties, *E. simplex*, which is superficial; and *E. phlegmonodes*, which burrows in the deeper textures, and is attended with suppuration, and sometimes with gangrene, *E. gangrænosum*. The varieties of *E. simplex* are as follows:—*E. erraticum*; metastaticum; miliare; phlyctenodes and œdematodes. *E. erraticum* and *E. metastaticum* illustrate two of the special characters of erysipelas, namely its erratic and its metastatic properties. *E. miliare* and *E. phlyctenodes* indicate the tendency to the production of vesicles, miliare, of small size; and phlyctenodes (*E. bullosum*) large vesicles or blisters. *E. œdematosum* is a form accompanied with an œdematous state of the integument.

*Urticaria* or nettlerash, is an eruption distinguished by extreme itching and tingling, which have gained for it its name, by its occurrence in patches and rarely affecting the entire body, by the suddenness of its attack and departure, and by the development of itchy elevations termed wheals, which are one while pale and round like small tubercles, and another while resemble the stripes left on the skin by the lashes of a whip, and are variously curved. The wheals are thrown up on a ground of inflamed skin, and sometimes the eruption is accompanied by derangement of the digestive organs. *Urticaria* may be acute or chronic; two varieties, namely, *U. febrilis* and *U. conferta* belonging to the former; and *U. evanida*, *perstans*, *subcutanea* and *tuberosa* to the latter. *U. febrilis* indicates the association of febrile symptoms with the eruption; and under this head is to be considered *Urticaria ab ingestis*, of which the symptoms are occasionally severe. *U. conferta* is distinguished by the confluence of its wheals; *U. evanida* by its evanescence, coming out wherever the skin is touched in the lightest possible manner, and disappearing in a short time completely. *U. perstans* indicates an opposite quality of the disorder to the evanescent form, in a word, a persistent eruption. In *U. subcutanea*, the spasm of the muscular structure of the skin takes place in the deeper strata of the corium, and the tingling pain and often the swelling is felt beneath the skin; while in *U. tuberosa* the wheals are large and prominent, and have the character of tubercles.

*Roseola*, or rose rash, is a patchy and punctated erythema, distributed more or less fully over the whole body. The tint of the eruption is crimson or roseate, and its distribution occurs in small clusters resembling those of measles, hence its synonym, *false measles*. It is sometimes accompanied with febrile symptoms of the slighter kind, and by a crimson suffusion of the fauces. The varieties of *roseola* are:—*R. infantilis*, *æstiva*, *autumnalis*, *annulata*, and *punctata*; to which may be added, *R. variolosa*, *vaccina*, *miliaris*, *rheumatica*, *arthritica*, *cholericæ*, and *roseola febris continuæ*. *R. infantilis* is not unfrequently mistaken for measles, which it very closely resembles; but is milder in all its symptoms. *R. æstiva* and *R. autumnalis* indicate the tendency of the eruption to occur during the hot months of summer and autumn; the former more frequently among adults, the latter in children. In *R. annulata* the patches spread by the circumference, while they fade in the centre and assume the figure of broad rings. *R. punctata* is developed in spots which occupy the mouths of the follicles of the skin; and are apt a

their close to assume the appearance of petechiæ. The remaining varieties of roseola are, those which accompany inoculated variola, vaccination, and are sometimes found associated with rheumatism, gout, cholera, and continued fever. *R. miliaris* is a vesicular roseola, observed by Bateman in the latter stages of continued fever, both typhus and typhoid.

3. BULLOUS AFFECTIONS.—HERPES is an eruption of globular vesicles, of large size as compared with those of eczema, but small when compared with the bullæ of pemphigus, developed on a circumscribed patch of inflamed skin. The vesicles are at first transparent, and have a pink hue; by degrees they become opalescent, then yellow and brownish, and, at the end of six or eight days, terminate in hard, black scabs, which are firmly embedded in the skin. They are often accompanied with a burning and pungent itching, sometimes with stinging pains, and sometimes with intense neuralgia, which may precede the eruption or continue for weeks or months after the cutaneous affection has subsided. The varieties of herpes are:—*H. zoster*, phlyctenodes, circinatus, and iris; besides which there are several local forms, for example, *H. labialis*, nasalis, palpebralis, auricularis, præputialis, and pudendalis. *H. zoster*, or shingles, occurs in patches which commonly form a half girdle around the trunk of the body, following the course of an intercostal nerve; sometimes they are developed on one side of the head or neck. On the limbs they take a longitudinal direction, also following the course of the superficial nerves. *H. phlyctenodes* may be developed on any part of the body, either as a single patch or as a cluster of patches; the local varieties belong to the phlyctenoid group. *H. circinatus* assumes the annular form, the vesicles forming rings of various dimensions. *H. iris* is also an annulate variety of herpes, and the rings mark their course by different shades of colour as they gradually creep outwards from a central vesicle; hence their designation, *iris*. We have counted as many as nine different tints of colour in tracing the successive rings of herpes iris from the central vesicle to the extreme circumference of the patch. Herpes iris is a rare affection, and is more frequently met with on the back of the hands than elsewhere.

*Miliaria* is an eruption of small vesicles, of larger dimensions than those of eczema, but smaller than the vesicles of herpes, and isolated in their distribution. They are unaccompanied by inflammation or redness, and are developed under the influence of the confined heat of clothing and excessive perspiration; hence they are termed *sudamina*. In their early stage, the fluid of the vesicles is transparent, and the vesicles themselves have a pinkish hue (*M. rubra*); at a later period the fluid is opalescent (*M. alba*). *Miliaria* is a trivial affection, and a not infrequent accompaniment of the clinical and puerperal state and of continued fever.

*Pemphigus* is an eruption of large vesicles, blisters, or bullæ; which vary in size, from that of a split pea to a hen's egg or an orange; they are developed singly, or in clusters, and they rise from a patch of erythematous skin, scarcely larger than the base of the bulla; their contents are at first colourless and transparent, and subsequently opalescent; they arise suddenly, in the course of a few hours, and, if broken, are apt to become

painful excoriations. The varieties of pemphigus are:—*P. acutus*, chronicus, and gangrænosus, together with several unimportant sub-varieties. *P. acutus* occurs for the most part in the form of clusters, and is chiefly met with in young persons and children; a mild form of the eruption has received the name of *Pompholyx benignus*; and another form, remarkable for the production of a blister of very large size, *Pompholyx solitarius*. *P. chronicus* is chronic, both in reference to its development and constitutional symptoms; it is the pompholyx diutinus of Willan. *P. gangrænosus* consists of bullæ which are purplish or livid in appearance, and are filled with a sanguinolent fluid. They terminate in sloughing sores, and appear to correspond with the epinyctis of Celsus.

4. FURUNCULAR AFFECTIONS.—ECTHYMA is an eruption of pustules distinguished by their large size and hard and inflamed base. They are never clustered like the pustules of impetigo, but are scattered irregularly over the surface of the body, like boils, and are often intermingled with the latter. The varieties of ecthyma present the acute and chronic type; the former including *E. vulgare* and gangrænosum, the latter *E. infantile* and cachecticum. *E. vulgare* is the more frequent and sthenic form of the eruption. *E. gangrænosum* is a rare variety described by Hardy, and corresponding apparently with the rupia escharotica of authors. *E. infantile* is the ecthyma of weakly and ill-nourished children; and *E. cachecticum*, that of persons of debilitated and cachectic constitution. The purplish and livid hues of a mild form of the latter have gained for it the name of *E. luridum*. *Furunculus*, common boil; hordeolum, or sty, a small boil occurring at the edge of the eyelids; and anthrax or carbuncle are the typical members of the group, and will be described under their respective heads. *Pustula maligna* is a large pustule, solitary in its distribution, generally occurring on the face or hands, associated with erysipelas and gangrene, and sometimes epidemic. *Pustula Aleppensis*, or Aleppo boil, is a chronic furuncular pustule, followed by a chronic ulcer, endemic in the East, lasting commonly for a period of twelve months or more, and leaving behind it a permanent and disfiguring scar.

5. NERVOUS AFFECTIONS are indicated by morbid alteration in the sensibility of the skin; for example, heightened sensibility or *Hyperæsthesia*, diminished sensibility or *Anæsthesia*, *Pruritus*, and *Prurigo*. *Pruritus* results from a morbid state of the cutaneous nerves, and is independent of any disease in the skin itself. Examples of this affection are, general pruritus and certain local varieties, for instance, pruritus ani, scroti, præputii, urethræ, and pudendi. *Prurigo* is more deeply seated, and more inveterate than pruritus, and is distinguished by intense and often unbearable irritation, the latter consisting of itching, tingling, creeping, tickling, burning, piercing, &c. It presents two varieties, *P. vulgaris* and *P. senilis*, the former occurring at every period of life, the latter, and most inveterate, in old age.

6. VASCULAR AFFECTIONS include the various forms of alteration of structure of the vessels of the skin which give rise to vascular nævus, and varicosity of the minute cutaneous veins, or hypertrophica venarum.

7. HÆMODYSCRASIC AFFECTIONS are represented by *Purpura*, or scorbutic eruption, an affection of



the skin, distinguished by the presence of purple spots consequent on the effusion of blood into the cutaneous tissues. The spots are of four kinds:—*Stigmata*, which are mere points or specks; *Petechiæ*, small round spots very much resembling a flea-bite; *Vibices*, spots larger than petechiæ, and irregular in form; and *Echymoses*, distinct extravasations of blood, presenting every variety of figure and dimension. Purpura is always associated with diminished vital power, and the sanguine effusion must be regarded as being due to a morbid change both in the blood and in the capillary vessels. The varieties of purpura are four in number, namely:—*P. simplex*, hæmorrhagica, urticans, and senilis. In *P. simplex* the spots are stigmata, petechiæ, and vibices. They are chiefly distributed upon the limbs, and are accompanied by constitutional symptoms of a mild kind. In *P. hæmorrhagica* the symptoms are more severe and the disease is more serious. Besides stigmata, petechiæ, and vibices, there are also echymoses of considerable extent; and the mucous membrane is affected similarly with the skin; the gums are spongy and bleed, and there not unfrequently occur hæmorrhages of considerable extent from the mucous membrane. This is the form of purpura which has been denominated *porphyra nautica*, and includes both land and sea scurvy. *P. urticans* indicates the association of tubercular wheals, like those of urticaria with simple purpura. These elevations are sometimes, but not always, accompanied with severe tingling and itching. When they subside, they leave behind them brownish yellow stains like those of a bruise. Occasionally, we have seen the spasmodic contraction and condensation of tissues which give rise to these tubercles extend deeply into a limb, and involve the muscles as well as the superjacent stratum of soft parts. *P. senilis* is a very harmless form of the complaint, occurring in elderly persons, and chiefly on the forearms: the general health is undisturbed.

8. DEVELOPMENTAL AND NUTRITIVE AFFECTIONS.—*XERODERMA* is a dry state of the skin, which at the same time is thin, wrinkled, ill-nourished and rough; the roughness being in part due to altered formation of epidermis, constituting xeroderma ichthyoides or ichthyosis; and partly to the concretion on the surface of altered sebaceous matter, xeroderma saurioides or sauriosis.

*Ichthyosis* is a congenital malformation and malnutrition of the skin, accompanied with a dry and morbid state of the epidermis and defective function of the sebiparous and sudoriparous glands. The skin is for the most part thin, inelastic, and wanting in subcutaneous and adipose tissue; and its pores are loaded with epithelial exuvizæ. The epidermis is dry; in some parts, as on the face, being roughened by the free edges of exfoliating cuticle; in others, as in the flexures of joints, pulverulent and mealy; in a third situation, as on the convexities of joints, presenting prominent horny scales; and in a fourth, as in the internodal region of the limbs, broken up by a reticulation of rough lines (*I. reticulata*) into smooth and glossy areæ (*I. nitida*), which have been compared to the scales of a fish, or serpents (*I. serpentina*).

*Sauriosis* is a xeroderma associated with the accumulation of sebaceous substance on the surface of the skin, one while assuming the form of scales

like those of a saurian reptile, and another that of spines; hence a division of sauriosis into two varieties, *S. squamosa*, and *S. spinosa*, the latter being the so-called porcupine disease. *Cacotrophia cutis*, is a state of defective nutrition of the skin, commonly of the face, occurring at all periods of life, and marked by thinness and discoloration of integument.

9. HYPERTROPHIC AND ATROPHIC AFFECTIONS.—*Nævus hypertrophicus* or common tegumentary mole, is a simple enlargement of the skin, from superabundant growth and deteriorated texture of its tissues; it is sometimes smooth and without alteration of colour, *N. H. vulgaris*; sometimes more or less deeply coloured with pigment, *N. H. pigmentosus*; and sometimes tufted with hair, *N. H. pilosus*. *Ecphyma*, signifying a growth or excrescence of the skin, is a genus including several varieties, the principal of which are: *E. mollusciforme* or molluscum simplex, a simple hypertrophy with degeneration of the fibrous tissue of the skin, constituting prominent and sometimes pendulous tumors of various size; *E. acrochordon*, a small pedunculated wart or pouch of the skin, consisting of degenerated fibrous tissue; *E. verruca*, or wart, of which there are several varieties; *E. clavus*, or corn, also with its varieties; and *E. papillosum*, a warty state of the skin induced by hypertrophy of the papillæ cutis. *Dermatolysis* or loosening of the skin, is a state of hypertrophy of the integument with relaxation of the subcutaneous areolar tissue, and giving rise to duplications and folds, of which some remarkable examples are narrated by Alibert. *Pachylosis* is a thickened state of the skin. *Cheloides* is an elevated thickening of the skin, commencing in one or more tubercles which are hard and prominent and gradually become blended until they attain a considerable size. They are very slow in their progress, never ulcerate, and sometimes subside and disappear. There are two varieties of Cheloides, namely, *C. vera* and *spuria*. *C. vera* arises from the sound skin without any cause of local irritation; its common seat is over the sternum, where it forms a flattened mass raised above and overlapping the adjacent skin and fixed into it around the circumference by hard tubercles which resemble roots (*C. radiformis*) implanted deeply in the integument. On the shoulders and limbs, two tubercles not unfrequently unite in their growth and form a prominent cylinder (*C. cylindracea*) or an oblong prominence, nodulated at one or both ends, and resembling a dumb-bell, *C. clavata*. *Cheloides spuria* is a hard tubercular prominence, generally elongated in shape, developed on the seat of a cicatrix and consisting of an hypertrophous growth of the fibrous tissue of the corium, consequent on ulceration, and not unfrequently following a burn; hence a very appropriate division of cheloides into idiopathic and traumatic. *Sclerosis* is a term for hardening and condensation of the skin; the hardening in some instances approaching the density of cartilage. *Boucœmia* is a state of hypertrophy of the integument, including the subcutaneous areolar tissue, and chiefly affecting the leg; it is the disease termed by the Arabs, dal fil, or the elephant leg, hence its synonym, elephantiasis Arabum; while another synonym is derived from its prevalence in Barbadoes, namely the Barbadoes leg, and in general in tropical countries, boucœmia tropica; a similar

pathological condition is occasionally met with in the scrotum. *Atrophia cutis* occurs in two principal forms, either as white and pearly lines which resemble cicatrices, *atrophia linearis*; or as an atrophy of greater extent, affecting in some instances the integument of the entire body.

10. ALPHOUS AFFECTIONS.—ALPHOS, the lepra of Willan, and psoriasis of most continental authors, consists of flat and slightly elevated red patches, usually of a circular figure, and covered with a thin laminated crust of white and morbid cuticle. The crust may be thin or thick according to the duration or activity of the eruption, but is commonly so thick as to conceal the redness and elevation of the patch, and become the most conspicuous character of the affection. The disease begins by small red papules and tubercles, which are soon surmounted with thin scales; the tubercles then increase by their circumference while they subside in the centre, and the thin scale is gradually converted into a white and lamellated silvery crust. At a later period the centre of the patch recovers the healthy appearance of the sound skin, while the margin spreads and the patch is converted into a ring; and, ultimately, the peripheral growth ceases, the prominent margin subsides, and the skin is restored to health. These changes occupy many months and often years, and the disease may be perpetuated for a lifetime by the outbreak of fresh patches as their predecessors fade and decline. Alphos selects the outer side of a limb and especially the convexity of joints, as of the elbows and knees, and is remarkable for its symmetry of distribution. On the elbows and knees it is never absent, and it assumes in those regions the diffused form, while the eruption is discrete over the rest of the body; not unfrequently it exists in these situations when no vestige of the disease is to be discovered elsewhere. Sometimes, in severe attacks, the patches present cracks and fissures from which an oozing of blood takes place. The varieties of Alphos are:—*A. guttatus vel alphoides*, *circinatus vel vulgaris*, *diffusus*, and *inveteratus*; to which may be added, in deference to Willan, *A. nigricans* and *syphiliticus*, and as local sub-varieties, *A. capitis* and *unguium*. *A. guttatus vel alphoides* has received its double name on account of the small size of its tubercles, resembling drops of water dispersed upon the skin, and their whiteness, due to the thin scales by which they are covered. *A. circinatus vel vulgaris* is the common variety of the eruption, the patches are circular, and vary in size from the diameter of a fourpenny piece to a crown piece or more. (*P. nummularis*, Devergie.) They increase by their circumference while the centre subsides and in the progress of growth are converted into rings, which are subsequently broken and ultimately disperse. *A. diffusus* is a confluent form of the eruption in which a number of primary tubercles are collected into a group, and become covered individually and collectively with a thin and interrupted crust. In both the preceding varieties the patch which forms upon the elbows and knees is of this kind; while the patches on the rest of the body are larger than those of *A. vulgaris* but vary considerably in extent. *A. inveteratus* is a diffused form of considerable breadth, often embracing the whole of the internodial portion or even the entire limb. The crust is thick and white, and forms a kind of case

to the affected extremity. *A. nigricans* scarcely deserves notice as a variety; its peculiarity depending on a blueish and livid appearance of the patch, resulting from a languid and debilitated state of constitution. *A. syphiliticus* is a tubercular eruption, resembling alphos rather than possessing its specific characters. *A. capitis* illustrates one of the habitats of alphos, the hairy scalp, where it is generally extremely obstinate. It extends just beyond the limit of the hair all over the head, and is covered with thin and broken scales. *A. unguium*: when alphos is extensive in its eruption over the body, it not unfrequently attacks the matrix of the nails; grey spots are developed under the nail, the nail covering the spot becomes yellowish like horn, and at a later period the nails are rough and deformed, more or less loosened, and ultimately fall. Sometimes *A. unguium* is met with without any eruption on the rest of the body.

11. STRUMOUS AFFECTIONS.—SCROFULODERMA is the proper designation of certain small indolent tubercles of a purplish hue, developed in a strumous constitution and terminating in chronic abscess; the abscess opens at one or more points, and is indisposed to heal, often becoming sinuous and permanent; also, of certain chronic and indolent ulcers equally of strumous origin, sometimes existing alone and sometimes in connection with scrofulous tubercles. A scrofulous inflammation of the matrix of the nail terminating in thickening of the end of the finger and ulceration at the root and along the lateral wall is termed *scrofuloderma unguale*. *Lupus* is a soft red tubercle of scrofulous origin, developed in the skin, commonly on the nose or face, causing a total disorganisation of the cutaneous tissues, and terminating by absorption or ulceration. When the tubercles subside, they leave behind them deep pits or permanent cicatrices. The varieties of lupus are:—*L. erythematosus*, *non exedens* and *exedens*. *L. erythematosus* is a circumscribed erythema of the skin of small extent, and commonly developed on the nose, cheeks, ears, and scalp. It presents nothing of a tubercular character excepting, in rare instances, a slightly raised margin of a deep red hue, and is allied with lupus only by its permanence and destructive nature. The area of the patch is dry and horny and somewhat depressed from thinness and atrophy of the affected skin; and the sebiferous pores are distended with dry epithelial exuvie. When it attacks the scalp it destroys the hair and gives rise to an incurable form of area. *L. non exedens* consists of one or more tubercles which are but slightly elevated, of a yellowish red hue, soft and transparent, and resembling a drop of jelly effused into the substance of the skin. They are commonly developed on the cheek and nose and form a patch which increases slowly by its circumference, while the central tubercles subside without ulceration; rarely, the tubercles ulcerate superficially and become covered with thin scales. The disease seldom gets well spontaneously, but commonly lasts for a lifetime; and the skin over which it has passed presents a remarkable cicatrix. When the disease affects the nose, it occasions absorption of the edges of the alæ; and sharpens the outline of the organ by rendering the form of the cartilages conspicuous. When it approaches the eyelids, it draws them down some-



times unequally and exposes more of the eyeball than natural; and when it reaches the lips it draws them apart and brings the teeth into view; inducing considerable deformity of the features. *L. caedens* presents itself as a single dull red tubercle developed on the nose. The tubercle becomes inflamed, suppurates in the centre and forms a scab; under this scab a small but deep ulceration takes place; another scab is formed of larger dimensions, and so the disease moves on slowly for years, without making much perceptible progress. At other times the ulceration is more rapid, the nose loses shape; first, one ala is destroyed or perchance the tip of the organ, then the other ala or a part of the column, and in this manner the nose is entirely destroyed. Occasionally the ulceration is rapid and warrants the appellation which has been bestowed on this variety, namely, *lupus vorax*.

12. CARCINOMATOUS AFFECTIONS.—Carcinoma cutis usually makes its beginning as an epithelioma of the follicle of one of the sebaceous glands, and forms a small hard transparent tubercle, becoming by degrees an indolent ulcer bounded by a prominent margin and gradually spreading into the surrounding skin. It is limited to the skin; rarely affecting the neighbouring lymphatic glands, and only in its latter stages attacking the deeper seated textures.

13. ZYMOTIC AFFECTIONS are the exanthematous fevers, originating in a special organic poison, communicable by contagion, and developing certain phenomena on the skin. They are: rubeola, scarlatina, variola, varicella, vaccinia, equinia, and possibly frambesia.

14. SYPHILITIC AFFECTIONS.—SYPHILODERMATA or syphilitic eruptions, in their evolution on the skin, follow the type of cutaneous eruptions in general and are presented to the eye in five principal forms:—namely, erythematous, papulous, tuberculous, pustulous and ulcerous, to which may be added alopecia and onychia. *S. erythematosum* occurs either as an erythema or roseola; *S. papulosum*, as a lichen; *S. tuberculosum*, as tubercles of various magnitude and number, which run their course as tubercles or pass into ulceration; *S. pustulosum*, which is represented by ecthyma and rupia; and *S. ulcerosum* which begins in the tubercular form and passes into the state of ulceration; one while sinking deeply into the skin, another while creeping along its surface in a semicircle; or, as a phagedæna, destroying everything in its course. Syphilitic eruptions are characterised by a dull tint of redness, which is commonly denominated “copper-coloured;” by the absence of pruritus which exists in nearly every other variety of eruption; by swelling of lymphatic glands in the regions chiefly affected, and by the presence of other symptoms denoting syphilis, for example, sore throat, neuralgia, and periosteal pains.

15. LEPROUS AFFECTIONS.—ELEPHANTIASIS or elephantiasis Græcorum is the leprosy of the middle ages; a disease, happily, lost in Britain, but still active in Norway, Sweden, the north of Russia, on the coasts and islands of the West Indies and Indian Ocean, and generally on the coasts of hot climates. It presents two varieties, *E. tuberculosa* and *anæsthetica*, which are founded on the two most striking symptoms of the complaint, namely, tubercles and insensibility of the

skin. The tubercles of elephantiasis begin as erythematous spots, which subsequently increase to the size of tubercles; the tubercles are brown or bronzed in colour, and are commonly developed along the line of the eyebrows, on the forehead and cheeks, along the alæ of the nose, along the lips, and upon the ears. Loss of sensation commences in the hands and feet, and gradually extends to other parts of the body, in the anæsthetic variety to the whole body. The tubercles are apt to pass into a state of ulceration which lasts for a time and then heals; and in anæsthetic leprosy the ulceration extends into the joints (*E. nodosa*) and the bones of the extremities are not unfrequently denuded and expelled through the ulcerated openings. *MORPHEA*, *nigra* and *alba*, are the vitiligo melas and leuce of Celsus: the melas and the leuce of the Greeks; both occur as symptoms of elephantiasis Græcorum; and morphea alba is not uncommon in Britain, where, as a native disease, elephantiasis is unknown.

16. PIGMENTARY AFFECTIONS.—*Dyschromatodermata*, or discolorations of the skin from changes of pigment, are referrible to three heads, augmentation, diminution, and morbid alteration. *Augmentation of pigment* produces a dark state of the skin, variously designated melanopathia, melasma, and nigredo cutis, and gives the dusky hue to pigmentary moles or spili. *Diminution of pigment*, or achroma, is seen in leucopathia, leucasmus, aliphosis, or albinismus, and is either general, as in the albino, or partial, and occurs in patches of various size and extent. *Morbid alteration of pigment*, or dyschroma, is shown in the development of hues differing from the natural type of colouration of the skin, the chief alterations of colour being black, white, yellow, blue, or compounds of black and yellow, giving rise to various tints of brown and green. The principal varieties of these affections are—ephelis, or sunburn; lentigo, or freckles; a black discoloration, or melasma; and a blue discoloration, described by Billard d’Angers under the name of cyanopathia cutanea.

17. PHYTODERMIC AFFECTIONS, or dermatophyta, are diseases involving the structure of the rete mucosum and epidermis, and possessing the character in common of developing a morbid tissue resembling a fungous plant or mucedo; hence another appellation for these affections, namely, nosophyta. The phytiform tissue has received the names of microsporon, trichophyton, and achorion, and the diseases with which it is identified, and of which it is the especial pathognomonic sign, are favus, tinea, sycosis, and phytosis versicolor. All these diseases are affections of the hair-follicles and hairs, hence their fuller consideration will be found in the group of “Affections of the hair system.”

18. UNGUAL AFFECTIONS.—Affections of the nails and nail-follicles include morbid aberrations of the cuticular margin of the nail-follicle; of the structure of the nails as respects development, growth, colour, and texture; and inflammation, suppuration, and ulceration of the matrix and adjacent soft parts. Growth of the cuticular margin of the follicle forwards with the nail is termed *pterygium unguis*, while the shredding of this portion of cuticle gives rise to *agnails*, and eversion of the cuticular edge so as to expose to view the nail-follicle, *ficus unguis*. Abnormal development is recognised in *congenital absence* of the nail; in fall

of the nail, *alopecia unguialis*; in faulty shape, as in the excessively arched and hooked nail, *unguis aduncus*; in *supernumerary nails*; and in abnormal situation, as on the cicatrix of the stump of an amputated finger or limb. *Abnormal growth* of the nails is illustrated in extreme tardiness of increase, so that they seem to be stationary; and in excessive length, as frequently occurs in bedridden and neglected persons. *Discoloration* of nails takes place in some diseases affecting the matrix of the nails, as alphas; then there are the dark spots of ecchymosis, and the small white spots, termed *stries unguium*. *Abnormal texture* may present itself as an increase or diminution of the natural thickness of the nail; as an alteration of density, being either too soft, or hard and brittle; or as an unnatural roughness, degenerative unguium. The roughness of the nail sometimes exhibits a fibrous condition of the organ, and sometimes it is hollowed on the surface as though it were worm-eaten. Inflammation of the matrix of the nail, resulting in suppuration and ulceration, constitutes *onychia*.

19. AFFECTIONS OF THE HAIR-SYSTEM.—Affections of the hair and hair-follicles comprehend an extensive group of disorders, some of which are referrible to congenital causes, some to altered nutrition, and others to inflammation. They constitute the genus *Trichosis* of Mason Good, more properly *Trichonosis*, and admit of arrangement into three groups:—1. Disorders of the hair; 2. Simple inflammation of the hair-follicles; and 3. Specific inflammation of the follicles.

1. *The disorders of the hair* present us with the phenomena of augmented formation, diminished formation, abnormal direction, and alteration of colour.

2. *Simple inflammation of the hair-follicles* and its consequences is represented by deficient and altered secretion, *morbus pilaris*, erythematous inflammation, and suppurative inflammation.

3. *Specific inflammation of the hair-follicles* includes a group of diseases which are remarkable for a peculiar state of alteration of the epithelium of the follicles, the hairs and the surrounding epidermis. We have designated this alteration a "granular degeneration" of the epidermic tissues and hair. Others have described the pathological alteration as a fungus plant which they deem parasitic, and in compliance with this idea have termed these diseases collectively, parasitic affections, associating them with the group of diseases which take their origin in the presence of animal parasites. The parasitic nature of these diseases is not, as yet, conclusively settled; much evidence is wanting to prove that they originate in a plant, the seeds of which, falling on the skin, take root and germinate, and thus act the part of an external cause. We have therefore thought it well to unite them under a title suggestive of their vegetable resemblances, namely, *Phyto dermatata*, and to place them as a group in the midst of diseases which like themselves are developed in the hair-follicles, the hair, and the adjacent epidermis and skin. The diseases belonging to this group are five in number, namely:—*Favus*, *tinea tonsurans*, *sycosis* or *mentagra*, *alopecia areata*, and *phytosis versicolor*. The French authors include three out of the number under the generic name of *Tinea*, for example, *tinea favosa*, *tonsurans*, and

*decalvans*. Willan calls them *porrigo lupinosa*, *furfurans*, and *decalvans*, and they might all be designated by the common term *trichonosis*, as follows:—*Trichonosis favosa*, *tonsurans*, *maxillaris*, *decalvans*, and *versicolor*. It is far from unlikely that *trichonosis plica*, or *plica polonica*, may belong to the same group, but our knowledge of this disease does not permit us to say so with confidence.

DISORDERS OF THE HAIR.—*Augmented formation* may be a simple abundance of hair in a normal situation, *hirsuties*, or the production of hair in an abnormal situation, as on pilous *nævi*, or moles. *Diminished formation* includes simple thinning of the hair, *defluvium capillorum*, or *trichorrhœa*, extending its ravages progressively to the baldness of advanced age, calvities; and *Alopecia*, whether congenital or accidental. Congenital alopecia is rare, but accidental alopecia by no means uncommon; in both the skin presents a state of paresis, being pale, thin, and smooth. *Abnormal direction* of hair is seen in an affection of the eyelids, *trichiasis ciliarum*, and in a state of clotting or felting of the hair arising from neglect, *trichiasis coacta*. *Alteration of colour* manifests itself in three principal forms; firstly, as a change from one tint to another, occurring after an illness or some pathological disturbance of the economy, *trichonosis decolor*; secondly, as a congenital blanching of a part or the whole of the hair; and, thirdly, as the blanching of age, *canities senilis*.

2. *Simple inflammation of the hair-follicles* may be made manifest either as a deficient or altered secretion of the follicles and their appertaining sebiparous glands; a chronic or erythematous inflammation; or a suppurative inflammation, the kerion of the Greeks. *Deficient and altered secretion* produce several troublesome affections of the scalp, attended with irritation of the skin and concretion of altered sebaceous substance around the mouths of the follicles. One form of this affection, *morbus pilaris*, commonly met with on the limbs, occasions the imprisonment of the hair within the follicle, a small film of hardened sebaceous matter collects over the mouth of the pore, and the growing hair forms a spiral coil beneath it, producing a pimply elevation. *Erythema* of the hair-follicles is accompanied with heat of the scalp, dryness and scaliness of the skin, more or less itching, and gradual fall of the hair. *Suppurative inflammation* of the hair-follicles, the kerion of the Greeks, is a disorder of the scalp, commonly occurring in young persons, and giving rise to scalled head; it may attack a single follicle (*achor*), or a group of follicles, forming a patch of small size, or one as large as a half-crown piece. The inflamed skin is tumid, vividly red, and studded over with yellow pustules (*achores*), and the dilated apertures of hair-tubes. The suppuration reaches the fundus of the follicles, the hair is uprooted, and in a short time the patch is left tender, red, and bald—scalled head. Not unfrequently subcutaneous abscess, or exudation beneath the epicranium, is produced, and the occipital and mastoid lymphatic glands become inflamed and enlarged.

3. *Specific inflammation of the hair-follicles*.—The group of diseases included under this head are the *phyto dermatata*, the so-called vegetable parasitic affections of the skin. They are five in number, namely:—*Trichonosis favosa*, or *favus*;



trichonosis, or *tinea tonsurans*; trichonosis maxillaris, or mentagra; trichonosis decalvans, or alopecia areata; and trichonosis, or phytosis versicolor; to which may be added, as possibly belonging to the same group, trichonosis plica, or plica polonica.

These phytodermata constitute a natural group having certain symptoms in common, being curable by a similar treatment, and, according to the supporters of the vegetable theory of the disease, obeying the same exciting cause. Their general symptoms are—pruritus, a furfuraceous condition of the epidermis, a certain circularity of figure, and disorganisation of the hair, which commonly results in baldness, either from breaking of the hair or expulsion by its roots. The class of plants associated with these diseases are the mycodermata, a group of microscopic fungi, belonging to the class of Arthrosporæ, and to the tribes Torulaceæ and Oidiæ; they are the trichophyton tonsurans, the parasite of trichonosis tonsurans and maxillaris; the microsporon furfur, or epidermophyton (Bazin), the parasite of trichonosis or phytosis versicolor; the microsporon Audouinii, a doubtful form, assigned by Bazin to trichonosis decalvans; and the oidium or achorion Schœnleinii, the parasite of trichonosis favosa. The dermatophyta are very simple in structure consisting of nucleated granules or sporules; of dilated tubes containing sporules termed sporidia; and of minute filaments more or less transparent or opaque, divided by septa and branched, the mycelium. The spores and the sporidia are the reproductive part of the mycoderma, the filaments its fully developed portion. The Torulaceæ, consisting of the trichophyton and the microsporon, are the simplest in structure, consisting only of spores or sporules and mycelium; the Oidiæ being more complex and comprising sporidia as well as spores, and a more phytiform mycelium.

Trichonosis favosa or favus is a specific inflammation of the scalp, manifesting itself at the apertures of the hair tubes, and resulting in the production of a peculiar yellow substance. This yellow substance is formed beneath, or rather in the deepest stratum of the epidermis, the rete mucosum, and at first, is a mere ring surrounding the mouth of the follicle; by degrees it enlarges in circumference, and constitutes a circular shallow cup pierced in its centre by the hair, which it gradually uproots; a number of these cups grouped together suggest the idea of a honeycomb, hence the term "favus." When the crusts of favus are examined with the microscope they are found to be composed almost entirely of the spores, sporidia and mycelium of the oidium or achorion Schœnleinii. The varieties of favus are two in number, dispersus and confertus; in the former the cups are separate (favus isolatus, urceolaris); in the latter they are clustered and coherent (favus urceolaris coherens, Bazin). Bazin describes in addition to these, favus scutiformis vel nummularis, distinguished by the absence of cups and a stratiform distribution of the favous matter on circular patches of diseased skin, and favus squarrosus, a form distinguished by the accumulation of the favous matter in small masses, which congregate around the shafts of the hairs. Neither of these forms is well defined or sufficiently distinct for separate consideration. Favus may occur on the body and limbs as well as on the head, and it then puts on the dispersed or isolated character.

*Trichonosis tonsurans* or common ringworm is characterised by the loss of hair in circular patches, the ground of the patch being dry, furfuraceous, and papillated, and the hair either broken off close to the head as though eaten off by the moth grub, hence *tinea tonsens*, or partly broken off and partly shrivelled and discoloured and matted into thin fasciculi, which lie in contact with the patch. In other parts of the head the hair has lost both its colour and texture, and has been aptly compared to *tow*. The change in the hair now described belongs to the second period of the disease, when the fungus has made its appearance on the surface, in the form of white films, which enclose the broken ends of the hairs as in a sheath, and white and pearly wreaths which crop up in the midst of the furfuraceous squamæ that cover the morbid surface. The period which precedes the appearance of the fungus is the period of germination, and is commonly accompanied with erythema in circular patches, sometimes with the superaddition of minute vesicles or vesiculopustules. The third period is indicated by the total destruction of the hair, and the appearance of a secondary eruption of the impetiginous type. The fungus of trichonosis tonsurans, is the microsporon tonsurans, and it is found in the substance of the hairs, in the morbid sheaths which surround the hairs, and amongst the exuviae of epidermis which cover the diseased plot.

Trichonosis tonsurans may attack any part of the body as well as the scalp; but from the minor degree of development of the hairs, it rarely oversteps the beginning of the second period. On the body and limbs, and especially on the neck, it is apt to take on the annulate or circinate form; and to appear either in the shape of an erythema, with a raised or papulated border (erythema circinatum, lichen circinatus), or of a ring, surmounted by a single or double row of papulæ or vesiculæ (lichen annulatus, herpes circinatus). When it assumes the annulate form, the area of the ring is yellowish in tint and dusted over with farinaceous furfuræ; sometimes the area is dotted over with papulæ; or the annulus may spread eccentrically; or throw out from its circumference a second or even a third ring (lichen annulatus serpiginosus).

*Trichonosis maxillaris*, mentagra vel sycosis, is a form of trichonosis tonsurans which attacks the region of the beard and whiskers. The first and second period of this eruption are comparatively insignificant; the most important and pathognomonic being the third. It differs from trichonosis tonsurans chiefly in the fact of affecting the follicles more than the hairs, and being accompanied by more serious secondary eruptions and pathological changes, for example simple pustules and papular pustules pierced by the hairs; tubercles superficial and deep; furunculi; and ulcerations covered with unhealthy granulations (fiei). These phenomena produce swelling and thickening of the skin and deeper tissues in the region of the beard and whiskers; the disease is very obstinate; and terminates by expulsion of the hairs, and closure of the morbid follicles, followed by a permanent cicatrix and permanent baldness. The mycoderm found in the hair and in the follicles of mentagra is the same as in trichonosis tonsurans, the trichophyton tonsurans.

*Trichonosis decalvans* (tinea decalvans, porrigo

decalvans), alopecia areata, or area, is a complete loss of the hair on one or more circular patches of the skin of greater or less dimensions. The hair falls out by the roots, it does not break off as in trichonosis tonsurans, and it leaves the skin smooth, shining, paler than natural, commonly depressed below the surrounding level, and less sensitive than the adjacent skin. Taking the loss of sensation and defective nutrition of the skin, with total loss of the hair and absence of colour, as the leading characteristics of this disease, we have been in the habit of regarding it as of neurotic origin, as being in fact a consequence of loss of tone in the branch of the nerve which supplied the faulty skin, as in fact, a kind of limited paralysis of the skin. But the phyto-pathologists claim it as one of their parasitic affections, as the consequence of the devouring operations, according to Bazin, of the microsporon Audouini. Gruby detected the fungus to which this name has been given on the surface of the epidermis in area; and although the hairs generally fall out by the roots, often attenuated by insufficient nourishment, nevertheless some are discovered in the circumference of the patches, which are broken off, and others enlarged at a short distance from the surface; and on examination, found to owe their varicose condition to the presence of granules or sporules in the midst of their fibrous tissue. There are two forms of area; one circular, the other oblong and extending in a serpentine course for some distance upon the head, generally in the direction of the longitudinal nerves of the scalp. To distinguish these latter the ancient name ophiasis has been retained. Bazin gives the title of teigne pelade to porrigo decalvans, and describes two varieties, one simple or ophiasic, the other achromatous: the achromatous form being especially distinguished by deficiency of pigment; and he further divides the achromatous form into two sub-varieties, one in which there is no alteration of thickness of the scalp; the other in which the skin is thinned and depressed.

*Trichonosis versicolor* (phytosis seu pityriasis versicolor) is, as its name implies, unfixed in its pathognomonic characters; it is furfuraceous without being a pityriasis, and it is something more than a mere alteration of the pigment of the skin. It has been classed heretofore with diseases of chromogenesis; but the presence of that peculiar granular condition of the exuviae of the epidermis, which is the leading character of the dermatophytic diseases, has obtained for it a place in the present group. *Trichonosis versicolor* is known by the presence of brownish yellow, greenish and sometimes blackish blotches (pityriasis nigra), which take their origin in the cutaneous follicles, where they are deeper in colour than elsewhere, and spreading by the circumference unite with similar blotches to form map-like patches of considerable extent; often occupying the greater part of the trunk of the body. The seat of election of the eruption is the front and sides of the chest, whence it extends to the axillæ and neck; the shoulders and spinal region of the back, upon which it often descends like a tippet; the flanks, the lower part of the abdomen and inguinal region of the thighs, on which it occupies the position of a short apron, and the bend of the elbows. It is remarkable for its symmetry, corresponding pretty accurately in size and general appearance on both

sides of the body. The eruption is accompanied and sometimes preceded by pruritus, and the pruritus increases with the progress of furfuraceous exfoliation; sometimes the pruritus is absent, and sometimes the exfoliation; the discoloration being the only symptom of the disease. In this latter case, the affection seems to belong rather to the dyschromatous than to the pruritic and furfuraceous group, with which it is at present associated. The fungus attributed to trichonosis versicolor is the microsporon furfur; the epidermophyton of Bazin; and, according to the doctrines of the supporters of the vegetable theory, the disease never proceeds beyond the first period of eruption in consequence of the deficiency of hair on the parts of the skin attacked.

According to the views of the supporters of the vegetable origin of the dermatophytic diseases, they are all necessarily contagious; the conclusion is inevitable, for if they produce sporules or seeds in myriads, and these seeds have the property of taking root whenever they rest upon the skin in a favourable spot, they must be highly contagious; the only protection against them being a state of the humours unfavourable for their nutrition; that is, we apprehend, a state of perfect health. In a practical point of view this theory of contagion is not supported; we are not prepared to declare that none are contagious, although we should incline rather to that view than to the opposite. Sub judice lis est.

*Trichonosis plica*, vel plica polonica, is a disease of the hair, apparently due to granular degeneration of structure; the shaft of the hair is tumid and filled with a viscous sanguineous ichor; the scalp is inflamed and excessively tender, and the hair becomes matted into one or several masses, *P. caudiformis et multiformis*.

20. AFFECTIONS OF THE SEBIPAROUS SYSTEM present considerable variety. They are characterised by:—augmentation, diminution and alteration of secretion, and inflammation and disease of the glands and their adjacent structures. Augmentation of secretion is represented by the term *stearrhœa simplex*, indicating an excess of secretion which produces an unnatural greasy moisture of the skin. *Diminution of secretion*, occasioning dryness of the skin, is expressed by the term *xeroderma*, and is the reverse of *stearrhœa*. *Alteration of secretion* is usually accompanied with excess; the secretion is sometimes changed in colour giving rise to tints of yellow or black, *stearrhœa flavescens* and *nigricans*; and, sometimes, in *consistence*, producing a spurious ichthyosis (I. sebacea) of which the scales resemble those of a lizard, *sauriosis*, rather than of a fish. In *sauriosis* the dried sebaceous concretion assumes the shape of the interlinear area of the skin, and is of no great thickness, *sauriosis squamosa*; while in other parts of the same skin, and particularly where the sebaceous secretion is more abundant, the scales are lengthened and columnar and assume the shape of spines, *sauriosis spinosa*, the porcupine disease. *Retention of secretion* results from alteration in the qualities of the sebaceous substance and its detention in the excretory duct and sometimes in the proper ducts of the gland. This pathological condition of the sebaceous substance may exist without any change in the excretory ducts or it may be the consequence of closure of the apertures of those ducts. Of the former kind are the accumulations known as *come-*



*done*s or grubs, small sebiparous tumors, or mol-luscum contagiosum, and larger sebaceous accumulations and horns. The affections in which the aperture of the duct is closed, are, miliary or pearly tubercles, and serous and sebaceous tumors, or, as they are commonly termed, *encysted tumors*. *Inflammation of sebiparous glands* and immediately adjacent tissues, of a chronic kind, gives rise to *acne*. *Acne* is a hard, conical pimple, pierced at the summit by the excretory duct of a sebiparous gland, slow in its progress, of a deep red and often purplish colour, and terminating sometimes by subsidence and sometimes by suppuration. When the pimple is small and the excretory duct loaded with sebaceous substance of a black colour at the outlet, the variety is called *acne punctata*; when hard and chronic and indisposed to resolution it constitutes *acne indurata*. *Carcinoma of the sebiparous glands*, is a disease of elderly persons; the gland is hard, and forms a small, flattened, and whitish semitransparent tubercle; the tubercle ulcerates slowly and exudes a small quantity of ichorous fluid which dries into a thin crust; under the crust the ulceration proceeds slowly, and, after many months, there is a small deep ulcer with fissured and sometimes everted edges. The ulcer is apt to bleed from time to time, and gradually, but very slowly, increases in size. Sometimes it puts on a more active character and becomes a true cancer, destroying the skin, the cartilages of the nose, and eventually life itself, from a continuance of irritation and pain.

21. AFFECTIONS OF THE SUDORIPAROUS SYSTEM naturally give rise to disturbance of the function of perspiration, and this disturbance may be represented by augmentation, diminution, and alteration of secretion. *Augmentation of secretion* is termed idrosis or sudatoria, the sweating sickness. *Diminution of secretion*, giving rise to dryness of the skin, is termed anidrosis; while *alteration of secretion* presents itself as an alteration of odour, osmidrosis; and colour, chromidrosis; the term hæmidrosis being reserved for those perspirations which are changed in appearance by admixture with the red colouring principle of the blood.

22. TRAUMATIC AFFECTIONS.—MALIS is a general term intended to signify the presence of parasitic animals on, in, and under the skin. The animals commonly known to draw their nourishment from the human skin, are, the *acarus scabiei*, *acarus autumnalis*, *pediculus*, *pulex*, *cimex lectuarius*, and *filaria medinensis*. Three species of *pediculus* are found to infest the skin, namely, *P. capitis*, *P. corporis*, and *P. pubis*, the latter not confining itself solely to the pubes, but being found also on every part of the body furnished with hairs, and notably in the armpits, eyebrows, and at the roots of the eyelashes. The species of *pulex* are two in number:—*P. irritans*, the common flea, and *P. penetrans*, the chiggre of the West Indies. The *filaria medinensis* is a native of India, but is sometimes imported into this country by those who have been for some time resident there.

AMBUSTIO, or burn and scald; and GELATIO, including frost-bite and chilblains, will be found treated of under their respective heads, in articles devoted specially to their consideration.

CAUSES.—Diseases of the skin, as of other organs and tissues of the body, obey, as an essential or fundamental cause of their existence, as in

fact a *proximate cause*, a lowered vitality of the affected tissues, together with a greater or less depression of power of parts or of the whole of the nervous system. Certain conditions of the body and certain agencies conduce to this pathological state, to this state of depression of the vitality of the organ; and these are the *predisposing causes*, while other agencies act the part of *exciting causes*.

The influence of the nervous system, as a *proximate cause*, is shown, among other examples, in the sudden and complete arrest of the normal secretion of the skin in certain diseases; in the excessive outbursts of perspiration in sudatoria; in the abundant and paroxysmal secretion of eczema madidans; in the violent itching of lichen and prurigo; in the stinging pruritus and muscular spasm of urticaria, and some forms of erythema; in the neuralgia of herpes zoster; and in the nerve paresis of area.

The *predisposing causes* that may be more especially noted, are:—age; sex; temperament; hereditary influence; moral influence; privations; occupation; visceral derangements; and climate. *Age* becomes a predisposing cause of cutaneous disease by virtue of the special characters of different periods of life; the sensitiveness of infancy; the activity of the nutritive functions during the growth and development of the body; the proneness to disturbance of balance between waste and supply consequent upon the completion of growth; and the rapid increase of waste in old age. *Sex* exhibits its influence at the periods of puberty and menstruation; in disturbances of the menstrual function; and in its cessation; in marriage, childbirth, and lactation. The power of *temperament* is evinced whenever the prominent quality of the temperament assumes an abnormal type; when the healthful standard inclines to an excess of the lymphatic, of the sanguine, of the nervous, or the bilious. Eczema, impetigo and diseases having a tendency to the production of morbid secretions accompany the hyper-lymphatic temperament; erythemata and pityriasis alba et rubra the sanguine; neuralgic, pruritic and melasmic eruptions, the nervous; and chloasma the bilious temperament. *Hereditary predisposition* is manifested in alphas and scrofula; and, indirectly, by acquired heredity, in ichthyosis, eczema and psoriasis. *Moral affections* of a depressing kind, such as anxiety, grief and dread, predispose to cutaneous disease by exhausting the tone of the nervous system generally, suspending appetite and nutrition, and depressing the vital power both generally and locally. While certain moral affections, such as anger and terror may, at the same time, act both as predisposing and exciting causes. *Privations*, whether of food, of clothing, or of pure air, as in badly ventilated apartments, predispose actively to cachexia, to a lowered vitality of the individual, and of the cutaneous tissues. To one or other of these causes must be attributed the eruptive diseases of nurseries; of schools; of workhouses; of the poor; of ill-fed or the improperly fed; the ill-clothed or the improperly clothed; of the inmates of ill-ventilated apartments and the inhabitants of close, obscure and unclean portions of towns, villages and cities.

*Occupation* is also a powerful predisposing cause, inasmuch as it too frequently leads to a direct violation of the laws of health; it prevents exercise

and a proper oxygenization of the blood ; it too often puts an unreasonable strain on the mental faculties ; it destroys appetite ; and weakens nutrition and innervation. Some are compelled to inhale a hot, stifling and impure atmosphere for many hours of the day and night ; others are led into an atmosphere which is chilly and damp, and checks the normal function of the skin ; some are forced to breathe an air charged with animal fumes, dust, or chemical vapours, sometimes poisonous ; and some have the skin irritated by saturation in an acid or alkaline solution ; by the hot dry particles of lime and brickdust, or by chemical substances, such as sugar, &c. These latter, like some others, perform the double part of predisposing and of exciting causes. *Visceral derangement* acts the part of a predisposing cause, not only in its necessary influence upon the nervous and nutritive functions, but also by a reflex irritation from the organ in a state of disease, as the gastrointestinal, the pulmonary, the urinary or the uterine mucous membrane, to the cutaneous organ. And, the influence of *climate* is shown in the development of eczema, in a warm, damp and relaxing locality ; in the production of lichen and prurigo, in a dry and stimulating region ; as also in the endemic nature of certain diseases, for example, the pellagra of Italy ; the plica of Poland ; the frambesia of Africa ; and the elephantiasis of certain regions of the world.

The *exciting causes* may be either external or internal. The *external exciting causes* are local irritants of various kinds, fluid, solid or gaseous : for example, moisture, dust, heat as of the sun or fire, friction, chemical substances or chemical vapours, parasitic animals such as the acarus, pediculus, cimex, &c., the extremes of heat and cold. *Internal exciting causes* present themselves to us either as an unknown influence creating a disposition or diathesis, such as that cause, whether present in the blood, in the nervous system, or in the tissues, which gives rise to alphas, lupus, scrofula, cheloides, or elephantiasis ; or certain specific causes, recognised as blood poisons, for example, the specific poison of syphilis, or the specific poisons of the eruptive or zymotic fevers.

**PROGNOSIS.**—Diseases of the skin are very rarely fatal ; they have a natural tendency to assume a chronic character ; but, eventually, in a longer or shorter space of time, their cure is accomplished. The diseases most apt to take on a grave character and terminate fatally, are such as are the consequence of a cachectic and exhausted state of the constitution, for example, the worst forms of pemphigus and purpura. Anthrax, also, is occasionally fatal, from the intense irritation and prostrating influence which it exerts upon the nervous system. The hereditary diseases, ichthyosis, alphas and psoriasis are among the most chronic of cutaneous affections. Cheloides is chronic, and little amenable to treatment ; other diseases of a specially chronic nature are, acne, sycosis and lupus. Of the chronic diseases, some have a tendency to persist for a life-time, for example, ichthyosis and psoriasis ; but, nevertheless, yield gradually to a well-directed treatment, and eventually get well. Alphas may be equally permanent, although not equally curable ; but, commonly, it has its periods of exacerbation and dispersion, and, although it may be removed entirely by medical treatment, it is its nature to return ; it

may be removed ; sometimes it may never return, but it cannot therefore be said to be cured. Acne is a disease of defective nutrition of the skin, depending on defective vitality of the general system, and the acquisition of power by the general system brings with it a natural cure of the disorder. Few diseases of the skin are, however, purely constitutional ; the greater part are of a mixed nature, constitutional and local, while some are almost entirely local ; and, in proportion to the simple local nature of the disease, is the facility of removing it. Molluscum contagiosum, follicular epithelioma and verrucae are local diseases, and one touch with a concentrated solution of potash suffices for their cure.

In eczema, it is not uncommon to find the eczematous inflammation pervading more or less of the mucous membrane of the body as well as the skin ; it may be the alimentary mucous membrane, it may be the pulmonary mucous membrane ; and it is also to be observed that amelioration of the state of the skin is apt to be attended with an increase of congestion of the mucous membrane, and *vice versa*. Now, this is a case of some gravity, and is to be dealt with cautiously ; and our efforts must be directed to the removal of the *causa morbi* by restoring the natural healthy functions of the body without too speedily checking the inflammation and secretion of the skin, which in this instance performs a derivative action. When a *causa morbi* is present in the economy, accidental circumstances generally determine the seat of its operation ; it may be a weakened internal organ, perhaps a vital organ, or it may be the cutaneous tissue ; in such a case, the safety of the patient may turn upon nature's selection, and if that selection be the skin, we are bound to admit the conclusion that, at least, the skin is the safest locality for its evolution. In this way, cutaneous diseases are sometimes derivative ; and a too sudden cure of an apparently local affection, might impress upon the *causa morbi* the necessity of seeking a field of operation in an organ more important to the comfort and perhaps to the life of the patient.

Among the active causes of cutaneous disorder, is a reflex irritation from an internal organ in a state of disease. And the only safe cure for our patient will be one, which, by removing the internal cause, leaves nothing but the cutaneous irritation to be conquered. Not unfrequently the local affection is nearly or wholly independent of constitutional origin, and then it may be cured immediately without any doubtful retrospect. And the same may be said, when the cutaneous disease is the cause of an internal irritation, which it serves to perpetuate and maintain.

Careful reflection on the nature of cutaneous diseases, has led us to the unalterable conclusion, that the doctrines of Abernethy in reference to the constitutional origin of local diseases, and especially the application of those doctrines to the manifestation and maintenance of affections of the skin, cannot too steadily be borne in mind. We may, and we ought, to avail ourselves of every contrivance which can improve the condition of the local affection, *per se* ; but we ought, at the same time, never for one moment to forget the dependence of the health and vitality of the part upon the general health and vitality of the whole.

**TREATMENT.**—The treatment of diseases of the



skin must be conducted on those general therapeutic principles, which govern the treatment of all other diseases to which the body is liable. In cutaneous diseases there are two principal objects which demand our attention:—firstly, there is the local affection, and secondly, there is the general condition of the patient; the management of the first of these constitutes the local or cutaneous treatment, the second the constitutional or bodily treatment.

The local treatment, which in the eyes of the patient is always the most important, because the more pressing and urgent, is often, in reality, the most serious in the judgment of the physician; the local disease may be grave while the constitutional disturbance is slight; whereas in other instances the local disease may be consequent upon constitutional derangement, and will get well spontaneously as soon as the bodily functions are properly regulated. It will be our business, therefore, to learn which of the two is the dominant evil; and while we do equal justice to both, we must so regulate our resources as to secure the readiest and the most complete cure for our patient.

To treat with success, and upon correct principles, the local affection, we must determine the present condition of the disease. There may be active inflammation, requiring the application of cooling and soothing remedies; inflammation originally active may have become passive, or continued, or have assumed the character of inflammatory irritability, in which case, our remedies must belong to the restorative, the tonic, or the mildly stimulant class; or, the inflammation may be persistent and chronic, and call for the use of alteratives and stronger stimulants, to change the existing action, to induce a more active vitality, and to excite the *vis medicatrix* to a healthy restoration.

So also in reference to the constitutional treatment; any function that upon careful examination may be found in disorder must be set right; the digestive organs which prepare the food for the operations of the nutritive functions, the nutritive functions themselves, the organs concerned in secretion and excretion, the vitalizers and the propellers of the circulating stream, and those great agents of power the nerves and the nervous system, must all be regulated as far as we are able, and brought into a state which is most conducive to harmonious action, and to the speedy confirmation of health.

We may therefore inquire—What are our appliances for the attainment of the objects which we have in view? What are our local, and what our constitutional means? and having determined what these means are, we may further inquire—In what manner they are to be employed; how they are to be used generally; and how in particular instances?

The local treatment is intended for the alleviation of those conditions of the diseased organ which give rise to inconvenience and suffering; they may be:—inflammation of an acute or chronic type, pain, burning heat, pruritus, moist or desiccated discharges, or dry exuviae in the form of scales of various degrees of thickness and size. The local remedies at our disposal for the relief of these conditions are:—rest, position, lotions, fomentations, poultices, cooling and absorbent powders, ointments, liniments, soaps, and caustics. In some cutaneous affections, and amongst others

in erysipelas, eczema in an acute stage or affecting a large extent of surface or the lower extremities, in pemphigus acutus, purpura hæmorrhagica, general rupia, erythema nodosum of the limbs, and erythema œdematosum, the repose of bed may be necessary. And in cases where confinement to bed is not absolutely needed, the diseased part, particularly if the lower limb, may require the support of position or of a well-adjusted bandage, or of both these means conjoined.

The *lotions* adapted for the inflammatory stage of cutaneous diseases, are:—the cooling and evaporating lotions, such as that containing alcohol or ether; the sedative lotions, for example, a weak solution of bicarbonate of soda, or sesqui-carbonate of ammonia, a drachm to the eight ounces; the liquor plumbi lotion, or that containing tincture of opium or belladonna; or, when the epidermis is dry and parched, a lotion of glycerine. A piece of thin washleather saturated with water, and lightly spread on the inflamed skin, quickly reduces the heat of the part, whilst with a similar purpose Devergie contrived an apparatus for effecting the irrigation of the inflamed integument, and speaks highly of its success in inflammatory eczema. In the chronic form of inflammation, and where pruritus is the distinguishing symptom, and the surface dry and parched, the glycerine lotion is again useful, or an antipruriginous lotion, such as that of hydrocyanic acid, of chloroform, of perchloride of mercury, of carbolic acid, or, best of all, of the pyroligneous oil of juniper. Or, if the intention be to stimulate the diseased skin to a more energetic action, a sulphur lotion, as in the case of acne; a lotion of nitrate of silver; a strong lixivium of potash in chronic eczema, or the tincture of croton, first recommended by ourselves many years since.

*Fomentations* are serviceable where a hot, dry, inflamed and painful surface is to be soothed, or where desiccated secretions are to be softened and removed. In this case we may employ simple water or emollient infusions or decoctions, for example, infusion of linseed, or decoctions of oatmeal, wheaten starch, bran, or poppyheads. Hebra has lately introduced a permanent fomentation in the form of a bed suspended in water; this apparatus admits of the patient being immersed in heated water of an uniform temperature for any required length of time, and the inventor finds it of great use in the treatment of small-pox, and extensive burn or scald. This permanent warm bath is most agreeable to the sensations of the sufferer, and Hebra has been enabled to keep a patient constantly immersed for several weeks together; for example, through the entire course of small-pox, and until the complete cure of a severe burn.

*Poultices*.—The lighter species of poultice are alone applicable to cutaneous affections, for example, and first in order and value, water-dressing; then starch poultice, rice flour poultice, poultice of potato starch, bread poultice, the spongio-piline saturated with simple water or some sedative decoction, oil poultice, and yeast poultice. Dr. Alison introduced a few years since a water-dressing, remarkable for its lightness and easy application, namely, a thin lamb-skin, made impermeable to moisture on one side by means of a varnish of caoutchouc. Poultices are especially valuable in softening and removing crusts formed by desic-

cated secretions, horny concretions, and epidermal squamæ: in promoting secretion and soothing irritation of the inflamed skin; but if they be kept on too long, they are apt to soften and weaken the skin, to increase the nervous irritability of the tissues, and perpetuate instead of relieving the morbid action. Thus a remedy which is the best for a time, may, by misjudgment of the principle on which it is intended to operate, be converted into a means of irritation, and keep up the morbid action which it was expected to obviate. The same observation may be made in reference to lotions, and further, as applicable to lotions, it must be remarked that however agreeable they may be while the moisture continues, the local irritation is apt to return with double force when their use is suspended and the surface becomes dry.

Certain *powders* of a cooling or absorbent nature are very useful remedies in some affections of the skin, and not unfrequently are the only application which the inflamed surface will bear; for example, wheaten starch in erysipelas, in some erythemata, in the phlyctenæ of herpes and zona, and especially in the bullæ of pemphigus. They should be dusted lightly and sparingly on the surface, lest they become agglutinated by the effused secretions, and converted into hard irritating concretions. Rice powder, the oxide of zinc powder alone, or diluted with starch, and the zinc and starch powder with camphor are also useful remedies in these affections, and equally so in intertrigo both of the dry and the moist kind.

The *ointments* applicable to affections of the skin are either soothing or stimulating in their nature; the former being intended to subdue inflammatory action and calm irritation and pain, the latter to arouse action and cause dispersion of the morbid affection. Of the former kind are—the linimentum calcis with or without alcohol or liquor plumbi; simple cerate or lard with liquor plumbi, alcohol, chloroform, glycerine, camphor, the cyanide of potassium, five grains to the ounce, or the calamine cerate of Turner; and above all the benzoated ointment of oxide of zinc, either *per se* or combined with alcohol, chloroform, liquor plumbi, or camphor. Of the latter kind are the unguentum plumbi compositum, ointments of the nitric oxide, nitrate, and ammonio-chloride of mercury; ointments of iodine, sulphur, carbolic acid, creosote, and tar, especially that of the pyroligneous oil of juniper.

*Liniments* may be made to combine the cooling or soothing effects of a lotion, with the emollient and sheathing operation of an ointment, and may, at the same time, be made the vehicle of sedative or stimulating remedies. Milk and butter-milk are the simplest forms of liniment; then the linimentum calcis either alone or combined with alcohol, liquor plumbi, tincture of opium or chloroform; the linimentum saponis, linimentum camphoræ, and linimentum ammoniæ of the Pharmacopœia. Or the juniper tar liniment used by Hebra in chronic eczema, and so invaluable in prurigo, namely, a mixture in equal proportions of the pyroligneous oil of juniper (Huile de Cade), sapo mollis, and alcohol. For the pyroligneous oil of juniper, Hebra sometimes substitutes the oleum betule, or oleum fagi, and we have found the pix liquida equally valuable. And another remedy, useful in lupus erythematosus, that may be treated of as a liniment, is ioduretted glycerine, a saturated

solution, containing five grains of iodine to the ounce of glycerine.

The purpose of *soaps* in cutaneous therapeutics, is to cleanse a secreting surface of its morbid fluids and the desiccated and irritating secretions which are apt to form on such surfaces; while, another purpose, in very chronic affections, or at the decline of acute diseases, is to restore the tone of the weakened tissues by mild stimulation of the skin, and bring it back to its normal power of resisting the influence of the air and external irritants. With these objects in view, the common hard and soft, the soda and potash soaps may be employed, a solution of soft soap in glycerine, the oxide of zinc soap, sulphur soap, petroleum soap, or, a very valuable therapeutical agent, the juniper tar soap. Soap is also used as a coating for the skin; as when it is smeared on the surface and left to dry, and in this way performs the office of an ointment, and in certain cases is found less irritating than a greasy application. In the treatment of cutaneous diseases our resources cannot be multiplied over much.

*Caustic* solutions and concentrated caustics are useful when a fixed abnormal action or chronic morbid irritation is to be removed, as in the case of chronic eczema, lupus erythematosus, or alphas, or where morbid tissues are to be destroyed, and the deeper structures stimulated to healthy action, as in the instance of lupus non exedens and lupus exedens. Hebra has introduced the use of caustic solutions of potash; they vary in strength, according to the nature of the disease to which they are to be applied, from five grains to the ounce of distilled water or glycerine to equal parts; and, employed with judgment and care, these solutions are of great value. The weaker kinds are simply stimulants, and by promoting exudation from the surface, disperse those thickenings of the skin, which are the result of infiltration of the tissues. The acetum cantharid is made with strong acetic acid acts in a similar manner. But the stronger potash solutions are actively destructive of the tissues to which they are applied. The potassa fusa is the best remedy for small vascular nævi, for verrucæ, sebaceous molluscous tumors, lupus tuberculosus, and for carcinoma glandulæ sebiparæ. For ulcerating lupus Hebra gives a preference to the solid nitrate of silver, which he inserts deeply into the morbid tissues. The chloride of zinc is sometimes used as a stimulating lotion, and in a concentrated form, namely, equal parts of chloride of zinc and alcohol has been employed as a caustic in the treatment of ulcerative lupus. An objection to the chloride of zinc is the great pain which it occasions. Arsenic has also been employed advantageously in the treatment of the ill-conditioned sores of lupus, and especially in cancerous ulcerations.

**CONSTITUTIONAL TREATMENT.**—Having taken in and carefully adjudicated for every possible requirement of the actual condition of the local disease, we must next turn our attention to the causes which may have given rise to it. The exciting causes will in most instances have been remedied by the local treatment, but if any exciting cause still remain it must be immediately removed. Next we must seek out the predisposing causes: and for these, the constitution, the state of health, and the actual condition of the patient, must be closely interrogated. Local disease is sometimes present without any constitutional cause



being discoverable: there are such cases, but they are exceptions to the general rule. Cutaneous diseases may be cured, by local means only; but they must be slight and unimportant to be so cured: diseases for example depending on a physiological action only, or diseases which may have originated in a constitutional cause, but that cause having ceased, they would seem to be independent local affections. It would be unjust to regard them, under these circumstances, as pure local diseases. If we treat a disease by local means, and require that our patient abstain from certain articles of diet, from physical or mental exertion, we treat the case, in reality, constitutionally as well as locally. We give no medicines, it is true, but we effect the same objects that medicines are intended to bring about. If we admit a patient into hospital, and place him in bed, we employ powerful constitutional medicines in the shape of rest, of repose, of wholesome diet. These curative conditions are sometimes overlooked, when we declare that certain affections are to be treated by local measures alone. Nevertheless, the fact may be admitted, that certain cutaneous diseases, for example, scabies, may be cured by local means only; and also that certain cutaneous affections, such as chronic eczema, and pityriasis may be cured by local means, without injury to the health and constitution of the patient.

The great authority who taught us the dependence of local diseases on a constitutional cause, also directed our attention very emphatically to the digestive organs as a possible seat of derangement when no other symptoms of disorder were appreciable in the economy; and to these organs we must carefully look in cutaneous disease. The tongue may be unclean, the stomach slow of digestion, the bowels torpid or relaxed; there may be pain, or distension, or weight, or flatulence of the stomach; there may be nausea or sickness; there may be signs of an excess or of a deficiency of bile, of disordered function of the liver or of the kidneys; there may be mal-assimilation, mal-nutrition, mal-sanguification, and mal-innervation. Some or all of these symptoms may be present, and in a degree which may be decided or slight, so slight as to admit of being overlooked, and yet such as they are, they may be powerfully influential in keeping up cutaneous disease.

In acute affections, for example in the erythema, it may be necessary to adopt an antiphlogistic treatment, consisting of mild purgatives and effervescent salines. In chronic affections it may be sufficient to regulate the digestive organs and promote healthful secretions. As soon as the febrile symptoms have subsided, in the former case, we must have recourse to tonics, and in chronic affections we shall probably find occasion to commence our treatment with tonics, and employ mild aperients or purgatives only as *adjuvantia* to the action of our tonic remedies.

Cutaneous diseases are essentially diseases of lowered tone of the vital functions, and are therefore ill calculated to bear a treatment of a lowering nature; on the contrary, they demand tonics at an early stage, in most instances from the first, and all those appliances are to be set in operation that will improve the condition of the blood, and increase the tone and healthy action of the nervous system.

The antiphlogistic remedies the best suited to our purpose are the effervescent salines, with ammonia, sometimes with the addition of hydrocyanic acid, of chloric ether, or of nitric ether. The aperient antiphlogistics are, sulphate of magnesia, either in effervescence with citric acid and soda or potash; or associated with carbonate of magnesia and colchicum in a gouty diathesis; or in combination with a tonic, as with quinine, sulphuric acid, and infusion of roses; or with quinine and sulphate of iron, or sulphate of zinc.

The tonics which in our hands have proved the most useful, are the nitromuriatic with infusion of orange-peel or gentian, nitromuriatic acid with quinine, and sulphuric acid with quinine. In some instances it has been of service to combine a vegetable bitter with alkalies, as infusion of calumba or bark with liquor potassæ or the bicarbonate of potash. When anæmia is present, and chalybeates are indicated, the formulæ that may be selected are the effervescing citrate of iron, the ammonio-tartrate, the tincture of the sesquichloride, the sulphate, the biphosphate, the syrup of the iodide, or the citrate of iron and quinine.

There are certain remedies in cutaneous medicine which are reputed specific; for example, sulphur, cantharides, and arsenic. Sulphur has lost much of its ancient reputation when employed in a solid form. It is a disagreeable remedy, and possesses no advantages that make it deserving of being retained among our auxiliaries. The only cases in which we still continue to employ it are those of scabies, wherein it is desirable to develop an atmosphere of sulphur as extensively as possible. Sulphur, when taken internally, is eliminated from the blood through the skin, and in this way acts as a stimulant to the cutaneous tissues, and by virtue of this action, probably performs the office of a cutaneous tonic. And it may possess, also, other and unknown modes of operation in contributing to the solidity and nutrition of the cutaneous textures. The best method of obtaining its beneficial action is by the use of the natural sulphurous mineral waters, such as those of Aix-la-Chapelle, the spas of the Pyrenees, and the spas of Harrogate in England, and Moffat in Scotland. At these places, in addition to being presented to the system in a condition the best suited for assimilation and inhibition by the blood, the remedy also admits of being used locally in the form of baths.

The tincture of cantharides also exerts a stimulant and tonic influence on the skin, as well as serving to increase the action of the kidneys. It is employed only in chronic cases, and especially in alphas, and in doses of two to six minims three times a day. When prescribed for alphas, it may be combined with Fowler's solution of arsenic, and its poisonous effects must at the same time be borne in mind. When taken for a lengthened period, it is apt, like arsenic, to cause an erythema of the skin, and, in instances where arsenic cannot be tolerated, the tincture of cantharides might be found an efficient substitute for that remedy.

Arsenic has enjoyed, and continues to enjoy, a deserved reputation for the cure of cutaneous disease. Properly administered, it is harmless and certain, and lays claim to be the best cutaneous tonic which we possess. It improves the nutrition of the skin, gives force to its circulation, and tone to the tissues and to the cutaneous

nerves. It should, however, except in certain instances, be reserved for the *coup de grace* of the cure, and it acts best when the general functions of the body are properly performed, and nothing remains to be effected by treatment but the restoration of power and vigour to the skin. When taken for a time, the limits of which vary in different individuals, arsenic produces a feeling of warmth, a tingling and even an erythema of the skin, the tingling being first perceptible in the fingers and hands, and the erythema first showing itself in that portion of the mucous membrane of the body which is habitually exposed to the atmosphere, and which is most conveniently placed for becoming a register of the degree of saturation of the system by the remedy, namely, the conjunctiva. Just as we look to the free edge of the gums to note the saturation of the system by mercury, so we look to the conjunctiva as an arsenometer for testing the occurrence of saturation of the system by arsenic. A moderate amount of congestion of the conjunctiva teaches us that the surface of the body, both mucous and cutaneous, is sensitive to the influence of the remedy, and that our medicine is effecting the purpose which we have in view; but if the congestion increase to such extent as to be inconvenient, the remedy must be stopped, or at least diminished in dose. Unless this be done, the extension of the arsenical congestion of the mucous membrane of the nose, the mouth and salivary glands, the bronchial tubes, the stomach, or the intestines, may give rise to coryza, to salivation, to a dry hoarse cough, to nausea and sickness, or to diarrhoea or dysentery. Subsequent to its action on the mucous membrane, and in rare instances before that action is established, the arsenic produces erythema of the skin, with more or less tumefaction, and often a very remarkable distension of the subcutaneous tissue of the whole body, such as is sometimes associated with the hyper-nutrition of pregnancy.

The pharmaceutical preparations of arsenic are somewhat numerous, namely, liquor potassæ arsenitis, or Fowler's solution; liquor arsenici chloridi, or De Valangin's solution; arseniate of soda; arseniate of ammonia; arseniate of quinine; iodide of arsenic; liquor hydriodatis hydrargyri et arsenici of Donovan; and the ioduretted iodide of potassium and arsenic of Neligan, the latter containing in the dose, five minims of Fowler's solution, one grain of the iodide of potassium, and a fourth of a grain of iodine, in solution in simple syrup.

Of all these preparations, Fowler's solution is the most simple and probably the best, but in some cases, the acid solution of arsenic may be found more convenient; indeed, it has always appeared to us that as arsenic is administered with meals, at a time when an acid reaction prevails in the stomach, the acid solution should have certain consequent advantages. In fact, we have known more than one case of chronic eczema cured by the acid solution after the alkaline solution had failed. The arseniate of soda is most conveniently exhibited in the form of powder, the arseniate of ammonia, in solution like the potash solution, and the arseniate of quinine and iodide of arsenic in pills. Donovan's solution must be prescribed with some simple fluid vehicle, such as syrup of ginger.

Arsenic may be administered at all ages, from

the infant at the breast to the most advanced term of life, and with equal security. It is amazing how well it is borne by the infant and by elderly persons, how rapidly the nutrition of infants is improved under its use, and how quickly the eczema for which it is prescribed puts on a better character, and the skin assumes a more healthy aspect. The dose of Fowler's solution for an infant a month old may be one or two minims, three times a day, and this up to the age of four or five; from five to ten years, the dose may be three minims; from ten to fifteen, four minims; and from and after fifteen years, four or five minims up to the period of decline of the physical powers in old age, when the dose may be again lowered to four, three, and two minims. Five minims of Fowler's solution may be assumed to be the full standard dose; that, in fact, which may be taken for the longest time without causing inconvenient effects. We have very seldom carried the dose beyond five minims three times in the day, and have rarely exceeded seven minims; therefore we are unable to say what the effect of increasing doses may be. Dr. McCall Anderson states the commencing dose of Fowler's solution for an adult, in a case of acute eczema, to be five minims three times in the day, to be increased, at the end of a week, by one minim every second or third day, "till the disease begins to yield, or the medicine to disagree." He moreover remarks that, "while five minims thrice daily soon disagree with some, ten, fifteen, or even thirty may be taken by others with impunity and with benefit." We may state as the result of our own experience that a very rapid improvement has often followed an increase of dose beyond the five minims to which the constitution has become habituated, and some excellent cures where the dose has been raised to ten minims. It is, however, most important that where these large doses of arsenic are administered, the patient should be watched with more than ordinary anxiety and care.

Besides a proper regulation of the dose, it is important that arsenic should be administered with the food; not before eating, because then it might be brought in contact with the mucous membrane of the stomach; not after the meal, because no limit is fixed for the interval subsequent to the meal, and the dose may be forgotten; but, if possible, in the midst of the meal and near its conclusion, that the remedy may as it were be incorporated with the food, digested with the food, and presented to the blood in the newly formed chyle that immediately succeeds to digestion. In the use of every remedy, it is important that the medicine should be presented to the stomach in the least objectionable if not in the most pleasant shape possible, hence, arsenic should be exhibited alone, or as nearly so as practicable, and in the most condensed form consistent with security of administration. A tablespoonful of any fluid, known to be a medicine, will soon affront the stomach, but five minims of Fowler's solution, with fifty-five minims of saccharized water, the whole constituting a measured teaspoonful, a fluid drachm, may be taken for any length of time without inconvenience so far as the imagination of the patient is concerned. We have used one formula for many years, and we know of none better for administering the remedy, for regulating



the dose, or procuring a more certain uniformity of result. It was first suggested to us by the frequent association of anæmia with eczema infantile, and at the same time by a desire to render the medicine as palatable as possible to children, for whom in the first instance it was prescribed; it is as follows:—

℞ Vini ferri ℥jss.  
Liquoris arsenicalis ℥ss. ad ℥iis.  
Syrupi simplicis ℥iiss. ad ℥iss.  
Aquæ anethi vel destillatæ ℥ij.  
Ft. Mist.:—

One drachm three times a day, in the middle or towards the end of the meal.

Furthermore, we make a rule of concluding our directions with the injunction that the medicine is to be immediately discontinued if it chance to disagree.

We sometimes meet with curious examples of intolerance of arsenic, but not more frequently than of other medicines and even of articles of diet, so that these instances may be referred to idiosyncrasy. But when the remedy is administered with moderate caution, it may be taken to be the safest as well as the best of the constituents of our Pharmacopœia. It has been reputed dangerous from a "cumulative" property, but we cannot understand such an objection if it be employed with caution. Taken in solution, and in association with food, it clearly cannot accumulate in mass; and, any sudden outbreak of serious symptoms supposed to arise from accumulative action, may be prevented by watching the patient, and instantly suspending the remedy if any premonitory signs of constitutional disturbance become manifest. We have scarcely once seen, in the course of twenty-five years' practice, any serious symptoms occasioned by arsenic, and this we attribute to the mode of exhibition which we employ, and the moderation of dose. We are unable to say what "cumulative" evils might result from larger doses, and especially from large doses continued for a length of time.

Having passed in review the remedies, and the nature of the remedies that we have at our disposal, let us inquire what is the class of subjects upon whom we may have to employ these remedies, and how the remedies should be modified to meet the different phases of life, and the different constitutions that we may have to treat. Our patients may be infants at the breast, governed as to their health by the milk as well as by the physical or the moral condition of the mother; or they may be brought up by hand; or they may be children struggling through the period of the first dentition, its sufferings and irritations, well-fed or sparingly fed. Thirdly, they may be youths contending with the second dentition, with education, with school training and with active growth, well fed or insufficiently fed. Fourthly, they may have entered upon the first functions of puberty, hungry, eager, standing in need of all the nourishment they can get to perfect the inward frame, and too much occupied with the more essential organisation to have nutrition to spare for the ornamental part, the skin and its dependencies; or they may be young females, victims of defective and deranged menstruation. Fifthly, we may have to deal with weakly manhood or womanhood, their toils, their cares, their labours, their indulgences, their pinchings, or their excesses, and the

hundred disorders which accompany this eventful period of life, the period of parental function and maturity. Sixthly, we meet with a most important and numerous group, in which the balance of supply exceeds that of waste, and like a neglected garden runs on to confusion and destruction; this is the *change of life*; the change from active function to torpid function; a period when the elements of disease are undergoing a daily production and development, and when the aid of the physician becomes necessary to guide the wayfarer of life to that easy decline which results in a restored balance or in the increase of waste, and an increasing necessity for nutrition and supply.

Then we have to consider the treatment applicable to the temperaments of the body, be they natural or acquired; the secreting and the non-secreting diseases of Devergie; the former the appendage of the lymphatic temperament, the latter principally accompanying the nervous temperament, while the exanthemata belong to the sanguine and the dyschromata to the bilious temperament. Next, there are the diseases of diathesis, and specially of the scrofulous and the leprous diathesis; and, lastly, the diseases originating in blood-poison, and emphatically in the poison of syphilis.

Children and infants are particularly liable to secreting or eczematous eruptions, the latter presenting the simple erythematous, the serous, or the pustulous forms; to infants belong the red gum or tooth rash, strophulus, and intertrigo, and to children a little further advanced impetigo and lichen urticatus. The remedies the most appropriate for infants and children, are grey powder with rhubarb, calomel, the nitromuriatic or sulphuric or phosphoric acid, with tincture of orange-peel and syrup, the syrup of the biphosphate of iron, the tincture of the sesquichloride of iron with syrup, and the ferro-arsenical mixture. In a scrofulous diathesis we may add to these means: cod-liver oil and the syrup of the iodide of iron; and when the bones are weak, the powder of the phosphate of lime exhibited with the food.

In the second period of life, namely, boyhood and girlhood, the exanthemata are apt to be prevalent; and at this period also we meet with eczema in all its forms, not unfrequently chronic, pityriasis, ichthyosis, and affections of the scalp, including ringworm. Our first attention must be given at this age to regimen, to securing a sound animal diet, fresh air and abundant exercise. Our remedies will be found in the class of tonics: cod-liver oil when there exist waste and emaciation, nitromuriatic and sulphuric acid, quinine, iron and arsenic.

The diseases of the third period take their origin chiefly in deficient nutrition, the amount of nourishment failing to keep pace with the exhaustive operations of growth and development. This is the period when schools assume their tyranny, when the laws of hygiene are forced to give place to Latin, Greek and mathematics, to the piano and the use of the globes; when learning shows its ignorance and bigotry by torturing the stomach and starving the body to give additional stimulus to the nervous system and brain; when the thews and sinews of physical strength are made to relax and bend, and the expanding chest to narrow, under the impulse of intellectual irritation and fever. At this age we still find eczema, and chiefly in the joints; we have herpes from ex-

posure to draughts of cold air and wet feet or clothes, and alphas begins its life-long career; chaps and chilblains prevail in the winter season, and acne at all times of the year. We still have need of tonics, of quinine, of steel, of arsenic, and of a diet of the most generous description.

The diseases of the fourth period, of manhood and womanhood, are commonly dependent on a weakly childhood or youth, on excessive or unhealthy occupation and pursuits, on dissipation or excess, or on debility consequent on maternity. At this age we meet with chronic erythemata, eczema, alphas, and furunculi, and after regulating the digestive organs, we are bound to have speedy recourse to tonic remedies, and to the specific power of arsenic. In women after pregnancy, the hair frequently falls out, and, from want of good management during the period of lactation, serous eczemata are apt to break out around the nipples, in the armpits, in the groins, behind the ears, and on the head.

The fifth period brings with it the change of life, when both man and woman have to stem the wave of habit, and adapt themselves to a new constitution, to a preparation for decline. This period once happily past, age begins its course healthful and vigorous, and goes on happily and almost without limit to its duration. This is the age when our great and distinguished men are apt to drop off; they die suddenly and unexpectedly. They have laboured in their useful and often brilliant career until the change of life has come upon them, and then, from want of care, from want of the direction of their physician, whom they believe themselves too well to consult, they fall before their time, victims to infirmities that all must pass through to reach a green old age. It is at this period that the greatest physical blessing that can befall man or woman is cutaneous disease. The blow must fall—where shall it fall? shall it fall on the heart, on the brain, on the lungs, the liver or the kidneys, or on the skin? clearly, if we value life, on the skin; and it is then that, by timely and judicious treatment, by that regulation of the functions of digestion and of secretion, by that attention to mental repose, to exercise, to diet, that constitute the basis of our treatment of these diseases, we shall be able to avert consequences which, but for this happy affliction of the skin, must have been fatal. It is at this period of life that we meet with critical eczemata, irritable lichenous eruptions, and teasing pruriginous affections. For these we have to cleanse and purify the blood, to strengthen the vigour of the vital powers, to restore comfort and health; and the body's health brings back the health of the skin. How often are we earnestly appealed to to refrain from "throwing an eruption in?" whereas we are little to treat the eruption at such a moment; we direct our powers to the re-establishment of the ordinary healthy functions of life, and when that is attained the seemingly neglected local affection is cured; we have not *thrown it in*, we have simply *starved it out*. Like an impure fungus, it only existed through the supply of unwholesome juices furnished by lowered vitality and exhausted tissue. We invigorate vitality and renovate tissue, and the fungus droops and disappears.

The sixth period is that of old age, the diseases such as result from imperfect and deficient nutri-

tion of the skin, and a greater or less degree of exhaustion of the nervous system. The skin is apt to become harsh and dry and hard, sebaceous and epidermal concretions, and sometimes carcinoma of the sebiparous glands, are formed upon the face, fleshy warts and pendulous mollusca grow out from the body, pityriasis occurs upon the scalp, vibices and petechiæ on the fore-arms and legs, and prurigo of the general surface of the skin. Age demands little modification of the principles of treatment of the tegumentary organ already advocated. The soap-bath should be used daily and abundantly, the skin should be submitted to moderate friction, concretions should be softened and removed, and anti-pruriginous remedies used to relieve the itching and irritation that pervade the surface. The constitutional remedies should differ in no wise except in mildness from the remedies employed during the other periods of life. The digestive functions must be regulated, and the powers of life supported with the aid of tonic medicines and regimen. Arsenic is well borne by aged persons; and hydrocyanic acid, with the bichloride of mercury, form one of the best local applications for senile prurigo.

Having now considered the natural division of cutaneous diseases into local and constitutional, and the general principles of application of the local and the constitutional remedies, we have next to turn our attention to the application of these principles to particular instances, and we shall most readily effect this purpose by passing in rapid review the whole series of cutaneous affections, selecting as we proceed those examples which may seem to deserve a more particular attention than they have hitherto received.

The acute forms of the *eczematous affections* call for the use of means adapted to regulate the digestive and nutritive functions, to be accompanied or followed by tonics, while the chronic forms demand an earlier adoption of tonics and the use of arsenic. Locally, the remedies suited for these affections are water-dressing or poultices, or soothing ointments in the acute stage, and graduated stimulants in the chronic stage. In psoriasis, pityriasis, and gutta rosacea, stimulants are especially indicated; in psoriasis, the tar-tincture and ointment, the stronger mercurial ointments, and sometimes the stronger solutions of potash; in pityriasis, the diluted nitric oxide of mercury ointment (1 ad 3); and in gutta rosacea, the hypochloride of sulphur ointment. The pruritus of lichen is best relieved by lotions containing acetate of lead, hydrocyanic acid, carbolic acid, or the pyroligneous oil of juniper, while in scabies sulphur is specific as a destroyer of the acarus. A few inunctions of simple sulphur ointment, or spongings with the solution of sulphuret of calcium, are sufficient to annihilate both the acarus and its ova. But the cure of scabies is not unfrequently followed by a prolonged lichenous irritation of the skin, the secondary consequence of the animalcular irritation, and in some instances the effect of the sulphur frictions.

The *erythematos affections* depend for their cure chiefly on constitutional treatment, which must be antiphlogistic and tonic, with local remedies to subdue heat and calm irritation. Some of the erythemata are closely allied with rheumatism and are benefited by iodide of potassium and colchicum. Erysipelas calls for the early use of the



tincture of the perchloride of iron, while the best local applications are flour and the solution of nitrate of silver, as recommended by Higginbottom. Urticaria in an acute form requires the treatment suitable to erythema, and roseola, which runs a specific course, is to be managed by the aid of salines, after a thorough clearance of the *primæ viæ*. In urticaria ab ingestis, vomiting is to be promoted, and, in its chronic forms, the disorder requires the tonic influence of bitters, with the mineral acids, of quinine, and, in some instances, of arsenic. The local irritation is best relieved by spongings with hot water, either simple or containing ammonia or vinegar.

Of the *bullous affections* herpes zoster is local and runs a specific course: hence the treatment must be directed to the regulation of temperature and the prevention of friction. Dredging with flour sometimes answers admirably, and covering up with cotton wool secured by a bandage, or a moderately thick coating of the benzoated ointment of oxide of zinc. A solution of nitrate of silver, when applied early, sometimes acts the part of an ectrotic, and neuralgic pains must be combated by quinine or arsenic, and by the local application of morphia, belladonna, or aconite. Miliaria is a clinical debility, for which the appropriate remedies are tonics, such as cinchona with sulphuric acid, tepid baths with the use of the juniper tar or carbolic acid soap, or spongings with a hot solution of ammonia or vinegar. Pemphigus, as a disease of debility, requires a tonic course of treatment, and the external use of oxide of zinc or peruvian bark powder, after previously puncturing and emptying the bullæ.

The *furuncular affections* are diseases of asthenia, and call for a tonic regimen, and local aid, in the first place to retard the advance of the morbid process, and secondly to relieve tension and give exit to the sphacelated fibrous tissue and pus. Boils and anthrax may often be retarded by the local application of liquor plumbi, by a solution of nitrate of silver or tincture of iodine; but at a later period they must be opened either with the knife or potassa fusa, and afterwards dressed with the yellow basilicon ointment. Anthrax may also be treated with success by graduated pressure.

*Nervous affections* must also be treated with the view of invigorating the nervous system, constitutionally and locally, by means of sedatives and stimulants; among the internal remedies are quinine, strychnine, iron, arsenic and cod-liver oil, while the local sedatives are aconite, belladonna and hydrocyanic acid, and the local stimulants, chloroform, tincture of tar, tincture of iodine, and the whole family of antipruriginous applications. Other remedies are the shower-bath, cold douche, hot-air bath, sulphur vapour bath, and stimulant soaps, particularly the juniper tar soap and carbolic acid soap. Pruritus of a part, as of the anus and vulva, is not uncommonly the result of a reflex irritation derived from some internal organ in a morbid condition, as of a hæmorrhoidal congestion of the rectum or vagina, or of an uterine congestion, in which case, while we do our best to alleviate the apparent evil, we must at the same time direct our attention to the exciting cause of that evil.

*Vascular affections*, for example, hypertrophy of the small veins and of the capillaries, may require the employment of pressure with or without as-

tringent applications, the use of a caustic, or of the knife. Isolated venules, such as are often met with in association with hypertrophy of the skin of the nose, may be cured by the application of a fine point of potassa fusa, to coagulate the stream of blood and produce obliteration of the vessel. The same procedure is applicable to the smaller nævi in which a single vessel only is implicated as a nævus araneus, and a similar principle, namely that of setting up inflammation in the abnormal tissues, and thereby bringing about obliteration of the vascular structure, is the basis of the treatment of every form of vascular nævus; to this end are the inoculation with vaccine lymph, the injections with astringent and stimulant fluids, and the breaking up of the tissue by means of a fine tenotomy knife. In infants, vascular nævi left to themselves will often get well spontaneously; at other times it may be necessary to remove them by ligature, the ligature passing beneath their base being the best adapted for that purpose.

The *hæmodycræmic affections* are essentially asthenic in their nature, diseases of cachexia; sometimes induced by bad air, bad food, and insufficient clothing; sometimes by sameness of an innutritious food, as in the case of sea scurvy; and sometimes by an idiopathic depression of vitality depending on feebleness of constitution, and producing the same physical effects as the causes above stated; a cachexia in which the blood loses its plastic and its nutritive properties, and the capillary vessels and the tissues their tone and their powers of resistance. Sometimes, as in purpura febrilis, there are feverish symptoms, but depending on irritability of system and weakened vitality; and bearing only the mildest form of antiphlogistic treatment, conjoined with tonic remedies. The constitutional treatment of purpura calls for the use of the sesquicarbonate of ammonia, with or without cinchona or calumba in the acute period, and in the chronic forms, of the mineral acids, and especially sulphuric, with liquor cinchonæ or quinine, the citrate of quinine and iron, and cod-liver oil. In those forms of the complaint which originate in bad or insufficient food, and general perversion of the laws of hygiene, the treatment is obvious, good food, proper clothing, and proper ventilation. Sea scurvy may be checked and even prevented by the addition of lemon-juice and potatoes to the ordinary diet. The local treatment of purpura must consist in the use of those means which harden and give tone to the skin; such are, the use of soap with cold ablutions, the shower bath, and sponging the surface with the sesquicarbonate of ammonia lotion. In purpura urticans it may be necessary to prescribe the juniper tar liniment or lotion, or a lotion of hydrocyanic acid.

*Developmental and nutritive affections* originating out of deficient vital power, necessarily demand the aid of a tonic treatment and regimen, and especially the adoption of nutritive tonic remedies, such as arsenic. On the same principle the local treatment must consist of baths, soaps, and mild stimulants applied to the skin. Tepid water with abundance of soap speedily removes all epidermic and sebaceous sordes and concretion from the skin, and a softening oleaginous pomade or glycerine paste, prevents their renewal, while the atmosphere and friction perform the part of local tonics. The same plan of treatment is applicable to cachexia cutis, with the addition of the stimu-

lant influence of the hypochloride of sulphur ointment.

In hypertrophic and atrophic affections, there is rarely any important disorder of the economy, and our chief dependence must be placed on local treatment. Nævus hypertrophicus and the ephymata are to be treated by ablation or caustics. Cheloma has hitherto defied treatment excepting with iodine, and boucnemia has yielded only to ligature of the main artery of the affected part. Atrophia cutis is doubtless a neurosis, and should be treated by arsenic and local stimulants, unless any special indications, such as cellulitis, be present.

*Alphous affections*, represented by alphas, the lepra vulgaris of Willan, the psoriasis of the German and French school, being independent of any known constitutional cause, might be supposed to be beyond the reach of constitutional remedies; nevertheless experience has proved that the eruption yields pretty certainly to an arsenical course of some months' duration, and has also been successfully treated from time to time with liquor potassæ, tincture of cantharides, tar in capsules or pills, and decoctions of dulcamara and bardanum. The dose of arsenic is five minims, to be taken three times a-day, with meals, and with the usual precautions, and after a few weeks the dose may be raised to six and seven minims, but always closely watched. The local treatment which is most successful, is that practised by Hebra, namely friction with soap and flannel with a view to remove the scales, and the subsequent application of a tincture of tar and soap, or a saturated solution of the sulphuret of calcium. The soap frictions and stimulant applications must be continued daily, unless an excess of irritation be created, until the local congestion and infiltration are removed.

*Strumous affections* call for a constitutional treatment to correct the morbid diathesis, as well as for local treatment to promote a more healthy nutritive action in the skin. The special remedies for the strumous diathesis are iodine, cod-liver oil, phosphorus, and chalybeates, conjoined with general tonics, a tonic regimen and sound hygienic conditions. The local treatment for scrofuloderma is chiefly tincture of iodine, and for the various forms of lupus, stimulant applications and escharotics; in lupus erythematosus, a strong potash solution, iodized glycerine, or the iodide of sulphur ointment; in lupus non exedens, caustic potash, or acid nitrate of mercury; and in lupus exedens, caustic potash, nitrate of silver, or acid nitrate of mercury.

*Carcinoma* of the skin, beginning in a sebaceous gland, or in the parietes of a follicle, and forming a small tubercle, should be destroyed as early as possible by potassa fusa; at a late period it escapes control, and then can be treated only with ordinary expectant remedies.

The *zymotic affections* are omitted from this article, as being in their nature fevers, and not belonging strictly to diseases of the skin; nevertheless, it may be well to register in this place the almost specific power of the sesquicarbonate of ammonia in the treatment of rubeola and scarlatina; the importance in these affections of inunctions with lard, and the equal importance of an external application in variola, which shall exclude the atmosphere, and, if possible, the light. The pre-

parations usually employed for this purpose, are ointments of mercury, or mercurial plaster, which are open to the objection of exciting pytalism; lard inspissated with charcoal, starch, or chalk might answer the purpose equally well. Other preparations of a non-mercurial nature have been suggested, but none possess that amount of simplicity of composition and application which is calculated to give them a standard place among therapeutical remedies. The best contrivance at present known for the treatment of variola is the permanent hot bath of Hebra, noticed in connection with the treatment of burns and scalds.

*Syphilitic affections* of the skin are essentially constitutional, and are either the first general evidence of the presence of the poison in the blood, *secondary*; or they may occur at a later period of life, years after the original inoculation, with or without intermediate or transitional appearances of the disease to connect it with the primary contagion, *tertiary*. Hence the treatment of syphilodermata must be chiefly constitutional; nevertheless, in the more distant and tertiary form of the disease, local treatment is of much importance; and at still later periods, local treatment may be relied upon for the cure of the eruption, without any constitutional treatment whatsoever. The constitutional remedies applicable to syphilodermata, are the iodide or bromide of potassium, with the compound decoction of sarsaparilla, aided by the mildest form of mercurial, the Plummer's pill, in the secondary eruptions; and the bichloride of mercury, syrup of the iodide of iron and cod-liver oil in the tertiary eruptions. The proto-ioduret of mercury is also a valuable remedy, both in the secondary and in the tertiary disease, but chiefly in the former. Locally, we shall derive benefit from the mercurial ointments and mercurial plaster, as also from the use of water dressing and opiate lotions. In the use of both the iodide of potassium and mercury, it is to be remembered that the constitution quickly becomes accustomed to the remedy, and it is therefore necessary to augment the dose every ten days. Another remedy of great value in the syphilodermata, and one which succeeds when all others have failed, is the so-called Zittmann treatment.

The *leprous affections*, typified by elephantiasis, the ancient lepra, are examples of disease of the blood and of the nervous system, the former evincing itself in the formation of tubercles and ulceration, the latter in atrophy and paralysis. Danielssen and Boeck, to whom Europe is indebted for their careful researches into this malady, place most confidence in abstraction of blood from the region of the spine, and the internal administration of arsenic. We have employed iodine, arsenic, the iodide of iron, the liquor hydriodatis hydrargyri et arsenici, cod-liver oil, bichloride of mercury with bark, sulphur, the oil of the chaoul moogra, and the hydrocotyle asiatica, but with no satisfactory result. The local treatment should be of a nature to strengthen the skin by mild stimulation, and at the same time modify its torpid action, namely, by means of frictions with sulphur and juniper tar soap, with the sulphuro-alkaline ointment, with iodine ointment, with the ioduretted glycerine, the juniper tar liniment, and the saturated solution of sulphuret of calcium. The blotches of morphea alba or vitiligo, which accompany this disease, may be stimulated to a more



healthy action by the ioduretted glycerine or acetum cantharidis; and the tubercles may be softened and dispersed by painting them over with a solution of potassa fusa, or with the compound tincture of iodine.

*Pigmentary affections*, or discolorations of the skin, are aberrations from the natural standard of health of the organ, and of its healthy function. The skin is a chromatogenous organ, and the absence of colour, its excess, or its alteration, are so many signs that the organ is performing its function unhealthily—hence the foundation for therapeutical interference. Excess of pigment or alteration of pigment may be due to hyperæmia, or have originated in hyperæmia as an exciting cause; simple excess in quantity may result from the presence of an excess of pigment in the blood, while loss of pigment may be, as it commonly is, a loss of nervous vitality in the skin. We may therefore have occasion to employ constitutional remedies, such as may be known to possess the power of giving tone to the skin, of altering its nutritive processes, of strengthening its nerves, and improving its vitality, such as arsenic, or the tincture of cantharides; or we may suspect an anæmic cause, and exhibit iron, or the iodide of iron, or even cod-liver oil. At other times, when the skin is simply performing the office of an eliminator of an excess of pigment, we must direct our treatment to those organs which may be seemingly in fault, and assist, if possible, the hyperformation of pigment. We have pointed out a cause of morbid production of pigment in exhausted power of the abdominal system of organic nerves; and Addison has shown an association between a morbid condition of the supra-renal capsules, anæmia, and melasma. Arsenic is known to increase the quantity of the melanic pigment in the skin, hence its peculiar adaptability to the dischromatoderma, and cantharidine, when used externally, is known to produce a similar effect. We may, therefore, place cantharidine at the head of our local remedies for restoring the normal chromatogenous function of the skin; and follow it up with other useful stimulants, such as the bichloride of mercury, ammonia, the juniper tar soap, hot-air bath, cold ablutions, cold douche, and the shower bath. The most effectual treatment of chloasma, is washing the skin with carbolic acid soap, and sponging with a lotion of carbolic acid, or with one of bichloride of mercury in emulsion of bitter almonds.

The *dermophytic affections* are amenable, with more or less success, to stimulant local applications, and especially to carbolic acid in lotion and soap, sulphur soap, and the bichloride of mercury in ointment or lotion.

Of *ungual affections*, degeneration of the structure of the nail may sometimes give rise to so much inconvenience as to render blistering of the matrix necessary; minor states of derangement may be benefited by painting with the compound tincture of iodine. Ingrowing of the lateral borders of the nail, such as commonly occurs in the great toe, may be best remedied by scraping the nail until it is thin and flexible, and then trimming its edges; while onychia will require an antiphlogistic treatment at first, and subsequently, if it get into a chronic condition, the free use of stimulant applications and caustics. Onychia is sometimes dependent on the syphilitic poison, and

sometimes on scrofula, in which case the constitutional remedies applicable to those diseases are rendered necessary, combined with mercurial lotions and ointments in the instance of syphilis, and mildly stimulating applications, for example, iodide of potassium, or ammonium rubbed down with lard, in scrofula.

Diseases of the *hairs and hair-follicles* being sometimes the consequence of a congenital weakness of tissue, sometimes of deficient nutritive power, and sometimes of actual inflammation of the follicles, commonly of a low or nervous type, may require the aid of constitutional remedies to improve the innervation and nutrition of the skin, as of arsenic, cantharidine, bitter tonics, or ferruginous tonics; and also of local remedies, of the class of stimulants, such as cantharides, iodine, ammonia, sulphur soap, or the juniper tar in alkaline solution or soap. When, however, inflammatory irritability with exfoliation of the epidermis exists, a diluted ointment of the nitric oxide of mercury is the more appropriate remedy. Alopecia, and especially areata, calls for the use of stimulants, the cantharidine pomatum for the former, the solution of cantharides in strong acetic acid or compound tincture of iodine for the latter. Altered direction of the hair, as in trichiasis ciliorum, is to be treated by avulsion; the trichiasis coacta by the removal of the clotted masses by cutting, followed, if convenient, by shaving; and altered colour by moderate stimulation of the scalp, and arsenic. Alteration of structure, giving rise to trichonosis, is a disease of debility—of general debility and local debility. It occurs in childhood and youth, and demands the constitutional aid of regimen, of a sound animal diet, bitter and ferruginous tonics, cod-liver oil, with the syrup of the iodide of iron, the mineral acids with mild bitters, and especially of arsenic. While, locally, the best remedies are ablutions with the carbolic acid, or juniper tar soap and cold water, and inunction with the nitric oxide of mercury ointment, diluted in the proportion of one part to three. The diseases more especially affecting the hair-follicles, namely, erythema with altered secretion, kerion, sycosis and favus, besides constitutional means requisite to improve the general health, are benefited by saponaceous ablutions, particularly with the juniper tar soap, and the diluted ointment of the nitric oxide of mercury already mentioned. These means will be sufficient to cure the hyperæmic state of the follicles that gives rise to excessive sebaceous secretion. Kerion and achores of the follicles require a soothing, and at the same time a mildly stimulating, method of treatment. A cold starch poultice or water dressing when there are crusts, an ointment of the acetate of lead subsequently, and at a later date, to disperse subcutaneous accumulations of serum, painting with the compound tincture of iodine. To restore the tone of the skin, with a view to reproduce the hair on the bald spots, ablutions with the juniper tar soap and cold water, with abundance of stimulation by combing and brushing, are the most effective means. A similar plan of treatment is applicable to favus, also a disease of childhood and youth. Sycosis, however, a disease of manhood, is remarkable for its obstinacy, and often for its severity. In sycosis, a local treatment is more especially indicated; avulsion of the hairs, ablution with the potash soap, frictions

with the hypochloride of sulphur ointment, with an ointment of the iodide of sulphur, or with ioduretted glycerine, and painting with the stronger alkaline solutions, are among the more forcible remedies; while in less severe cases, a lotion of the bichloride of mercury may be successful. After the use of the strong alkaline solutions, it will be desirable to apply a starch poultice, or some mild protective ointment, such as that of the acetate of lead or camphor.

Diseases of the *sebiparous glands* arise chiefly from want of healthy vitality of the skin; some occurring in youthful life, when the powers of the integument are not yet attained, for example, acne; others, in adult age, such as encysted tumors; and some in elderly persons, for example, sebaceous ichthyosis of the face, and carcinoma. Some of these affections are associated with an excess of secretion, which may therefore be considered as morbid; and others with a deficiency. The purpose of treatment should be to give tone and vigour to the skin; and this we may effect by constitutional means, as by bitter and ferruginous and acid tonics, and by arsenic; and locally by the aid of soaps, sulphur ointment, and lotions of sulphur and of the bichloride of mercury. The morbid sebaceous secretions may always be removed by saponaceous and mildly alkaline remedies, however hard and horny they may be in their dried state; and this removal must be effected before stimulant applications can be made to act upon the skin, to stimulate it to more healthy action. This is the principle of treatment of stearrhœa, of sebaceous ichthyosis, and even of sebaceous xeroderma. Horns may be softened by poultices and alkaline applications, and on their removal, the skin upon which they had grown may be brought into a healthy condition by mild stimulants. The tubercles of molluscum may be touched with a solution of equal parts of potassa fusa and water. They are commonly developed in scrofulous children, and this treatment may be advantageously accompanied with the constitutional treatment adapted to the scrofulous diathesis. Sebaceous accumulations may be squeezed out of their sac, often without enlarging the dilated aperture of the follicle; at other times a small incision may be necessary to assist their release. Encysted tumors are best treated by incision and avulsion of the horny sac which constitutes their cyst. Acne is a consequence of lowered tone of the skin, and generally of weak powers of constitution, hence it will require general tonics at first, and subsequently the operation of arsenic, while the external treatment should consist of frictions with the hypochloride of sulphur ointment or of sulphur lotions or paste, and copious ablutions with soap.

Disorders of *perspiration* rarely present themselves in an acute form so as to require antiphlogistic treatment; they are commonly dependent on debility, for example, sudden perspirations on slight exertion, or night perspirations, and yield to the use of sulphuric acid and quinine. Fetid perspiration, though in general constitutional, may often be much alleviated by regulating the functions of digestion, and in improving assimilation. For this purpose, when ordinary alteratives and tonics have effected all of which they are capable, a course of arsenic is sometimes advantageous. Local treatment in the way of soaps,

ablutions and the cold shower or sponging bath cannot be insisted on too strongly.

*Malis* and *scabies*, depending on a living cause of irritation, on or in the epidermis, and wholly disconnected with constitutional disorder, require for their treatment only local means; sulphur for scabies; mercurial ointments or washes for pediculi, and sulphuro-alkaline ablutions for both. The local remedies for pediculi are, the ammonia-chloride of mercury ointment, with camphor and a few drops of the essential oil of almonds; the bichloride of mercury with alcohol in emulsion of bitter almonds may also be used for the hair, and is the best means of destroying the nids in which the ova are contained, and the unguentum staphisagriae, an old popular remedy. To these means may be added ablutions with an abundance of soap night and morning. For the pediculi pubis infesting the eyelashes, the best application is the nitrate of mercury ointment, of moderate strength.

In *burns* and *scalds*, and also in frost-bite, the great art of the surgeon is to restore the vitality of the injured tissues, and in the case of burns and scalds to exclude the contact of the air, and particularly of that most stimulating, and, to weakened tissues, most irritating element of the atmosphere, oxygen. Various appliances have at various times been suggested for this purpose, such as the linimentum calcis: a paste of creta præparata, or the unguentum resinae reduced to the state of liniment by the addition of oil, but none has proved so eminently successful as the invention of Hebra, the permanent hot bath, in which he keeps the patient during the whole period of treatment, and until the healing of the skin is accomplished. The water of this bath is constantly undergoing change, flowing in at one end and out at the other; it is therefore always clean and fresh, always of the same temperature, and in it the patient reclines upon a soft mattress. The gravity of the water almost floats his body, and obviates the pressure on the dependent parts, which would otherwise be occasioned by his mere weight, and the flayed surface is preserved of the same continuous and grateful temperature, and always moist, a perfect dressing throughout the cure. For a more complete description of the treatment of burns and scalds, and also of frost-bite, we must refer the reader to the special articles devoted to these subjects in this Dictionary.]

*Erasmus Wilson.*

**SOUND.** An instrument which surgeons introduce through the urethra into the bladder, in order to discover whether there is a stone in this viscus or not. The sound is made of highly polished steel, in order that it may convey to the surgeon's fingers the sensation of any thing against which its end may strike. It is also generally rather less curved than a catheter, and the curved part shorter, so that its extremity may be more easily inclined to the lower part of the bladder, where the stone is most frequently situated. However, some practitioners occasionally employ a sound which is straight, except a small portion of it near the back, which, after the introduction of the instrument, is turned down to either side, so as to touch any calculus lodged just behind the prostate gland.

[**SOUND (UTERINE).** The uterine cavity is explored like the bladder by means of sounds. The introduction of sounds of various forms and



material was counselled by Hippocrates, chiefly with a therapeutic intention. Since his time the sound has been frequently used as an instrument of diagnosis. Harvey relates a case in which he used an iron sound to dilate the uterus. Samuel Cooper, in the early editions of this Dictionary, describes the use of the probe or sound in distinguishing polypus, prolapsus, and inversion of the uterus from each other. Its more methodical use, however, dates from 1826, when M. Lair (*Nouvelle Méthode du Traitement des Ulcères de l'Utérus*, Paris) specially directed attention to the subject. Sir James Simpson (*Edinb. Monthly Journ.* 1843—*Obstetric Works*, 1855), Kiwisch (*Klinische Vorträge*, 1851), Huguier (*Hystérométrie &c.*, Paris, 1865), about the same time—1843—gave precision to the instrument and its applications. It extends the faculty of touch beyond the reach of the fingers. Simpson's sound is in most general use. It generally resembles the male bladder sound. It has a rounded knob at the end to avoid injuring the uterus. It is graduated by notches, to enable the operator to tell the depth of penetration. At two and a half inches from the knob is a projecting elbow, which marks the normal length of the uterine cavity. The stem tapers towards the end, and is made of soft silver or other flexible metal, so as to admit of its being bent as desired. The uses of the instrument are: 1st, *diagnostic*; it measures the length; it determines the degree of mobility; it tells the direction or axis of the uterus; it discovers flexions of the organ; it distinguishes the uterus from tumors attached or contiguous to it; it reveals constriction or permeability of the uterine canal. 2nd, *therapeutic*, and more doubtful: it may, acting as a lever, restore a flexed or prostrate uterus to its normal position; it may dilate the constricted canal; it may hold the uterus out of the way during operations upon neighbouring parts. The instrument may be applied through the speculum or alone. For most purposes it is better to use it alone. But it is an essential aid to the speculum by drawing the os uteri into the field of vision, and by drawing upon one or other lip to procure a better view of the cavity of the cervix.

To use the instrument the patient should lie on her left side, with the nates near the edge of the couch. This position allows the handle to be carried as far backwards or forwards as the case may require. The forefinger of the left hand is then passed up to the os uteri, and serves to guide the point of the sound into the uterus. In the ordinary condition, the body of the uterus being slightly bent upon the cervix, and the whole organ being set at an obtuse angle into the fundus of the vagina, and directed a little forwards, it is necessary to give the sound a gentle curve to correspond with this flexion and inclination. When introduced in such a case the uterus is slightly elevated by the sound, and the fundus supported on the sound may be felt above the pubes by the hand outside. Commonly slight resistance and pain are experienced at the point of junction of cervix and body of the uterus. If the organ is abnormally bent upon itself or reclined, a corresponding bend must be given to the sound, and the point must be duly directed. Commonly, the position of the body of the uterus can be felt by the examining or finding finger; but sometimes what feels like the body of the uterus is in reality a tumor

bulging from its wall. In such a case the direction taken by the sound shows where the cavity of the uterus proper really is, and puts the tumor in distinct evidence. The sound is also the best *porte-caustique*. The knob, dipped in fused nitrate of silver, receives a coating, which can be carried, if necessary, into the cervix, or even to the fundus uteri. The dangers attending the use of the sound are, if roughly handled, metritis, great pain, and, above all, the risk of procuring abortion. Hence it is necessary to ascertain beforehand if pregnancy exist. It should not be used if metritis or peri-uterine inflammation be present, nor during or near a menstrual epoch. Dessaut relates (*Acad. de Médecine*, 1854) fatal results: one by Dr. De Mussy; one by Huguier, who unwittingly induced abortion at two and a half months, which was followed by death. Aran relates a case ending fatally through the use of the sound to restore a retroverted uterus which was bound by adhesions.]

In some cases a gum-elastic bougie will answer the purpose of a rigid sound, and is safer.]

Robert Barnes.

**SOUNDING.** The operation of introducing an instrument for detecting stone in the bladder. In the male, sounds are generally introduced much in the same way as catheters, either with the concavity towards the abdomen, or the convexity; in which last method it is necessary, as soon as the beak of the sound has arrived in the perineum, to bring the handle of the instrument downward by a semicircular movement to the right, while the other end is kept as much fixed as possible. This is what the French term the *coup* or *tour de maître*; a plan less often followed at the present day than formerly, because, except in very corpulent subjects, it has no particular recommendation; and, even in such individuals, the inconvenience of the protuberant hypogastric region may be avoided, by inclining the handle in the first stage of the operation towards the patient's left groin.

The instrument having been introduced, its extremity is to be turned, and moved in every direction, when, if there be a calculus, its presence will usually be indicated by the collision against the beak of the sound. When the symptoms afford strong evidence of the presence of a stone, which cannot be detected in these ways, the patient should be sounded, while his pelvis is raised up, and his chest depressed. He should also be sounded both in the full and empty state of the bladder, and both in the erect and recumbent positions, with sounds and catheters of different shapes.

Stones have sometimes been found in the bladder after death, although they could never be discovered with a sound while the patient was alive, suffering all the symptoms of the complaint. The celebrated French surgeon La Peyronie was thus circumstanced: he was so fully convinced of there being a stone in his bladder, notwithstanding neither he, nor any of his friends, could feel it with a sound, that, on his death-bed, he gave directions for ascertaining the fact. Hence, when the usual symptoms of a stone in the bladder continue, patients should be searched several times, before a positive opinion is delivered respecting the nature of the disease. When, during the operation of sounding, all the urine has escaped from the bladder, the inner surface of this viscus comes into con-

tact with the end of the sound, and such a sensation may be communicated to the surgeon's fingers as leads him to suspect that a fungus, or some other hardish extraneous substance, is contained in the bladder. In such cases, patients have actually been cut for the stone, when no foreign body whatever was present. (See LITHOTOMY.)

**SPECULUM.** [An instrument by which a view may be obtained of the interior of the mucous cavities of the body in the neighbourhood of their natural outlets. The speculum ani and speculum uteri are those most frequently in use, but instruments have been devised for the inspection of the larynx (laryngoscope), of the pharynx (rhinoscope), of the interior of the eye (ophthalmoscope), and even of the deeper parts of the urethral canal and of the bladder (endoscope). There is also the speculum auris for the examination of the membrana tympani.]

**SPECULUM, ANI.** [The instrument most commonly employed for the examination of the interior of the rectum is composed of plated metal, and is conical in shape, with a lateral opening about half an inch in width extending along its whole length. It is fitted with a wooden plug to facilitate its introduction, the plug being of course withdrawn as soon as it has been passed into the bowel. The speculum is directed so that its lateral opening corresponds to any ulcer or other morbid condition which it is desired to examine. The edges of the instrument should be smooth and well-rounded, or they may cause the part to bleed, and the view will be thereby impeded. Specula of glass, coated externally with vulcanite, similar to those in common use for the vagina, are also very convenient, especially for the application of nitric acid to an ulcer within the rectum. When it is desired to cauterise the interior of the rectum more extensively, as in cases of hæmorrhage from a hyperæmic condition of the mucous membrane near the anus, the three-bladed expanding speculum will be found exceedingly useful. (See RECTUM, DISEASES OF.)]

**[SPECULUM, UTERINE.** The speculum uteri appears to be one of the most ancient of surgical instruments. In 1818, there were disinterred at Pompeii, amongst other instruments, two specula. These are really the prototypes of all the specula subsequently made. They are figured in *Vulpe's Illustrazioni di tutti gli stromenti chirurgici scavati in Ercolano e Pompei*, 1847; and are preserved in the Museo Borbonico, at Naples. As Pompeii was overwhelmed A.D. 79, the speculum must have been in use before that date. Aëtius, who lived four centuries later, described its use. Jacob Rueffus (1587) figures and describes it. Scultetus (*Armamenta Chirurgica*, 1650) figures it. The illustrious Harvey had actually used the instrument before this date. So that there is, as Dr. H. C. Wright (*Uterine Disorders: their Constitutional Influence and Treatment*, 1867) observes, "a tolerably continuous history of the speculum from the time of Aëtius down to the present day."

The modern revival, however, of the speculum, is mainly due to Récamier, in 1816. From that time it has been considered an essential means of diagnosis and treatment of uterine and vaginal diseases. The variety of forms of uterine diseases, and the various aspects from which they have been considered by different practitioners, have given rise to endless

modifications of the speculum. They are made with two, three, or four valves, of every variety of shape. Two objects have to be borne in mind in constructing specula. A speculum should be of service in exploring the vagina, and the vaginal portion of the uterus; it should also enable the surgeon to apply remedies to the structures discovered to be morbid. These objects may, to a certain extent, be combined in one instrument; but each is occasionally better attained by devoting to it a separate instrument. The most generally useful speculum is the bivalve known as Coxeter's, recommended by Dr. Henry Bennet. The two blades form, when closed, a cylinder, gently tending to a truncated cone. To facilitate introduction, it is furnished with a wooden plug, the end of which forms a rounded knob, and guards the ends of the blades. When introduced, the blades are opened at the uterine ends, by a screw working at the handle. The plug is then withdrawn, and the operator is enabled to see the parts. A common fault in the construction of this form of speculum is in making the tubes formed by the closed blades quite cylindrical; the blades of exactly equal length, and the groove in the end of the plug which receives the ends of the blades too deep and angular. The consequence is, that when introduced, the pressure exerted on the end of the plug by the uterus, and the contracting fundus vaginæ, tending to expel the instrument, fixes the plug so tightly that it is difficult to withdraw it. This error I have obviated completely, by slightly flattening the blades, so that when closed, they form an oval in section, by making the blades of unequal length, and the groove of the plug shallow. By this contrivance, the plug is expelled by the contraction of the vagina, the instant the blades begin to open. To use the speculum, the patient may lie either on her back or on one side. Some practitioners prefer the left side. If this position be chosen, it is desirable that the couch be rather elevated, and the nates must be drawn over the edge, the head and shoulders must be low, and the thighs well bent upon the abdomen, so as to command the light. Careful examination by the finger should always precede the use of the speculum; first, because the finger may detect conditions in which the speculum not only would teach nothing, but would probably do harm. Cancer is one of these conditions. Secondly, the finger may detect conditions concerning which the surgeon can learn nothing further of any value by the speculum. Polypus and fibroid tumors of the uterus are cases of this kind. Thirdly, the touch by ascertaining the position, form, and size of the vaginal-portion of the uterus, serves to guide in the exact application of the instrument. Fourthly, the finger discovers the capacity of the vagina, and thus determines the size and form of instrument to select. The speculum having been warmed by washing in warm water, and lubricated with oil, lard, or soap, is held in the right hand, whilst two fingers of the left hand, one of which has just been used for exploration, gently separate the labia. The end of the speculum is then slipped between the guiding fingers over the edge of the perinæum, and directed at first under the pubic arch. It is then soon turned backwards towards the hollow of the sacrum, pushing it steadily onwards, and simultaneously carrying the handle a little backwards, so as to make the uterine end describe a circle around



the symphysis as a centre. When it has penetrated to the proper extent, that is, from four to five inches, resistance is felt, the screw is then turned to open the blades at the uterine end; the plug is projected by the contraction of the vagina, and perhaps by a bearing-down effort of the patient. If the instrument has been rightly directed, the os uteri will have fallen into the field between the expanded ends of the blades. Should it not be seen, it has been pressed behind one or other blade. It will sometimes be released and fall into view if you gently withdraw the instrument a little way. Or sometimes, the margin of the cervix only is caught, and it may be drawn completely into view by the sound. The sound is further of use by drawing the os open so as to enable the operator to see a little distance into the cervical canal. This object is still further attained by the use of a METROSCOPE, an instrument which may be described as a secondary speculum, whose function it is to open the cervix uteri, just as the primary speculum opens the vagina. To get a satisfactory view of the os, and especially of the state of the tissues, it is generally necessary to wipe away the secretions by means of a pledget of cotton wool, carried by the speculum forceps. When the os and cervix uteri have been inspected, and, if necessary, treated by the application of medicaments, the screw is turned back to allow the blades to close, the instrument is slowly withdrawn, following the converse proceeding described for the introduction. This is the time to observe the condition of the vaginal canal and vulva. As the ends of the blades retreat, the walls of the vagina close in upon them, returning to their ordinary state of approximation. During this process, every part of the vaginal walls comes into view. It is not necessary to expose the patient in this operation. The preliminary digital examination and the introduction of the speculum are performed under the clothes, part of which can be gathered round the vulva and the speculum, so as to leave nothing but the mouth of the instrument exposed when the plug is withdrawn.

With many others, I prefer the dorsal decubitus. The advantages are these: the superincumbent weight of the intestines, aided by inspiration, press the uterus downwards, so that the os falls better into the field of the speculum; the light, which generally comes in an oblique line from above downwards, penetrates directly in the axis of the speculum, to illuminate the fundus; the operator, standing over the patient, is not in his own light, and has more perfect command in manipulation. The dorsal position and the bivalve speculum have this great advantage, that no special couch or preparation is necessary. Any sofa or bed will do.

A very useful form of instrument is the speculum known as *Fergusson's*. It consists of a glass cylinder, silvered on the outer aspect, and strengthened by a coating of vulcanite. It is recommended by its smoothness, cleanliness, the brilliant light thrown upon the parts to be inspected, and by its resisting the action of the acid caustics sometimes used. The expanding valves are, however, necessary when free access is required for the passage of other instruments, and generally for manipulation.

A very distinct form of speculum is the *duck-bill* of Dr. Marion Sims. (*Clinical Notes on Uterine*

*Surgery*, 1866.) This is a single-bladed instrument, and its action is essentially different from that of the valvular or tubular specula. The patient lies on her left side. The blade is guided into the vagina by the fingers of the left hand; and is then held firmly back against the perineum and posterior wall of the vagina. The patient leaning forwards a little on her abdomen, the intestines falling away from the pelvis, create a vacuum, which draws air into the vagina, and helps to keep the walls apart. For most operations that have to be performed on the cervix uteri and vagina, this instrument, by giving greater space, and exposing a larger surface of vagina, offers the greatest facilities. It is especially useful in the operation for vesico-vaginal fistula, although sometimes simple flat spatulas of different widths, bent at convenient angles, are more convenient.] *Robert Barnes.*

SPHACELUS. (from σφάζω, to destroy.) Complete mortification, as contrasted with that stage of it, in which the parts are not yet totally deprived of life, and sometimes termed *gangrene*. (See MORTIFICATION.)

SPICA. (from σπάχυνς, an ear of corn.) A name given to a bandage, in consequence of its turns being thought to resemble the rows of an ear of corn. In order to apply the spica bandage to the shoulder, the margins of the axillæ must first be protected from the effects of the pressure, by means of soft compresses, and the end of a common roller is then to be placed under the armpit, on the sound side. After conveying the bandage backward, obliquely over the scapulæ, the surgeon is to bring it forward over the injured shoulder. The roller is next to descend under the armpit, then be carried upward again, and made to cross on the deltoid muscle. It is now to be carried obliquely over the front of the chest, and under the opposite armpit, where the end of it is to be pinned, or stitched. The bandage is next to pass across the back, over the part of the roller previously applied in this situation, and is to be conveyed round the head of the os brachii, so as to form a turn, or *doloire*, with the first circle of the roller. Three or four *doloires*, or turns, each of which covers about one-third of the preceding one, are to be made, and then the upper part of the arm is to be once surrounded with a plain circle of the bandage. This last circular application leaves between it, and the cross previously made, a triangular, equilateral space, technically named by writers *geranis*. The roller is now to be carried upward in a spiral manner; its head is to be brought to the opposite armpit, and the application of the whole concludes with a few turns round the body. The bandage is to be fastened with pins at the place where it commenced.

SPINA BIFIDA. (i.e. the Cloven Spine.) *Hydro-Rachitis*. An affection attended with an incomplete state of some of the vertebræ, and a swelling containing fluid, which is most commonly situated over the lower lumbar vertebræ, but sometimes over the dorsal or cervical, and, in some instances, over the os sacrum. An analogous tumor sometimes occurs upon the heads of children, attended with imperfect ossification of the cranium. The malformation of the spine seems to consist in a deficiency of one or more of the spinous processes and arches of the vertebræ. Sometimes, indeed, these processes are wanting, throughout the whole length of the vertebral column, as was seen in the

case reported by Fieliz. (See *Richter's Chir. Bibl.* b. 9. p. 185.) Sometimes the tumor is composed of two distinct cysts, as happened in the case recorded by Mr. Brewerton (*Edin. Med. and Surg. Journ.* vol. xvii.); but this is uncommon.

The Arabians, who first treated of this disease, erroneously imputed the deficiency of the spinous processes to the tumor, while it is now well known, that the incomplete state of the affected vertebræ is a congenital malformation, and that the swelling is only an effect. In fact, the tumor generally becomes larger and larger, the longer it continues. Spina bifida is seldom met with, except in children, very few living to adult age with this highly incurable affection. Warner, however, has related a case, in which the patient lived till he was twenty. (*Cases in Surgery*, p. 134, 4 edit.) I have also seen, under the care of Mr. C. Hutchison, a young woman, 19 years of age, who had a spina bifida, which was of astonishing size, and situated at the lower part of the vertebral column. One curious circumstance in the case was, that the patient used to menstruate through a sore in the thigh. I conclude this is the same case as is described by Mr. Jukes (see *Med. and Phys. Journ.* for Feb. 1822), and who states the measurement of the swelling to have been 30 inches in its vertical line. The urine and fæces used to pass involuntarily.

The swelling is most frequently situated towards the lower part of the spinal canal, particularly at the place where the lumbar vertebræ join the sacrum. The fluid which it contains resembles serum, being somewhat more liquid than the white of egg, and, like the latter, coagulable. It is in general limpid and colourless; but, occasionally, turbid and tinged with blood. On pressing the tumor, a fluctuation is very perceptible, and a preternatural space may also be felt existing between some of the spinous processes. The fluid is contained in a kind of cyst, which is composed of the continuation of the dura mater, investing the spinal canal, and is for the most part closely adherent to the integuments.

Spina bifida is frequently attended with hydrocephalus, and the enlargement of the head has been known to undergo a considerable diminution, after the casual rupture of the tumor over the spine. (*Morgagni, de Sed. et Caus. Morb.* epist. 7. art. 9, *Ephem. Cur. Nat.* decad. 3. art. 1, decad. 2. art. 2.) The fluid, which was lodged in the lateral and third ventricles, passed into the fourth, through the aquæductus Sylvii, ruptured the calamus scriptorius, and thus passed into the spinal canal.

Spinæ bifidæ usually occur on the lower part of the spine; but they occasionally take place on the cervical vertebræ, where the tumors have the same characteristic marks as those near the sacrum. Many facts, recorded by Ruysch, confirm the preceding account. (*Obs. Anat. Chir. Centuria*, 4to. Amst. 1691.)

This affection generally terminates fatally; some few cases are recorded which have got well of themselves, and others which have been cured by treatment. Death, however, usually follows an operation upon the tumor, and sometimes instantly. Tulpinus observes on this subject: *Quam calamitatem si quidem reformides, chirurgæ, cave sis improvide aperius, quod tam facillè occidit hominem.* (*Obs. Med.* ed. 5, Lugd. Bat. 1716.)

But, whether the tumor be operated upon or not, still the disease is one of the most fatal to which children are exposed. When afflicted with it, they seldom reach the age of three years; but, after lingering several months from their birth, suddenly die. It has been said that children with spina bifida always have their legs in a paralytic state. However, this is not true; for one of the largest spinæ bifidæ I ever saw was under my friend Mr. Maul, of Southampton, and was unattended with any weakness of the legs. Indeed, the child was, to all appearance, as stout, healthy, and full of play as possible. The fatal event, however, took place after a time, as usual; and, a little before death, a remarkable subsidence of the swelling occurred, which however never burst externally. Still it is a fact, that many infants, with spina bifida, have paralytic legs, and can neither retain their fæces nor urine.

[Spina bifida is, after club-foot, the most common malformation of the fetal skeleton. Billaud met with seven children thus affected in one year at the Hôpital des Enfants-Trouvés (*Traité des Maladies des Enfants, nouveaux-nés et à la mamelle*), and Chaussier records twenty-two cases of the same disease out of 132 children who were malformed. It is nearly always congenital, although according to Morgagni it may be developed in the first years of life, when the component parts of the vertebræ are still capable of separation; and he relates a case of Genga's where a tumor of this nature came on in the coccygeal region after a blow on the head, in a child four years of age, who was the subject of hydrocephalus (Morgagni, *Op. cit.* epist. xii. art. 9). Gross also states that it may occur weeks or even months after birth, before the two portions of the arch have coalesced. (*System of Surgery*, vol. i. p. 186.) Such cases, however, are extremely rare.]

This affection is analogous to the malformations in other parts which arise from a want of union between their lateral halves, as is seen in cleft palate, hare-lip, umbilical hernia, &c., and consists either in an arrest of development of the vertebral arches, or in a separation of the laminae, so that the fluid within the spinal canal protrudes the meninges, and a tumor containing fluid is formed along the course of the spine. In a very few instances this absence of union has been seen to extend through the bodies of the vertebræ as well, completely dividing the spinal column into two lateral halves (Fleischmann, *De Vitius Congenitis*). Spina bifida is most frequently met with in the lumbar and sacral regions; it is seldom found higher than the lower dorsal vertebræ, though Cruveilhier (*Traité d'Anatomie Pathologique*) and others mention its occurrence in the neck. Rarely there are two or even more of these swellings over the spine, and according to Rokitsky, when this is the case, one is usually situated in the lumbar or lower dorsal region, and the other in the neck, a deficiency in the cranial bones also existing (*Path. Anat.* vol. iii. p. 226); more rarely still the fissure has been seen to extend throughout the whole length of the spine, exposing the canal from one end to the other, and the skull is then generally implicated in a similar manner. (Bidloo, *Valsalva*.) This affection is often more or less associated with hydrocephalus, and not unfrequently with other malformations as well. (Meckel, *Handbook of Path. Anat.* Leipsig,



1816-18.) In the *Path. Soc. Trans.* vol. xi., a case is related where a spina bifida existed with an antero-posterior curvature of the spine, from imperfect development of the bodies of the lumbar vertebrae, together with other deformities. The tumors vary much in size; they are usually about as large as a walnut or a small orange, but may attain the dimensions of a man's head: they are round or oblong in shape, the long axis corresponding to the spine; the base is sometimes narrow and pediculated, at others broad and large. The skin covering them is usually natural in appearance; it may be hard and leathery, but is more commonly thinned and sometimes translucent; when the swelling is very large the integument is congested and of a blueish tint; in rare cases it is altogether deficient over the tumor, ceasing at its base. The walls of the sac are then very thin, composed only of the membranes of the spinal cord blended together and forming a common investment, upon the inner surface of which the nervous filaments or the neurilemma are sometimes spread out.

The fluid within the cyst is slightly yellow, watery, limpid, albuminous, with flocculi occasionally floating in it: it is derived from the cerebro-spinal fluid contained in the subarachnoid space, and, like that fluid, when tested gives traces of sugar; it does not always communicate with the liquid within the ventricles, but usually if there be hydrocephalus, or another swelling along the spine, pressure upon one tumor will fill the other and make tense the fontanelles. Crying, and other expiratory efforts, distend these cysts, whilst during inspiration they recede. Longuet accounts for this by the sinuses and spinal plexuses of veins being filled during expiration, and emptied during inspiration; by the respiratory movements, therefore, the amount of compression to which the fluid within the subarachnoid space is subjected varies considerably. (*Anatomie et Physiologie du système nerveux de l'homme et des animaux vertébrés.*)

Ollivier states that symptoms of compression of the brain may sometimes be produced by pressing the fluid out of one of these tumors, and so causing it to fill the cavity of the skull (*Traité de la Moelle épinière et de ses Maladies.* See also Billaud, *Op. cit.*). Chelius mentions coma and convulsions as resulting from this cause (*System of Surgery*, by South, vol. ii.). Pressure upon a spina bifida will often cause paralysis of the parts which receive their nervous supply from that region of the spine which is affected.

Fluctuation is not always to be felt in these swellings, but it is sometimes very distinct. The tumors are firm and resisting to the touch when the patient is in the erect posture, but become soft and flaccid when he lies upon his face, and especially when the head is lowered.

A few cases have been observed where a tumor containing fluid was found over the vertebrae, connected with the spinal canal, but not communicating with the interior of the membranes. Velpeau is doubtful as to the real nature of these swellings, but Malgaigne unhesitatingly pronounces them to be the sacs of spinae bifidae, in which the neck has been occluded by inflammation, growth of the laminae, or some other cause, so that their connection with the membranes is cut off, and a spontaneous cure of the affection

thus results; this happy termination is, however, very rare. (*Bull. de la Soc. de Chir. Paris*, 1860; see also a case by Mr. Solly, *Med. Chir. Trans.* vol. xl. p. 19.)

The condition of the spinal cord and the nerves, and their position with respect to the tumor, are very variable, and consequently very different effects are produced upon the parts below the lesion; the relation between the nervous structures and the sac is of the greatest importance. In the large majority of cases the medulla or the nerves are contained in the tumor, and either float loose in its cavity, or are intimately adherent to its walls: sometimes these parts are not displaced, but retain their normal position in the vertebral canal. Mr. Prescott Hewett states that, if the tumor correspond to the two or three upper lumbar vertebrae only, the cord seldom deviates from its course, and then the posterior divisions of the spinal nerves alone are connected with it; but if, as is most commonly the case, the lumbo-sacral region be affected, the nerves of the corda equina leave the spinal canal and are blended with the sac (*Lond. Med. Gaz.* 1844, vol. xxxiv.); out of twenty cases in this region of the spine he has seen but one exception to this. Cruveilhier's observations also are to the same effect.

The medulla may be in a natural condition, and then usually ceases abruptly at the level of the vertebral opening: it may be much softened and thinned so as to be almost diffuent, and then is often studded with small watery vesicles; sometimes it is abnormally hard, at others atrophied, and again it may be cleft with its lateral halves widely separated. In a few instances it has been found spread out as a layer over the inner surface of the sac walls. As the tumor increases the child gradually becomes languid, feeble, emaciated; the lower limbs waste, and are more or less paralysed; the urine constantly dribbles away, and the faeces pass involuntarily. During the progress of the disease the child is very subject to convulsions, which often end fatally; or the increasing quantity of fluid causes great tension of the sac, and the skin ulcerates, allowing the escape of its contents; or, after rupture, inflammation of the cyst may be set up, and the fluid, becoming purulent, will act as a source of irritation to the medulla; or the inflammation may extend from the sac walls along the membranes, and produce meningitis: in any of these cases death from convulsions is almost invariably the result. The higher this affection occurs in the spine, the more severe are the symptoms occasioned by it, and the sooner does it prove fatal. The large majority of children who are the subjects of this disease do not survive their birth more than five or six months; some few, however, attain the age of puberty, and even adult life. One case is recorded by Behrend as having reached the age of fifty-one years; another died at forty-three from stone in the bladder, after having recovered from a previous operation (*Bull. de la Soc. de Chir.* 1860). A case of Mr. Haynes Walton's lived twenty-nine years. Usually these persons are more or less crippled in their lower limbs, but not always so. Moulinié of Bordeaux met with a man aged thirty-seven years, who was able to work, and suffered no inconvenience whatever from the large tumor in the back (*Bull. Méd. du Midi. et Gaz. Méd.* 1818). A very

similar case, twenty years of age, is reported in the *Path. Soc. Trans.* vol. iii. p. 10.

Spina bifida generally occurs during the latter months of foetal life, and, although rupture of the cyst soon proves fatal after birth, it is not necessarily so in utero; if it take place during parturition the child is generally still-born, or speedily dies from convulsions in consequence of the sudden removal of the pressure exercised by the fluid upon the brain. Vinchon, in the *Gazette des Hôpitaux*, 1838, relates an instance where a large spina bifida opposed so complete an obstacle to the passage of the child during labour that he was compelled to puncture it, when delivery readily took place and the child lived fifteen hours after its birth.

The causes of this disease are very obscure. Some authors are of opinion that it depends upon, and follows hydrocephalus: the fluid in that affection, gravitating from the cranium into the spinal canal, distends the meninges and projects as a tumor, separating the laminæ of the vertebræ or preventing their development. (Acrel, Morgagni.) Mechanical causes, whether the result of external violence, or of mental emotion on the part of the mother, have been considered to produce this deformity. (Hoffmann, St. Hilaire.) Cruveilhier regards the malformation as due to an accidental adherence of the spinal marrow and its membranes with the skin, in early foetal life, before the development or ossification of the laminæ has taken place. Fisher classes the disease with those of the nervous system, and considers that the arrest of development in the spine is due to an imperfect or irregular development in the corresponding part of the medulla spinalis, and not to any special defect in the ossific process. (*Lond. and Edin. Phil. Mag. and Journ. of Science*, vol. x. 1837.)

Instances have been known of the same woman giving birth to two, or even more, children in succession who were thus deformed, and Camper mentions a case of twins, both of whom had spina bifida.]

If we draw our inferences from the cases and remarks, offered by most writers on spina bifida, we must regard the attempts to cure this disorder, by making any kind of opening into the tumor, as exceedingly perilous, and generally fatal. It is to be observed, at the same time, that some practitioners have not altogether abandoned the hope of accomplishing a cure, at least in some instances. Mr. B. Bell, says, that if the tumor proceed from disease of the spinal marrow, or its membranes, no means of cure will probably ever be discovered. But, if the deficiency in the spinous processes of the vertebræ with which the disease is always accompanied, be the cause of the complaint, and not the effect of it as was commonly imagined; and if the collection of fluid take place, from the want of resistance in the dura mater, in consequence of the imperfect development of the bones, Mr. Bell questions, whether it would not be proper to tie the base of the tumor with a ligature, not merely with the view of removing the swelling, but in order to resist the propulsion of the cyst further outward. He acknowledges, that the result of this practice must be considered as dubious; but expresses his wish to devise any plan that would afford even the least chance of success, in a case which must otherwise terminate in an unfavourable manner. He further stated his inten-

tion of putting the method to a trial on the first opportunity, and after the detachment of the swelling on the outside of the ligature, he intended to keep a soft compress on the part with a proper bandage. It is objected to by the author of the article *Spina Bifida* in the *Encyclopédie Méthodique Part. Chir.*, because the disease is often attended with other mischief of the spinal marrow and brain, and the base of the swelling is almost always too large to admit of being tied at all, or not without hazard of dangerous consequences.

[Ligature of the base of the tumor has been often practised, but always with a fatal result when the strangulation has been immediate; it is only adapted for those cases which are pedunculated, and even then is most hazardous. Beynard strangulated the pedicle by means of quills, placed on either side of it, and sutures which he gradually approximated; in one instance with success. (*Gaz. Méd. de Paris*, 1841, vol. ix. p. 573.) Dubois cured a patient by compression of the base of the swelling with a clamp: and a very similar case is related in the 14th vol. of the *Path. Soc. Trans.* p. 214, by Dr. Wilson, which also terminated successfully.]

Richter proposed the trial of two caustic issues at a little distance from the swelling; but I am not acquainted with any facts in favour of this practice.

[This method of treatment has been tested, but found to be useless, as also have blisters to the tumor, frictions with stimulating applications, &c. The passing of a seton through the swelling was proposed by Chopart and Desault; this practice has been followed by others, but has long been abandoned as too dangerous. Excision is a simple and quick proceeding; it counts a few successful cases, but also a considerable proportion of fatal ones. Incision with a lancet has been tried, and in one or two instances the patients were cured, but the dangers attending it are too great to justify its adoption.]

Mr. Abernethy first suggested the trial of a gentle degree of pressure on the tumor from its commencement, with the view of producing absorption of the fluid, and preventing the further distension of the unsupported dura mater. Were the fluid to continue to increase, notwithstanding such pressure, Mr. Abernethy thinks, that as death would be inevitable on the tumor bursting, it might be justifiable to let out the fluid, by means of a puncture, made with a finely-cutting instrument. The wound is to be immediately afterwards closed with sticking-plaster, and, if possible, healed. Another accumulation of the fluid is then to be prevented, if possible, with bandages and topical applications. Mr. Abernethy actually made the experiment of a puncture in one hopeless instance, in which, indeed, the swelling had just begun to give way. The puncture was repeated, every fourth day, for six weeks, during which time the child's health continued unaffected. The wounds were regularly healed; but the plaster having been rubbed off one of the punctures, the part ulcerated, and the opening could not be healed; the discharge, from having been of an aqueous quality, became purulent, and death ensued. This case was unfavourable for the trial of the method, as the integuments covering the tumor were diseased, and had no disposition to contract.

[Sir Astley Cooper considered spina bifida as



"a species of hernia, and that the deficiency of the spine might be compensated for by external pressure;" he therefore treated a case in a child by means of simple compression. He modelled some plaster of Paris to the tumor, and, lining it with lint, kept it in position by strips of adhesive plaister, and a bandage: this was continued for some months, and then a truss, similar to those in use for umbilical hernia, was applied and constantly worn, with the effect of preventing further increase in the size of the swelling, which was then about as large as a small orange. This patient was seen by Mr. Samuel Cooper at the age of twenty-nine, and described by him as being "active and in perfect health," although the continuous use of the truss was still necessary: when this was removed the tumor reappeared, and an opening into the spinal canal could be felt with the finger. Another child under Sir A. Cooper's care was treated by repeated punctures of the tumor with a needle, so as to draw off small quantities of the fluid, and pressure was afterwards applied by means of a piece of pasteboard and a roller. After several punctures, inflammation was set up in the cyst, followed by rapid diminution in its size, and ultimate cure. (*Med. Chir. Trans.* vol. ii.) This patient was also seen by Mr. Cooper twenty-eight years after the operation, and he remained well.]

The first of the preceding observations exemplifies the palliative treatment, and consists of the application of pressure in the manner of a truss for hernia; the second shows the radical mode of cure by puncturing the swelling from time to time with a needle, and exciting adhesive inflammation, which, with the assistance of pressure, stops the disease altogether, in such examples as admit of cure.

[The plan of tapping the tumor repeatedly with a small trocar, and afterwards applying pressure either with an air-pad and India rubber bandage, as recommended by Erichsen (*System of Surgery*, 1861), or by other suitable means, should certainly be tried before more severe measures are adopted. Many cases have been much benefited by this procedure, and a cure has occasionally been obtained; when this result has taken place, it has been in consequence of adhesive inflammation having followed the punctures, and thus closed the sac or cut off its communication with the spinal membranes: sometimes, however, the inflammatory action has spread along the membranes and led to a fatal termination, or it has caused paralysis. Before practising this, or in fact any other, operation for spina bifida, the position of the cord with respect to the tumor should, if possible, be ascertained, and a careful examination will generally enable the surgeon to decide with considerable certainty whether it be contained in the sac or not. Where such is the case, the probabilities of death from operation are so great, that none should be attempted, and palliative treatment alone employed. In puncturing the tumor, Mr. Prescott Hewett directs that the trocar or grooved needle should always be introduced at the lowest part, and on one side, so as to avoid wounding the cord or the nerves which generally are found connected with the sac along the median line, and this must be especially borne in mind when the swelling is in the sacral region. (*Loc. cit.* p. 463.)

The whole of the fluid within the cyst should

not be withdrawn, at any rate not until the tapping has been practised several times, and it is very desirable to heal the wounds as quickly as possible, and to prevent the admission of air into the sac: to this end the punctures should be covered with collodion immediately the trocar is withdrawn, and indeed it may be applied with advantage to the whole of the skin. The method of treatment by punctures and compression has received the sanction of Malgaigne, who, though usually averse to operating upon these cases, considers this to be less perilous than any other proceeding. (*Op. cit.*)

In some instances, the fluid re-collects almost as quickly as it is withdrawn, and the tumor steadily increases in spite of treatment. To meet this class of cases, Dr. Brainard, of Chicago, has injected the sac with a solution of iodine, and his results have been most encouraging (*Amer. Journ. of Med. Science* for 1861, vol. xlii.). He draws off a small quantity of the fluid by means of a fine trocar, and injects an equal quantity of iodine solution; if much irritation supervene, he withdraws the contents of the cyst, and replaces them with warm distilled water, or some of the original fluid kept for the purpose: this process he repeats as often as may be necessary. When the tumor begins to contract, or becomes flaccid, he employs pressure to support it, or paints it with collodion. He relates several successful cases in his own practice, and in that of others, claiming for this treatment a comparative absence of danger, from which, however, some fatal cases have recently shown that it is not altogether exempt. Velpeau has proposed to treat this disease like an ordinary hydrocele, by emptying the sac and injecting a solution of iodine, but this method does not show such favourable results as Dr. Brainard's.]

Children are sometimes born with tumors analogous to spinæ bifidæ, but situated on the head. There is a deficiency of bone at some part of the skull, and through the opening a sac, composed of the dura mater, protrudes, covered only by the integuments. Mr. Earle met with such a swelling, situated upon the occiput of a female infant. The plan of repeatedly making small punctures with a common needle, discharging the fluid, healing up the punctures, and applying pressure, was tried, and followed up for some time, without the occurrence of any unpleasant symptoms. Even punctures were sometimes made with an ordinary lancet; yet the child suffered no harm from the operation, and some hopes of a cure were indulged. At length, however, ulceration of the swelling took place, the child became indisposed, and rapidly sunk. (*Med. Chir. Trans.* vol. vii. p. 427. See also *Chelius' System of Surgery*, by South, vol. ii. p. 465.)

Mr. Dawson has recorded the particulars of a spina bifida in a lady, 38 years of age, which occasioned a tumor at the upper and back part of the thigh, and was supposed to be a swelling of a different kind. When an operation for the removal of it was about to be performed, a puncture was made in the thinnest part of the skin covering its apex, and twelve ounces of clear fluid were discharged, leaving the sac collapsed, which was found to have a narrow neck passing to the lower part of the sacrum, in which there was an aperture capable of admitting the little finger. The patient sunk on the nineteenth day after the operation.

Amongst the curious facts adverted to by Mr. Dawson, "In this instance, there was not more functional disturbance present than is often met with in cases of hysteria; while the post-mortem examination unfolded an extent of actual disorganisation of the nervous centre of a most appalling character: to such an extent, indeed, as might have been believed to be, not only incompatible with the exercise of voluntary power, but with life. There was no paralysis of the lower extremities, nor of the sphincters. The inability to empty the bladder indicated some want of consent of parts; but not more than is frequently met with in hysterical females, or after a tedious labour." (See *Trans. of Prov. Med. and Surg. Association*, vol. i. p. 219.)

G. G. Gascoyen.

*Ruysschii*, Obs. Anat. Warner's Cases in Surgery. B. Bell's System of Surgery, vol. v. *Acrel*, in Schwed. Abhandl. b. x. p. 291, &c. *Murray*, Opusc. ii. No. 5. et. Méd. Pract. Bibl. iii. p. 612. *Portal*, Cours d'Anat. Méd. t. iv. p. 66. *Lassus*, Pathologie Chir. t. i. p. 260, et seq. edit. 1803. *Abernethy's* Surgical and Physiological Essays, parts i. and iii. T. F. *Oakes*, An Account of Spina Bifida, with Remarks on the Method of Treatment proposed by Mr. *Abernethy*, 8vo. Cambridge, 1810. *Richter*, Anfangsgr. der Wundarzn. b. v. kap. 17. *Sir A. Cooper*, in Méd. Chir. Trans. vol. ii. p. 322, &c. *H. Earle*, in the same Work, vol. vii. p. 427, &c. *Edinb. Med. and Surg. Journal*, No. 67. *J. A. Murray*, De Spina Bifida ex mala Ossium Conformatione Initio. Göt. 1779. *Fleischmann*, De Vitiis Congenitis circa Thoracem et Abdomen. Erlang. 1810. *Otto*, in Seltener Beobacht. Breslau, 1816. *P. Hayes*, in New England Journal, 1817, vol. i. No. 3. *Neuendorff*, De Spina Bifida Curatione Radicali. Lips. 1820. *W. Law*, in *Edinb. Med. and Surgical Journ.* No. 100. (A case in which punctures, followed up by pressure, were tried; but though the child went on favourably for a time, suppuration afterwards occurred, and death took place rather suddenly.) *Morgagni*, De sedibus et causis Morborum, 1761, epist. vii. *J. F. Meckel*, Handbook of Pathological Anatomy. Leipzig, 1816, vol. i. *Bouyer*, Traité de Maladies Chirurgicales, 1818. *C. P. Ollivier*, Traité de la Moelle Épineire et des Maladies. Paris, 1827. *C. M. Billaud*, Traité des Maladies des Enfants nouveaux-nés et à la mamelle. Paris, 1828. *Fisher*, Lond. and *Edinb. Philos. Mag. and Journal of Science*, 1837, vol. x. *Vinchon*, Gazette des Hôpitaux, 1838. *Moulinié*, Bull. Méd. du Midi et Gaz. Méd. 1838. [*Beynard*, Gaz. Méd. de Paris, 1841. vol. ix. *Longet*, Anat. et Physiol. du système nerveux de l'homme et des animaux vertébrés. Paris, 1842. vol. i. *Prescott Hewett*, Cases of Spina Bifida, with Remarks, Lond. Med. Gaz. 1844, vol. xxiv. *Malgaigne*, Sur la nature et le traitement du Spina Bifida, Journ. de Chir. Paris, Feb., 1845. *Nélaton*, Elémens de Path. Chir. 1847, vol. ii. *Chelius*, System of Surgery, by South, 1847, vol. ii. *Cruveilhier*, Traité d'Anat. Pathol. générale, 1849. *Rokitansky*, Manual of Pathol. Anatomy, 1850, vol. iii. *Solly*, Méd. Chir. Trans. vol. xi. 1857. *Dubois*, Bull. de la Soc. de Chir. Paris, 1860. *Erichsen*, System of Surgery, 1861. *Brainard*, Amer. Journ. of Medical Science, 1861, vol. xlii. *Gross*, System of Surgery, 1864, vol. ii. *Holmes*, System of Surgery, 1864, vol. iv. *Path. Soc. Trans.* vols. iii. viii. xi. xiv.]

**SPINA VENTOSA.** The Arabian writers first employed this term to express a disease in which matter formed in the interior of a bone, and afterwards made its way outward beneath the skin. Until the matter had escaped from within the skin, these authors describe the pain as being incessant and intolerable; but that, after the pus had made its way outward by fistulous openings, the patient's suffering underwent a considerable diminution. The matter sometimes insinuated itself, from the interior of the bone, into the cellular substance, so as to render it soft and flabby, though not always attended with any change of

colour in the skin. The swelling had somewhat the appearance of emphysema. To express this state, the Arabians added the term *ventosa* to that of *spina*, which was employed, before their time, to express the nature of the pain attendant on the disease. (See an account of this subject in the *Encyclopédie Méthodique*, Part. Chir. art. *Spina Ventosa*.)

The term *spina ventosa* has, since the time of the Arabian writers, been used by many to signify the disease named *white swelling*; and the former may have intended to express by it a similar affection, though the contrary may be inferred from their account of the matter forming in the interior of the bone and passing thence under the integuments, a thing which, I believe, never yet happened in any case of white swelling. Another, and perhaps a decisive argument, against the original signification of the word being the same as that of white-swelling, is, that it was not restricted to diseases of the joints and heads of the bones; but was also applied to abscesses, which commenced in the cavities of the middle portions of the long bones, where, I need hardly observe, white swellings are never found.

For these reasons, many respectable authors have implied, by the term *spina ventosa*, an abscess in the interior of the bone. (See *Latté's System of Surgery*, vol. i. p. 165.) Cases of this kind are rare compared with that common disorder, white swelling; and I am certain, from the descriptions given by some authors, that their cases of *spina ventosa* were in reality only instances of necrosis. But, that abscesses do sometimes occur in the interior of the bones, more particularly of those of young persons, cannot be doubted by any surgeon of experience.

[This very indefinite expression has been applied to almost every description of tumor which occurs in bones, and its indiscriminate application has been a source of confusion in the pathology of these cases. When a tumor forms in bone, slowly and gradually expanding its tissue, and causing swelling of the soft parts over it, no matter what the real nature of the growth may be, the symptoms and appearances are for a time very similar for each; and this incidental resemblance between them formerly led to the application of the term *spina ventosa* to any morbid enlargement of bone which presented certain appearances and certain symptoms.]

The disease which has been described under this name consists of a growth or deposit within the substance of a bone, and, by its gradual increase, causing expansion and thinning of the osseous walls, with separation of the cancellated texture. The portion of bone affected becomes much enlarged, and forms a smooth round or oval swelling; as the disease advances, the spongy tissue may undergo complete absorption, leaving a large single cavity surrounded by the thinned osseous walls, or the cancelli may be expanded until several of them are blended together, forming thus a number of cysts or cells of various sizes, encased by a delicate fragile shell of bone, which yields under pressure with a peculiar crackling sound, like a piece of parchment, or as if air were contained in the swelling. Occasionally, this bony envelope is more or less absorbed, the periosteum alone forming the wall of the tumor, and it is usually pierced by numerous openings. When



such a bone is macerated, it is seen to be reduced to a mere osseous shell, empty and brittle, with numerous large perforations, and often imperfectly divided into incomplete cellules which freely communicate. The affection is usually met with in adults, and most frequently in the articular extremities of the long bones, although the shafts are sometimes attacked. The jaws, the lower end of the femur, and the upper extremity of the tibia are its favourite situations; the cranium, ribs, and other flat bones are occasionally involved, whilst the short bones are less liable to it. The old writers on this disorder stated that it was very common in children, and called it then a *pædarthrocace* (*παις*, a child; *ἄρθρον*, a joint; *κακός*, bad), confounding it with the scrofulous affections of joints so common in young persons.

The principal symptoms are, deep-seated pain in the affected part to a greater or less degree, and an enlargement of the bone, which slowly and steadily increases; the swelling is smooth and even; the skin over it long retains its normal colour, though the veins become tortuous and congested. When the osseous walls are much thinned and the tumor is very large, it is elastic or gives an indistinct fluctuation on pressure; the skin then becomes reddened, painful, inflamed; abscesses often form and burst, leaving unhealthy foul ulcers, and the constitutional symptoms are very severe.

These swellings depend upon a great variety of causes: as before mentioned, an abscess, or collection of matter, within a bone may give rise to this expanded, rarified condition of its tissue; so also may deep-seated necrosis or caries, tubercular infiltration, cancerous deposits, cystic formations of various kinds containing fluid, fungous excrescences from the medullary membrane, as well as fibrous, cartilaginous, and other solid growths occurring in the substance of the bone, and by their increase causing its absorption.

The tumors often attain a very considerable size, especially those which contain fluid, and then they are usually multilocular; those with solid contents generally consist of a single cavity only, which is completely occupied by the morbid formation. Dupuytren was the first to describe, and attempt a diagnosis of, this affection. He states that the medullary membrane is the primary seat of the disease, being ultimately converted into a fungous substance which, by its mechanical effect upon the bone, causes dilatation and thinning of its walls; he thus distinguishes it from cancerous disease, which commences in the substance of the bone itself and completely destroys it. He admits, however, that these affections present several points of resemblance to each other, and that spina ventosa not uncommonly passes into cancer. (*On the Diseases and Injuries of Bone*, Syd. Soc. p. 416.) Many writers follow Dupuytren in regarding spina ventosa as a distinct disease, depending upon fungoid degeneration of the medullary membrane; but their descriptions closely resemble malignant disease. (Béclard, Bromfield, Sanson.)

With many authors spina ventosa is synonymous with *Osteo-sarcoma* (see that word). Sir Astley Cooper considers it to be a variety of cancerous disease, which originates in a growth from the medullary membrane. Nélaton applies the term to that form of malignant deposit which expands the bone uniformly into a thin shell or cyst investing the cancerous mass.

According to some authorities, and especially the older ones, the disease depends upon the deposition of scrofulous matter in the substance of a bone. Wiseman says it is "of a certain species of king's evil and of no other." (Several Chirurgical Treatises, 1676.) Heister is evidently of the same opinion, as is Boyer also; and later still Chelius.

Cloquet and others speak of two kinds of spina ventosa: the one, occurring in children, is due to scrofulous deposit, and is especially found in the articulations of the metacarpus, metatarsus, and phalanges; the other, much more severe, is seen in adults, attacking the articular ends of the bones of the extremities, and is generally cancerous. The cause of the disease must generally be sought in the peculiar diathesis of the patient, as it is one of those maladies which depend upon constitutional causes, but it has often been known to follow upon external violence.

The term spina ventosa is so very vague that it is now but little employed, and is used rather to express the expanded, rarified and cellular condition of a bone than to denote the disease which occasioned it.

If the bony enlargement depend upon an abscess in the bone, or a collection of fluid, a trephine may be applied and the pent up matter or fluid evacuated. (See ANTRUM.) If necrosis or caries be the cause, the proceedings recommended in the pages devoted to those subjects should be pursued; should tubercular deposit take place in bone, the treatment advocated under the head of scrofula will be advisable; in case of cancerous disease, or disease of the medullary membrane, amputation is the only resource. (See OSTEO-SARCOMA.)

G. G. Gascoyen.

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**SPINE, CURVATURES OF.** A review of the anatomical and physiological peculiarities of the spinal column would lead us to expect that this complicated structure, adapted to so many different functions, would become liable both to disease and distortion. Diseases affecting its various structures—bones, cartilages, and ligaments—and analogous to diseases affecting similar structures in other parts of the body. Of these diseases, ulceration of cartilages, necrosis and caries of bone, resulting in posterior or angular curvature, known also as Pott's disease, and rheumatic inflammation of the ligaments, are the most common; but these affections it is not intended to describe in the present article. For a description of Pott's disease and the resulting angular curvative, see article SPINE, DISEASE OF.

*Distortions or curvatures of the spine*, depend either upon the failure of some of the internal conditions necessary to its preservation in a healthy

form, such as its proper and healthy nutrition; or upon some external physical influences to which it is pre-eminently exposed; or, as occurs in the great majority of cases, upon a combination of both these causative influences. Hence we have the constitutional and local origin of distortions.

These two classes of cases, viz. diseases and distortions of the spine, were, by the older surgical authorities, frequently considered as one and the same form of disease; but the wide separation between them, and their easy diagnosis, may now be considered as well established and too well known to require comment here.

The spinal column, then, is liable to *distortion*, i. e. fixed deviation from the erect position, in various directions, so as to produce external deformity. The distortion may take place in the *antero-posterior* direction, either as an exaggeration of the natural curves of the spine, which become so much increased as to produce external deformity; or the natural curvatures of the spine in the antero-posterior direction may be reversed, especially in the dorsal and cervical regions, i. e. the dorsal curve may become depressed so as to project anteriorly, curving forwards instead of backwards; the cervical curve may project backwards instead of forwards; and the lumbar curve frequently becomes straight instead of curving anteriorly. Or distortion may occur as a lateral deviation, though the deformity described as *lateral curvature of the spine* does not depend upon a true lateral deviation, but rather upon a peculiar twisted, or contorted, condition of the spinal column, in which an external lateral deviation of the spinous processes generally, but not invariably, forms a conspicuous feature.

Deviations of the spine, either in the antero-posterior or the lateral directions, may coexist with destructive disease of the spine, affecting the intervertebral cartilages and the bones in the early stage; or they may be consecutive to such diseases, and remain as permanent distortions after the destructive disease has been completely arrested. For example, when destructive disease occurs in the dorsal region, as we frequently see it in children, and sometimes in adults, the posterior convexity of the spine is increased, and there may be great difficulty in deciding upon the existence or non-existence of disease. At a later stage, however, a sharp angular projection of one or more spinous processes generally takes place, and all doubt as to the existence of disease is removed; but occasionally it happens that several intervertebral cartilages are affected without caries of the bones, as exhibited in preparations in St. Thomas's Museum, N E 20 and E 22, and in such cases no angular projection of the spinous processes would take place.

When destructive disease in the lower dorsal and upper lumbar vertebræ has become arrested, with the ordinary result of angular projection backwards of three or four spinous processes, the spine becomes altered in form, as a consecutive condition, in the middle dorsal region, which is either depressed so as to form a straight line, or the natural direction of its curve may be reversed, and a concavity instead of a convexity may exist in the middle dorsal region.

Deviation of the spine in a lateral direction may also occur in the early stage of destructive disease, when it attacks the bodies of the vertebræ, or the intervertebral cartilages, laterally instead of their

anterior aspects as it usually does; or in the later stages, it may exist as a consecutive curve, either above or below the angular projection resulting from destructive disease, when this has affected the lower or the upper portion of the spinal column.

Curvature of the spine, then, either in the anterior, posterior, or lateral direction, may coexist with destructive disease of the spine in its early stage without any reliable symptoms or indications of such disease being present. It is as well this should be borne in mind, because, in the course of practice, cases will occasionally present themselves in which the diagnosis must be one of considerable difficulty, as well as of great importance; and we know that disease of the spine in the early stage is at all times difficult of diagnosis.

Curvatures or distortions of the spinal column, not connected with, or directly dependent upon, destructive disease of the bones or intervertebral cartilages, generally depend either upon muscular debility associated with some unfavourable constitutional condition, or upon the long continuance of some faulty position, the result either of acquired habit or of some occupation; or they may depend upon both these causes combined. This is essentially the class of cases it is here proposed to describe, and first with regard to the antero-posterior forms of curvature.

#### ANTERIOR CURVATURE OF THE SPINE.

**LORDOSIS**—*λόρδωσις* from *λορδῶω*, to bend *supinely*, so as to throw the head back. Curvature of the spine in an anterior direction, with the convexity in front, occurs chiefly in the lumbar region, as an increase of the natural curvature, from several causes; but it may also exist in the dorsal region to a less extent, and more rarely it occurs in the cervical region.

In the *lumbar region* this increase of anterior curvature is found:—

1. As a peculiarity in the natural conformation of the individual, often existing in several members of the same family, and hereditary. It is more common in some countries than in others, but in England I have most frequently observed it in short people with long bodies and short legs, i. e. belonging to the rachitic type of development, and whose bony development exhibits some indications of a rachitic tendency.

2. As a constant effect of rickets in its more severe forms, in which the entire skeleton indicates the existence of this affection in the stunted growth of the individual from arrested development of the bones—more conspicuous in the leg-bones from their normal rapid rate of growth during early childhood, as compared with the spine and other bones of the body, hence the disproportionate shortness of the legs in these cases—and in various curvatures especially affecting the leg-bones and the pelvis. In severe rickets, the pelvis becomes flattened from above downwards, from the inability of its bones to support the superincumbent weight, and the sacrum assumes a horizontal direction. As a necessary result of this alteration in the direction of the sacrum, and the deviation in the axis of the pelvic cavity, an increase of the lumbar curve of the spine takes place to preserve the equilibrium of the body, and in these cases of rickets a very marked *lordosis* is the result.

3. As a constant effect of congenital dislocation, either of one or both hip joints, an affection



which occurs more frequently than is generally supposed. It is in congenital dislocation of both hips that extreme incurvation of the lumbar region takes place, as a compensative effort to preserve the equilibrium of the body, disturbed by the tilting of the pelvis which necessarily results from the abnormal position of the heads of the thigh bones.

4. Either coexisting with destructive disease of the lumbar vertebræ in the early stage, or as a consecutive curve after destructive disease has become arrested, and angular curvature, i.e. posterior projection of one or more spinous processes, produced in the middle or lower dorsal regions. In such cases the lordosis in the lumbar region is necessary to preserve the equilibrium of the body, and is, of course, persistent through life.

5. As a constant effect of ankylosis of the hip-joint, with the thigh in a flexed position. After strumous disease of the hip-joint, rheumatic inflammation, and several other affections, ankylosis of the hip-joint, either ligamentous or bony, frequently takes place, with the femur in a flexed position, in most cases at an angle of about forty-five degrees, but sometimes at a right angle with the pelvis. The angle is generally much greater than is apparent at first sight, because in standing or walking, the patient brings the foot to the ground, by increasing the natural curvature of the spine in the loins, and in these positions, therefore, lordosis is produced, but it is more or less completely removable when the patient sits down. In such cases we have a greatly increased amount of flexibility of the lumbar region.

#### TREATMENT.

Surgically speaking, *lordosis* occurring in the lumbar region is of very little importance, as in its worst forms it is only a part of a more serious affection, and seldom becomes the subject of treatment; but it may sometimes assist us in the difficult diagnosis of destructive disease occurring in the lumbar vertebræ, and sometimes, though rarely, it may become the subject of special treatment. In connection, however, with the treatment of the diseases, such as rickets and caries, which sometimes produce this form of curvature, special attention may be directed to a few practical points.

*In the first class*, above described, viz. that dependent upon natural configuration or peculiarity, either of family or race, of course there could be no attempt at surgical interference.

*In the second class*, the rachitic form, no special treatment is indicated, but our attention must be directed to the means of arresting the general affection, and thus either preventing the consecutive deformities, or diminishing their severity.

*In the third class*, i.e. lordosis in cases of congenital dislocation of the hip-joint, it is doubtful whether any permanent diminution of the spinal curvature can be effected by mechanical means, though it has been attempted, and with some appearance of temporary benefit. Possibly the lordosis may be diminished by the constant use of a spinal instrument from early childhood to the completion of growth, but as the hip-joint articulations must remain in their abnormal condition, the permanent advantage obtained by such means is not likely to be considerable.

*In the fourth class*, i.e. lordosis existing durin

the progress of destructive disease in the lumbar region, or as a consecutive curve after destructive disease has subsided and angular curvature been produced in the middle or lower dorsal regions, there can be no doubt of the great advantage of mechanical support during the progress of caries or destructive disease in any region of the spine.

This treatment will be found equally applicable to all stages of caries or destructive disease of the spine, from its commencement, which we may in most cases diagnose before any angular projection has taken place; and even when the destructive process is evidently advancing, provided the patient be able to bear the support, and is disposed to walk. The mechanical support enables such patients to walk about with comfort, and does not in any way interfere with, but essentially promotes, the proper constitutional treatment of the disease. During periods of increased pain, such as may occur in the stage of abscess, confinement to the bed is dictated by the patient's feelings, but as soon as the child (most of these cases are seen in children) is disposed to walk again, he should be allowed to do so.

*In the fifth class*, i.e. lordosis consecutive to hip-joint disease, the curvature is also a natural compensating effort to maintain the equilibrium of the body, and there are no indications for surgical interference.

#### LORDOSIS IN DORSAL REGION.

*Lordosis* may also occur in the dorsal region, but to a much less extent than in the lumbar region. In the former it is frequently met with as a consecutive condition to caries, or destructive disease, after angular curvature has been produced either in the lower cervical, or in the lower dorsal and lumbar regions. Above or below the seat of disease, a flattening and sometimes a deep sinking-in of the dorsal vertebræ frequently occurs. No surgical importance, however, attaches to this form of curvature; but there is another form of *lordosis* occurring in the dorsal region, of considerable importance in a diagnostic point of view, to which attention should be especially directed, viz. the sinking-in or depression of the spinous processes, which occurs in the dorsal region in some cases of double lateral curvature of the spine.

The surgical interest which attaches to this deviation arises, not from its existence in severe cases of lateral curvature, but from the fact that it frequently occurs before any lateral deviation of the spinous processes takes place, and therefore before any lateral curvature has become obvious externally. In such cases, some slight prominence of the shoulder is generally the reason of the surgeon being consulted, and, finding no lateral deviation of the apices of the spinous processes, he usually gives a favourable opinion of the case. The *lordosis* probably does not amount to more than a loss of the natural posterior curvature of the spine in the dorsal region, i.e. a flattening of the back, and a straight appearance of the spine, which he regards as of no importance. The prominence of the shoulder, however, depends upon slight rotation of the bodies of the vertebræ, and, in such a case, *internal curvature* of the spine already exists. Some additional confirmation of this view will be found in the fact that the angles of the ribs, on the side corresponding to the pro-

minence of the shoulder, project a little posteriorly when comparison is made with those of the opposite side, i.e. the angles of the ribs on one side project, and on the other recede, and, as this can only take place in consequence of rotation of the bodies of the vertebræ, the fact is of the utmost importance. The prominence of the shoulder, i.e. the scapula, depends upon the posterior projection of the ribs on the corresponding side, and when the prominence of the scapula and the angles of the ribs are considered in conjunction with the flattening or depression of the spinous processes in the dorsal region (without any lateral deviation), we may most confidently diagnose the existence of internal curvature of the spine, and the case must, without delay, be submitted to appropriate treatment.

#### TREATMENT OF LORDOSIS IN THE DORSAL REGION.

*Lordosis* in the dorsal region consecutive to caries and angular curvature in the lower cervical, or in the lower dorsal and upper lumbar regions, does not require any special treatment. It is essentially a natural effort to restore the equilibrium of the body disturbed by the angular curvature, but if the destructive disease of the spine be treated during its progress, upon the principle of mechanical support previously described, both the angular and the consecutive *lordosis*-curvature will be much less than if no mechanical support had been applied. The object of mechanical support is not in any degree to straighten or diminish by pressure the angular projection when formed, but, when the spine is properly supported during the progress of destructive disease, the resulting angular curvature will not take place to a greater extent than is absolutely necessary for curative purposes, i.e. bony ankylosis, and therefore the consecutive curve will be proportionably small; whereas, without mechanical support, the angular projection is generally much larger than necessary for curative purposes, and the consecutive curvatures are proportionably excessive, frequently producing an unsightly external deformity, where very little need have existed.

With regard to the treatment of the other form of *lordosis* in the dorsal region, existing in some cases of the so-called lateral curvature of the spine, this will be more fully described when the treatment of lateral curvature is considered, but essentially it should consist in partial lying down, i.e. to the extent of four or six hours a day, combined with the use of a spinal instrument with a steel plate, acting upon the principle of horizontal rotation. On the whole, the prospects of such a case, even when slight, are worse than in a more marked case of lateral curvature, with greater lateral deviation of the apices of the spinous processes, and prominence of the shoulder.

#### TREATMENT OF LORDOSIS IN THE CERVICAL REGION.

*Lordosis* occurs much less frequently in the cervical than in the dorsal or lumbar regions of the spine, and is nearly always the result of caries or destructive disease of the spine, occurring in the upper cervical vertebræ, generally in children. The head is drawn backwards and the face directed upwards; the larynx projects forwards, and it is hardly possible to feel the spinous processes

of the cervical vertebræ at the back of the neck. Any attempt to alter the position of the head is accompanied with pain, as the disease is generally progressing when these cases are brought under our notice.

We may sometimes see *lordosis* in the cervical region as a persistent condition after the destructive disease has subsided, but then the position of the head is more natural than above described; the frequency, however, with which caries in the upper cervical region terminates fatally, necessarily makes these cases very rare.

In only one instance have I seen *lordosis* in the cervical region of congenital origin, and in this case it evidently depended upon muscular contraction, and was part of a more general affection involving the muscles of the trunk and limbs.

*Lordosis* in the neck, either coexisting with, or consecutive to, caries of the cervical vertebræ, does not admit of the application of mechanical support so easily as when situated in the dorsal or lumbar regions; but thick gutta-percha splint-like supports passing upwards from the shoulders, along the neck, to the occiput, may be adjusted so that the weight of the head would be to some extent removed from the neck, and transferred through the large and strong splint directly to the shoulders, and all motion of the neck prevented.

#### POSTERIOR CURVATURE OF THE SPINE.

*CYPHOSIS*—κύφωσις, from κυφώ, to bend or crook forwards.—Curvature of the spine in a posterior direction, with the convexity projecting backwards, occurs chiefly in the dorsal region, as an increase of the natural curvature from several causes, and is most frequently produced by muscular debility, or the long continuance of a stooping position, as in certain occupations, &c.; hence this form of spinal curvature most frequently occurs in children and old people, but it may be produced by other causes at different periods of life.

1. *In infancy* posterior curvature of the spine is the constant result of general debility, and weakly infants, unable to sit up in the nurse's lap long after the period at which children generally hold themselves somewhat erect in the sitting position, are frequently brought to us. Sometimes such children do not appear to be imperfectly nourished—they may even be fat, and look well—but there is a general want of muscular power difficult to explain. At this early period of life the spine has not, as yet, assumed its natural antero-posterior curvatures in the dorsal and lumbar regions, and is naturally straight. Muscular and ligamentous debility will, therefore, easily cause the spine to assume the form of a large posterior curvature when the sitting position is attempted; and if such a child were habitually nursed in the sitting position, and especially by a nurse who always carries the child on the same arm, a permanent deviation of the spine in the posterior direction would result, generally combined with some degree of lateral curvature.

**TREATMENT.**—Such cases are best treated by a combination of local support to the spine and constitutional treatment. For local support, it is best to employ a very thick kind of leather, prepared in a peculiar way known to some instrument



makers, which, when moist, may be moulded to the form of the back whilst the child is lying down on its stomach; or a plaster cast may be taken of the child's back in the same position, and the leather moulded on the cast. This kind of leather becomes very hard and unyielding when dry, and then, softly padded, is retained in its position by elastic material passing across the chest and abdomen. Gutta-percha, perforated by small holes to prevent heat, may also be employed, but is not so good as the leather. The child should also be nursed as much as possible in the reclining position. *Constitutionally*—Cod-liver-oil, with small doses of steel, should be given; but it is most essential to see that the child has a sufficient supply of good milk.

2. *In early childhood*, i.e. from two to three or four years of age, posterior curvature of the spine is also frequently seen dependent upon muscular and ligamentous debility, in most cases probably only a continuance of the condition above described; but at this period cases not uncommonly present themselves in which a suspicion of caries or destructive disease of the spine exists, and the diagnosis may be difficult and uncertain. Such cases frequently terminate in angular curvature, even when opinions against the probability of the existence of disease had been strongly expressed, so that a cautious opinion should always be given, and the cases watched carefully.

Another form of posterior curvature sometimes shows itself about this period of life, which, as it occurs in children of parents similarly deformed, and sometimes commences as early as two years of age, may be called *hereditary humpback*.

**TREATMENT.**—The general principles of treatment are the same as in the first-class, viz. local support to the spine, with constitutional treatment, and the reclining position as far as may be practicable. The mechanical support employed may consist either of leather moulded to the back, as previously described, or a steel instrument adapted to the peculiarities of the case.

3. *In youth*.—Posterior curvature of the spine more frequently occurs in boys than in girls, and presents itself in the form commonly described as "*round shoulders*." Some boys have naturally a thick, clumsy, awkward figure, with high shoulders, and soon acquire a habit of stooping, which, if not checked before eighteen years of age, settles into a permanent cyphosis, or exaggerated posterior curvature in the dorsal region. This may sometimes be hereditary, but is more frequently only an acquired bad habit, and often coexists with an indolent and sluggish disposition.

**TREATMENT.**—These cases are best treated by the drill master, and active gymnastic exercises, which are decidedly preferable to any mechanical support; but in girls especially, a well contrived leather backboard is often useful, and sometimes a steel spring backboard of the T shape, or some such mechanical contrivance is preferable.

4. *In the middle period of life*.—Cyphosis or an increase of the posterior curvature of the spine in the dorsal region, is not uncommon in the middle period of life, and may arise from various causes. Sometimes we see it as the result of chronic chest affection, in those who have for several years suffered from bronchitis or some pulmonary complaint. A severe form of cyphosis in the adult is not uncommonly the result of chronic rheumatism,

the individual having a confirmed stoop, and presenting the appearance of premature old age. In a few instances which have fallen under my observation, the termination of the case has proved the cyphosis to have depended upon caries or destructive disease of the spine, when there were no symptoms by which the invasion of such a formidable affection could have been diagnosed. In one instance of this kind, the true nature of the affection was not suspected till after the formation of the psoas abscess.

In other cases cyphosis may be simply a continuance of the form just described as occurring in the period of youth, but the long-continued position from certain occupations is an obvious cause in many cases.

**TREATMENT.**—As a general rule, posterior curvature of the spine occurring about the middle period of life may be more or less relieved by the patient wearing a double-crutch spinal instrument, with a strong webbing band connecting the crutches posteriorly, so as to exert a certain amount of pressure on the projecting portion of the spine. This pressure may be increased with great advantage by the addition of a steel plate, especially in those cases in which the existence of destructive disease is suspected; a firm unyielding steel support evidently gives much more relief in these cases than the webbing belt.

5. *In old age*.—Increase of the posterior curvature of the spine in the dorsal region, or cyphosis, in a severe and rigid form, is a frequent concomitant of old age, and may be the result chiefly of occupation, or of debility. A severe form of cyphosis is sometimes observed in old cavalry officers who have seen a great deal of service in India, and who have attributed it to the fatigue of frequent and long marches commonly taken by the Indian army. Among the agricultural labourers of this country, a severe form of cyphosis is also of common occurrence; in very old men of this class, it is almost constant, and among men from fifty to sixty years of age it is also frequently witnessed, evidently as the result of their occupation at the plough and other field labour.

From these observations, then, it will appear that cases of cyphosis differ very much in their pathology, according to the different periods of life at which they occur; and therefore the classification above made appears to be best suited to these cases, which, except at the earlier periods of life, and occasionally in the adult, present very little either of surgical interest or practical importance.

#### LATERAL CURVATURE OF THE SPINE.

Sufficient reason might be found for objecting to the continued use of the term "*lateral curvature of the spine*," in the fact that the curvature is never primarily or essentially in a lateral direction. Mr. John Shaw considered the term *serpentine curve* more strictly applicable; Sir Charles Bell described it as the *lateral or sigmoid, or complex curvature of the spine*; and Dr. Dod as the *rotated or contorted spine*; but the alteration of a name which has been so long applied to this class of cases, and which at once points to a well-known form of *spinal distortion* as distinguished from the posterior or angular curvature always produced by *destructive disease* of the spine, would be attended with more inconvenience than benefit.

*Lateral curvature of the spine*, then, or, as it is

termed, *Scoliosis*, from *σκολιῶ*, to make crooked, may be defined as a case of deformity, or contortion of the spine, in which the bodies of the vertebrae deviate laterally in a horizontal direction, with or without a corresponding deviation of the apices of the spinous processes. In many severe cases of scoliosis the spinal column presents on its anterior aspect a large sigmoid curve, whilst posteriorly very little deviation exists in the perpendicular line of the apices of the spinous processes; and in slight cases, whilst an internal curvature affecting the bodies of the vertebrae essentially exists, there may be no external curvature or lateral deviation of the apices of the spinous processes.

GENERAL DESCRIPTION OF CASES INCLUDED UNDER THE TERM "LATERAL CURVATURE OF THE SPINE"—WEAK SPINES EXCLUDED.

Now by the definition above given, it will be obvious that in speaking of lateral curvature of the spine, a condition is referred to necessarily associated with certain structural changes, and that there can be no curvature of the spine, however slight, unaccompanied by such structural changes; in other words, lateral curvature of the spine never exists merely as a functional condition.

According to the generally received opinion as to the mode of production of lateral curvature, this deformity is supposed to depend primarily and essentially upon muscular debility, with a lax condition of the ligaments of the spine; structural changes in the bones and intervertebral cartilages taking place only at a late period. There is no doubt that muscular debility frequently coexists with spinal curvature, as seen in young ladies from twelve to sixteen years of age, and that in such cases it may be regarded as largely contributing to the production of curvature, though not the only cause; but it is equally certain that lateral curvature of the spine as frequently, if not more frequently, exists in individuals who do not exhibit any indications of muscular debility; and it is by no means uncommon to see this form of spinal distortion in girls, and also in boys of a healthy and robust appearance, associated with more than ordinary muscular strength.

On the other hand, physicians and surgeons can hardly have failed to observe how frequently general muscular debility exists in very delicate boys and girls, often with a marked consumptive tendency, without any disposition to lateral curvature of the spine. It is certain that only a small percentage of such delicate children with feeble muscular power, ever become the subjects of lateral curvature. Of all the cases of lateral curvature which have passed under my notice, less than half of them have exhibited any marked indication of muscular debility.

Something more than muscular debility, then, is required to produce lateral curvature of the spine, and the additional cause will generally be found either in some constitutional condition marked by an hereditary tendency to spinal curvature, or in the existence of some local cause acting mechanically so as to produce a long-continued irregular distribution of weight through the spinal column; or both of these causes may coexist with muscular debility.

In the description of lateral curvature of the spine, now given, let it be understood, then, as

my intention to exclude a large class of cases frequently simulating lateral curvature, but which, I think, should be more properly grouped as a special series, and described as *weak spines, or cases of threatened lateral curvature*.

It is doubtless true, that of such cases a certain proportion will terminate in the formation of lateral curvature, if this event be not prevented by proper treatment, and cases thus originating, will be included in my description of lateral curvature generally; but by many writers on spinal curvature, all such cases are absorbed into the class of lateral curvature, of which they are described as the first stage, and magnified into an undue importance. The result is, that they are very unnecessarily submitted to a long course of treatment required only by cases of actual curvature.

Proceeding now with the description of cases of undoubted curvature of the spine, let us first trace the

EXTERNAL CHARACTERS IN CASES OF SINGLE CURVATURES IN DIFFERENT REGIONS, AND IN CASES OF DOUBLE CURVATURE.

Several forms of lateral curvature of the spine as judged of by the more obvious external characters, are generally described, the most frequent arrangement being into *single curves* and *double curves*; the single curve generally existing in the lumbar, but sometimes in the dorsal region, and occasionally involving both the lumbar and dorsal regions; the double curve generally consisting of a deviation to one side in the dorsal region, and a deviation in the opposite direction, i.e. the lumbar region, so that one curvature compensates for the other with more or less mechanical accuracy.

*Triple curves, quadruple and quintuple curves* are also described by those who aim at further refinement. In reference to the division into *single and double curves*, it is only necessary to observe that anatomically it is impossible that any such condition as a single curve can exist in the spine, so long as the individual is able to maintain the equilibrium of the body and keep the erect position; at each extremity of the so-called single curve, a return curve, or deviation in the opposite direction must take place, though this may not be very obvious externally; however, as we certainly have the external appearance of single and double curves, and as the terms are well understood, there is some advantage in retaining them for descriptive purposes.

Other writers more frequently speak of *primary* and *secondary* curves, or as the latter are frequently called the *consecutive* and *compensating* curves, the secondary curve being supposed to take place after the primary curve, as a mechanical compensation for the latter; but I doubt whether it can rationally be inferred, or in any way demonstrated by cases, that a second curvature takes place after the first is formed: to me it appears that both curvatures take place simultaneously, or very nearly so.

It is evident that, as soon as a curvature begins to form, say in the lumbar region, the necessity for a second curvature immediately exists, for the purpose of maintaining the equilibrium of the body, and such a curve as quickly begins to form. The rate of increase, however, will vary according to a variety of circumstances, and ultimately the



appearance presented will approach more or less towards either the so-called double or the single form of curvature, and this will depend very much upon the equal or unequal length of the curves formed. More attention than is generally given should be directed to the inequality in the length of the curves, because, in proportion as one curve increases and predominates, so the external deformity increases, and with it frequently the more severe symptoms, affecting the general health. Three or four short curves, of about equal lengths, and, therefore, mechanically counterbalancing each other, may exist in a spinal column without producing more than very slight external deformity; but if two curvatures of unequal lengths should exist, the longer curve is sure to increase with greater rapidity than the shorter, and must necessarily give rise to external deformity, as well as cause displacement of internal organs. The external characters will vary, then, according to the form and situation of the curvature.

#### EXTERNAL CHARACTERS IN SINGLE LATERAL CURVATURE.

When a *single curve* (the term being employed with the explanation above given) exists in the *lumbar region*, and also involves, as it generally does, the lower dorsal vertebrae, a *prominence of the hip*, corresponding to the concavity of the curve, is the most conspicuous external indication, and is itself diagnostic of this form of spinal deviation. In these cases, the *crest of the ilium* becomes *prominent* simply on account of the abdominal walls in the lumbar region sinking in as a result of the curvature of the spine in this region, the *depression* or *receding* of the abdominal walls corresponding to the concavity of the curve; whilst, on the opposite side to the depression, and corresponding to the convexity of the curve, an *increased prominence of the spinal muscles*, especially the *sacro-lumbalis* and *longissimus dorsi*, takes place. The depression on one side and prominence on the other, essentially depend upon rotation of the lumbar vertebrae, the effect of which is to alter the relations of the transverse processes, causing these processes to project posteriorly on one side, i. e. on the convexity of the curve—and in this movement the spinal muscles are thrust outwards—and to recede inwardly on the opposite side, i. e. on the concavity of the curve, in consequence of which a *prominence of the hip*, or, more correctly speaking, of the *crest of the ilium*, is produced. The diagnostic value of the prominence of the hip in these cases was especially insisted upon by the late Mr. Lonsdale.\*

A *lateral deviation of the apices of the spinous processes* also generally exists in this form of curvature, but frequently only to a slight extent, and seldom in any very marked degree; the prominence of the hip, however, first and principally attracts attention. A disposition to sit awkwardly, with an occasional falling of one shoulder, may have been noticed, but this is by no means constant.

When a *single curve* exists in the *dorsal region* it generally involves a considerable length of the spinal column. The curvature is most conspicuous about the central, or the central and lower portions of the dorsal region; but in a severe case, the whole

of the dorsal, and two or three of the lumbar vertebrae, are involved in one large curvature. The symmetrical form of the body is more disturbed in this than in any other so-called variety of lateral curvature, in consequence of the length of the curve, and its relation with the thoracic parietes.

The *level of the shoulders* is conspicuously altered, even when the curvature is slight, and as it advances, *one shoulder becomes permanently elevated and the other depressed*. When attention is first directed to the inequality in the level of the shoulders, it is thought to be only a habit of the girl to raise one shoulder in consequence of the make of her dress, i. e. from the shoulder-strap slipping off, etc.; but, in such cases, the so-called habit will generally be found to be produced by a slight spinal curvature in the dorsal region.

A *prominence of the scapula*, corresponding to the convexity of the curve, always exists, and in many cases this is the indication first observed. The *scapula* will also be found *unequally distant from the spinous processes*, that on the convexity being more distant than the other, and also raised above the level of the opposite bone.

A *posterior projection of the angles of the ribs*, on the side corresponding to the prominent scapula, and a depression of the angles of the ribs on the opposite side—depending upon rotation of the vertebrae—also constantly exist, and as the curvature increases becomes one of the most conspicuous external characters.

The *ribs* also become more *oblique in their direction*, and *depressed*, laterally as well as posteriorly, in the concavity of the curve, so that the chest sinks in, and becomes obviously deformed; on the convexity of the curve the ribs are more horizontal in their direction, and more widely separated from each other, than in their natural condition.

The *apices of the spinous processes* present a more marked lateral deviation in this than in any other form of curvature, though, even in severe cases, they afford but a very imperfect indication of the extent of the internal curvature as affecting the bodies of the vertebrae. In slight cases the lateral deviation of the spinous processes may be scarcely perceptible, though the other external characters are sufficiently well marked.

When a *single curve* exists in the *upper and middle portion of the dorsal region*, it gives to the individual a high-shouldered and short-necked appearance, and produces a disposition to stoop. The *scapula* on the side of the convexity is tilted forwards, and the portion of the trapezius muscle just above the scapula is often very prominent, so much so as to be occasionally mistaken for fatty or cystic tumor, or chronic abscess. All such muscular swellings convey to the touch a doubtful sense of fluctuation, which it is as well to be aware of. The *shoulders* are unequal in height, one raised and the other depressed, and the chest sinks in at the upper part, a little below the axilla, on the side of the concavity.

#### EXTERNAL CHARACTERS IN DOUBLE LATERAL CURVATURE.

When a double curvature of the spine exists, one curve usually occupies the dorsal region, and presents its convexity to the right side, and the other the lumbar region, with its convexity to the left side. The deviation to the right side in the middle dorsal region, as compared with the devia-

\* On *Lateral Curvature of the Spine*. By E. F. Lonsdale. Second edit., page 46. London: Churchill, 1852.

tion to the left side, occurs in the proportion of seven to one, according to Bouvier.\* When these curves are only of moderate extent, and *about equal to each other in length*, so as to balance each other, as it were, and preserve the equilibrium of the body, *very little external deformity exists*—much less than in either of the single curves above described. The level of the shoulders is not disturbed, and therefore the girls do not sit in the same awkward way as in the other forms of curvature, when one shoulder is higher than the other and the body twisted. Such curvatures are frequently unaccompanied by pain or other symptoms, and therefore allowed to become comparatively severe before the surgeon is consulted.

*The lateral deviation of the apices of the spinous processes is often very slight*, even when the curvature, as affecting the bodies of the vertebræ, is rather severe, and affords no safe indication of the extent of the mischief. But the *natural posterior projection of the spinous processes in the dorsal region is either diminished or lost*, so that a *flattening* exists instead of a convexity; and in some more severe cases, the spinous processes are depressed in the middle dorsal region, so that the natural curvature is to some extent reversed. This may be regarded as one of the worst features such a case can present.

*The scapulae will be found unequally distant from the spinous processes* in these cases, when of moderate severity, the angle of the right scapula being further removed than the left—i. e. assuming the convexity of the dorsal curve to present to the right side, which it does in a very large majority of cases, and in some instances the angle of the right scapula will also be somewhat raised above the level of that of the opposite bone, but this is not so marked as in the other forms of curvature.

*A posterior projection of the scapula, and a posterior projection of the angles of the ribs upon which, indeed, the projection of the scapula essentially depends, are constantly present, on the convexity of the curve, in these cases in a degree proportionate to the extent of the internal curvature, or deviation of the bodies of the vertebræ.*

*A depression or sinking-in of the angles of the ribs in the concavity of the curve also constantly exists to an extent corresponding to the posterior projection of the angles of the ribs on the side of the convexity; and, as a consequence of this depression of the ribs, the angle of the left scapula often appears more conspicuous than natural, though not really projecting further backwards. A posterior projection of the angles of the ribs in the dorsal region, on the convexity of the curve, and of the transverse processes of the lumbar vertebræ on the convexity of the lumbar curve, is in each region a more certain means of diagnosing the extent of the internal curvature or deviation of the apices of the spinous processes upon which it is customary for surgeons to rely.*

*The form of the chest may not be perceptibly altered in these cases, when slight, but generally the left breast is rather more prominent than the right, and its aspect towards the left side rather than directly forwards. Sometimes it happens that the increased prominence of the left breast is the first thing noticed either by the girl or her mother, and on this account the surgeon may be consulted, in*

the same way that the prominence of the right hip is sometimes the cause of the curvature of the spine in the lumbar region being brought under the notice of the surgeon.

*The external appearances in the lumbar region are not generally very conspicuous, in cases of moderate severity, but there is some prominence of the right hip, i. e. corresponding to the concavity of the curve, and a sinking-in of the right loin in which the transverse processes of the vertebræ are felt at a greater depth than natural. There is also a posterior prominence of the spinal muscles on the left side (that of the convexity of the curve) and a general fullness of the left side of the loin, and to some extent of the lower ribs on this side. The spinal muscles are rendered prominent on the convexity of the curve chiefly by the posterior projection of the transverse processes of the lumbar vertebræ resulting from the movement of horizontal rotation of the vertebræ, which always takes place in such curvatures; the muscles are thus pushed out by the deviation of the bones, and, as the muscles on the convexity of the curve are also thrown into action to resist increase of the curvature, their prominence is increased by their active tension.*

Now, although all these anatomical deviations may exist in the dorsal and lumbar regions in a marked degree, and clearly indicate the extent and nature of the deviation as affecting chiefly the bodies of the vertebræ, i. e. the internal curvature, yet the general effect as regards the external form and figure is frequently slight and easily concealed, even when the spinal curvature is rather severe; and in this condition (the curves being about equal to each other as above described), when the general health remains good, no further increase of the deformity may take place; spontaneous arrest may be said to occur, and the affection remain *in statu quo* through a long life; but of this there is no certainty: a liability to increase remains and may occur at any period of life, from failure of the general health, or from local causes, such as occupation, acquired habit of certain positions, &c.

When increase of the curvature occurs, then the curves no longer remain of equal size, and failing to counterbalance each other the equilibrium of the body is disturbed; the dorsal curvature generally increases to a much greater extent than the lumbar curve, and all the deviations above described become exaggerated—the scapula and the angles of the ribs on the right side project more posteriorly, and the right shoulder becomes disproportionately raised, and the left depressed to a corresponding extent. The lateral deviation of the spinous processes becomes more distinct, and often very considerable; but to this rule there are some remarkable exceptions. The form of the chest becomes altered, and in severe cases is much deformed; the ribs on the right side become flattened in their convexity, and bent upon themselves a little in front of their angles, varying very much as to their degree of separation and their horizontal or oblique direction; the ribs on the left side become depressed in a very oblique direction downwards, so that the left side of the chest falls in, and a considerable hollow is formed; in the left pectoral region the ribs project anteriorly, and the prominence of the left breast is increased to a corresponding extent. The external deformity, therefore, becomes very considerable in such cases. The

\* *Dictionnaire de Médecine et de Chirurgie Pratiques*, t. iv. à Paris, 1836. ART. VERTEBRALE.



increase of curvature in the lumbar region, although taking place to a less extent than in the dorsal, is accompanied by a corresponding increase of the anatomical deviations described in the slighter cases. The sinking in of the right loin increases, and the transverse processes of the lumbar vertebrae are at too great a depth to be felt; whilst on the left side, the prominence of the spinal muscles, and the general enlargement, increases; the transverse processes on the left side (that of the convexity) can often be distinctly felt, as they sometimes rise to the level of the apices of the spinous processes. The prominence of the right hip increases from the sinking in of the loin, and becomes conspicuous, but as the lumbar curve is very short, these deviations are not externally very conspicuous.

When the form and situation of the spinal curvature vary from those just described, the external characters are modified accordingly, but it will be unnecessary to enumerate in detail all such deviations.

#### MORBID ANATOMY OF LATERAL CURVATURE.

The normal curvatures of the spinal column in the antero-posterior direction have been already shown to depend upon the relative thicknesses of the intervertebral cartilages and the bones in the different regions of the spine; and there can be no doubt that the abnormal curvatures in the lateral or other directions, when not connected with disease, also depend upon alterations in the relative thickness of the intervertebral cartilages and the bodies of the vertebrae at parts corresponding to the curvatures; but in the abnormal conditions, these deviations are also associated with changes of direction in the articular facets of the oblique articulating processes. How these changes are brought about, it will be for us to inquire; but such structural changes must exist in every case of lateral curvature of the spine, however slight, and the existence of lateral curvature of the spine as a merely functional condition cannot be admitted.

We must therefore consider what are the precise deviations in direction assumed by the vertebrae, and the nature of the structural changes affecting the bodies of the vertebrae, the intervertebral cartilages, and the oblique articulating processes in the so-called lateral curvature.

#### GENERAL DIRECTION AND FORM ASSUMED BY THE SPINAL COLUMN IN THE SO-CALLED LATERAL CURVATURE.

In the so-called lateral curvature the spinal column does not yield in a purely lateral direction, as a flexible column would bend, but presents the appearance of a spiral twist, owing to the bodies of the vertebrae turning round in a direction of *horizontal rotation*, so that their anterior surfaces are directed laterally along the convexity of the curvature. In a severe case this rotation commonly extends to a quarter of a circle in the centre of the curve, and diminishes from this point to the two extremities, so that the vertebrae unequally turned upon themselves, cease to correspond in their natural relations to each other, as well described by Bouvier. In a case of extreme severity, this rotation will sometimes extend even to half a circle, so that in the centre of the curve the anterior surfaces of the bodies of the vertebrae have a directly lateral aspect; in such cases the angles of the ribs project

posteriorly, and are bent sharply upon themselves, extreme deformity of the chest of course resulting.

This deviation of the bodies of the vertebrae does not necessarily correspond to, nor is it indicated by, any lateral deviation of the apices of the spinous processes. It may exist to a considerable extent—the rotation extending to a quarter of a circle in the centre of the curve—without any, or, at least, with very slight, lateral deviation of the apices of the spinous processes.

A case in which this fact was demonstrated, together with a description of the appearances presented on the *post-mortem* examination, and the dissection of the specimen, accompanied by lithograph plates, was published jointly by Dr. Hodgkin and myself in the “Transactions of the Medico-Chirurgical Society,” vol. xxvii. 1854. After describing the parts removed, I observed:—“The fact of the greatest practical importance which this specimen illustrates and clearly proves, is one which I believe has not hitherto been described, viz., that a very severe degree of lateral curvature of the spine, with transverse rotation of the bodies of the vertebrae, accompanied with lateral absorption of the bones and intervertebral cartilages to a considerable extent, and attended with all the distressing symptoms of the most aggravated form of this affection, may exist, with only a very slight lateral deviation of the apices of the spinous processes; in short, that the severest degree of deformity of the spine may exist internally, without the usual indications in respect of the deviation of the spinous processes externally.”

If it be rare to find the extreme degree of internal curvature coexisting with an absence of external curvature, as in the case above described, it is undoubtedly true that internal curvature very frequently exists to a slight extent without any external curvature, or lateral deviation of the apices of the spinous processes, and the class of cases in which this condition will be found, is where a prominence or a growing out, as it is called, of one shoulder is said to exist without any spinal curvature. Such cases are frequently the cause of great anxiety to parents, but are dismissed by surgeons with the comforting assurance *that there is no curvature of the spine*, whereas, the prominence of the shoulder, i.e. the posterior projection of the scapula and the angles of the ribs, might most certainly be relied upon as indicating the existence of internal curvature, or lateral deviation of the bodies of the vertebrae. The prominence, or *growing out* of the shoulder, ought therefore to be regarded as indicating the existence of internal curvature of the spine, rather than an unimportant external appearance depending, as it is generally said, upon enlargement of the muscles caused by excessive use of the right arm.

A little consideration, and the examination of specimens preserved in museums, will satisfactorily prove that the spiral twist which the spine undergoes in lateral curvature, and which is due essentially to a *horizontal rotation* movement of the bodies of the vertebrae, must necessarily produce a *posterior projection of the angles of the ribs*, on the side of the convexity of the curve, in the dorsal region; and a *posterior projection of the transverse processes* on the side of the convexity of the curve, in the lumbar region, in a degree proportionate to the extent of deviation of the bodies of the vertebrae; whilst in the concavity of the curve, the

angles of the ribs in the dorsal, and the transverse processes in the lumbar region, are depressed or sunk inwards to a corresponding extent. And as already shown the lateral deviation of the apices of the spinous processes bears no definite or constant relation to the lateral deviation of the bodies of the vertebræ—that an extreme degree of internal curvature may exist without any lateral deviation of the spinous processes, and that, as an invariable rule, the internal curvature exists to a much greater extent than the external curvature—it follows that the posterior projection of the angles of the ribs in the dorsal region, and of the transverse processes in the lumbar region, may be more certainly relied upon than any condition of the spinous processes, as indicating the existence of internal curvature, or lateral deviation of the bodies of the vertebræ. This condition of horizontal rotation of the bodies of the vertebræ in lateral curvature was first described by Dr. Dods, of Bath, in the year 1824, and subsequently by Mr. J. Shaw, Bouvier, Sir Charles Bell, Guérin, and other authorities.

But the existence of internal without any external curvature, or lateral deviation of the apices of the spinous processes, either in severe cases such as that already described, or as a constant pathological condition in slight cases, and the means of detecting this deviation have not, as far as I am aware, been previously described.

All the authorities on spinal curvature who have described rotation of the vertebræ regard this condition as a late change, a complication, or a super-added condition of lateral curvature, which they consider essentially to be a lateral deviation of the spinal column, caused by muscular weakness before rotation takes place; but a careful study of this affection has led me to consider that horizontal rotation of the bodies of the vertebræ occurs in all cases of lateral curvature, as a constant and essential condition of this affection, however slight the deviation may be, and that it occurs in a large number of cases before any lateral deviation of the apices of the spinous processes—the indication generally relied upon as diagnostic of lateral curvature—takes place. I need hardly say, however, it does not exist in those cases of muscular debility or *weak spines*, which are too often assumed by some practitioners to be cases of lateral curvature, and treated as such, with wonderfully good results, under any and every mode of treatment.

*Diminution in Height of the Spinal Column.*—When lateral deviation of the spinous processes takes place—coexisting as it necessarily does, though not to a proportionable extent, with horizontal rotation of the bodies of the vertebræ—we have in addition to the posterior projection of the angles of the ribs in the dorsal region, and of the transverse processes in the lumbar region, a positive loss in height of the spinal column, proportionate to the extent of the lateral deviation; so that the general alteration which takes place in the conformation of the chest in severe cases of lateral curvature, depends upon the combined influence of horizontal rotation of the bodies of the vertebræ, and lateral flexion of the spinal column.

In addition to the spiral twist, and the diminution in height from lateral deviation, there is another peculiarity in the form assumed by the spinal column in the so-called lateral curvature, simultaneously with the other deviations, viz. :

*The Obliteration of the Natural Curves in the Antero-Posterior Direction.*—In cases of double curvature of a moderate degree of severity, when unaccompanied by a stoop or falling forwards of the head from a curvature in the upper dorsal region, we may generally observe a flattening, and in some instances a positive depression, instead of the natural convexity of the middle dorsal region. This has been previously alluded to when describing the external appearances in cases of double curvature, as one of the most unfavourable indications: there can be no doubt that it depends upon rotation of the bodies of the vertebræ; also indicated in these cases by the altered relations of the angles of the ribs, and therefore it is a certain and reliable evidence of the existence of internal curvature of the spine, necessarily accompanied by certain structural changes, even though there may be no lateral deviation, or, as more frequently occurs, a comparatively slight deviation of the apices of the spinous processes. In the more severe cases of curvature with conspicuous external deformity, a careful examination will show that the prominence on the side of the convexity essentially depends upon the posterior projection of the angles of the ribs, and even in these cases there is frequently no posterior projection of the spinous processes. In some cases, however, especially in what are called *large single curves*, accompanied by a stoop, the spinous processes project posteriorly in the general yielding of the spinal column.

In the so-called lateral curvature in the lumbar region, the normal curve in the antero-posterior direction is also frequently obliterated, this portion of the spine appearing in profile view to be remarkably straight.

In articulated skeletons exhibiting spinal curvature, and in dried specimens preserved in museums, this obliteration of the natural curves of the spine in the antero-posterior direction may be traced not only in spinous processes, but in the outline formed by the bodies of the vertebræ when viewed in profile. Sometimes the natural curvatures are even reversed, and this was remarkably conspicuous in the specimen above adverted to. In my description of this specimen in the *Medical Chirurgical Transactions*, I observed, "Viewed in profile, or from its lateral aspect, the natural curve of the spine in the lumbar region is seen to be reversed; and, instead of presenting a convexity forwards, the three upper lumbar vertebræ, together with the twelfth dorsal, present anteriorly a concave outline. This is not produced by any absorption or destruction of the bodies of the vertebræ anteriorly, but is evidently caused by the very remarkable degree of rotation above described, by which the natural anterior convexity in this region is made to assume a lateral position, as if the spinal column had been laterally twisted on its vertical axis, the centre of motion being fixed at the apices of the spinous processes.

The general effect of this obliteration of the normal curves in the antero-posterior direction is to produce externally the appearance of a straightening of the spine as far as the profile view of the apices of the spinous processes is concerned, and in examining cases of spinal curvature this condition may frequently be noticed.

Having now described the general direction and form assumed by the vertebral column in the



so-called lateral curvature of the spine, let us proceed to examine

THE NATURE OF THE STRUCTURAL CHANGES AFFECTING THE BONES AND THE INTERVERTEBRAL CARTILAGES.

The earliest structural changes which occur in lateral curvature of the spine are traceable, and I believe take place simultaneously, in the intervertebral cartilages, and at the articulations formed by the oblique articulating processes. These changes are essentially the result of atrophy and absorption produced by the long-continued irregular distribution of the superincumbent weight of the head, upper extremities, and thorax.

The *intervertebral cartilages* suffer from unequal compression, and become more or less wedge-shaped, according to the severity and duration of the curve, the thinning of the cartilage corresponding to the concavity of the curve. It is necessary here to remember the fact that in the vertebral column we have nearly four inches in height of this soft elastic tissue which, during the day, when equally compressed, diminishes in height or thickness from half to three-quarters of an inch, so that during the day we lose from half to three-quarters of an inch in height; but this is regained during the night, when the weight is completely removed by the recumbent position. If, however, during the day the intervertebral cartilages should be unequally compressed in consequence of any long-continued disturbance of the equilibrium of the spinal column from any cause, the cartilages do not completely recover their natural form during repose, but remain permanently reduced in thickness by the compression in the concavity of the curve. The nature of any structural changes which the intervertebral cartilages may pass through as they become thinned by irregular compression, has not, so far as I am aware, been determined; but from several specimens in the more advanced stages, which I have examined microscopically, I have no doubt that these changes are essentially of an atrophic and degenerative character.

The *bodies of the vertebræ* also become more or less wedge-shaped, but at a much later period than the intervertebral cartilages. It is, however, a common error to suppose that the bodies of the vertebræ become altered in form only in severe cases of curvature of long duration. In very slight cases of lateral curvature, when the deformity has existed a sufficient length of time, probably one or two years, the bodies of the vertebræ become perceptibly altered in form. Length of time, then, rather than degree of curvature, is essential to the production of these changes.

The bodies of the vertebræ do not present on section any unhealthy appearance, at least in the late stages at which I have examined them, and there are no reasons for suspecting any changes in the texture of the bones at an early period. In cases of long duration the bones increase in solidity in the concavity of the curve; the cancellous texture of the bodies of the vertebræ on the compressed side becomes more dense or compact in appearance, and the thin layer of compact bone which naturally forms the shell or outer surface of the bodies of the vertebræ, becomes increased in thickness and density, so that it may be said to be

replaced by a thick wall of compact bone of ivory-like appearance. These changes are essentially of a reparative character, and calculated to arrest the progress of the curvature.

The *oblique articulating processes*, and more especially the articular facets on these processes, which form the only *direct articular connections* between the separate bones of the vertebral column—the bodies of the vertebræ being separated from each other by a thick layer of elastic intervertebral cartilage—undergo very important structural changes at an early period of the formation of lateral curvature, probably even at its commencement. In the specimens of lateral curvature before alluded to, as well as in all the specimens in museums, the articular facets situated on the oblique articulating processes, are altered in their direction and aspects, according to the extent of the lateral deviations of the bodies of the vertebræ. In the lumbar region, where these articular facets are naturally nearly vertical in direction, looking inwards and outwards respectively, they gradually assume, in a severe case of lateral curvature, a very oblique direction, so that in aspect they are directed obliquely upwards and inwards and downwards and outwards. This exists in all cases, and a little reflection on the anatomical construction of these articulations will lead to the conviction that it is impossible for any persistent deviation in the form of the spine to take place without an adapted alteration in direction of these articular facets.

These very important deviations in the oblique articulating processes appear to have escaped the attention of nearly all writers on spinal curvature, and even in the works of the late Mr. John Shaw, published in 1823 and 1825, which decidedly contain the most accurate pathological description and general account of lateral curvature in the English language, no mention is made of these deviations; but Mr. Alexander Shaw, who was long engaged in the same field of inquiry with his late brother, and also with his relative Sir C. Bell, has accurately described the changes above alluded to, and adduced them in explanation of the rotation of the bodies of the vertebræ, which had been previously observed by Mr. J. Shaw, and was also, at a later period, described by Sir C. Bell. Mr. A. Shaw's description is so clear and exact, and has been so completely confirmed by my own observations, that I make no apology for extracting the following quotation:—

"If we attend to the natural structure of the spine, it will be seen that whilst we lean the body to one side, the pressure is thrown, almost exclusively, upon the articulating processes of that side; these processes, delicate as they are, being the only bony structures which check the lateral movements of the trunk. Hence, when a habit is acquired of inclining to one side, or of resting upon one hip, as in sitting, the sharp edges of these small points of bone receive the weight of the entire body. But as the articulating processes are remarkably soft, and are imperfectly formed at the age of puberty, it follows that they will become wasted by absorption when this position is long persisted in, and an inequality of the length of these two lateral props, on which the vertebræ rest posteriorly, will be the consequence, those of the concave side being shorter than those of the convex.

"5th. In lateral curvature of the spine we have a distinct demonstration that the articulating processes give way more extensively than any of the other parts of the column. This is evinced by the rotation which the spine makes in its perpendicular axis, at the same time that it inclines laterally. The joints of the articulating processes being situated posteriorly, as well as laterally, the spinal column cannot yield in their direction without wheeling partially round; and it is owing to this rotation that the transverse processes, and the ribs, are directed obliquely forward upon the concave side, and obliquely backwards upon the convex side of the curvature, thus giving rise to a fulness or swelling on the one hand, and a depression or sinking inwards on the other." \*

This is the earliest description I have been able to find of the appearances, to which I desire especially to direct attention, and it is somewhat remarkable that it has not attracted the notice of any subsequent writer on the subject of lateral curvature. Even Sir Charles Bell, who wrote ten years afterwards, and carefully described the rotation of the vertebræ as a most important element in the distortion, passed by unnoticed the facts described by his relative, Mr. A. Shaw. To me it appears that the account given by Mr. Shaw of the mode in which these structural changes are induced, affords, at the same time, a satisfactory explanation of the way in which the rotation of the bodies of the vertebræ is produced, and is certainly quite in accordance with my own observations.

The transverse processes are altered both in direction and form. In their general direction and relations to the soft parts they are altered as a result of the horizontal rotation of the bodies of the vertebræ, so that when the curvature is in the lumbar region, the transverse processes in the concavity of the curve are depressed towards the abdominal cavity, and in a severe case cannot be felt by external examination; whilst those on the convexity of the curve project backwards towards the skin, rise to the level of the apices of the spinous processes, and can readily be felt along the outer margin of the spinal muscles, which they also protrude backwards and render prominent. This deviation in direction of the transverse processes is extremely important in a diagnostic point of view, and enables us to diagnose a curvature in the lumbar region in cases in which no lateral deviation of the apices of the spinous processes exists. The transverse processes, it should also be mentioned, become widely separated from each other on the convexity, and approximated to each other on the concavity, of the curve.

The transverse processes also become very materially altered in form in severe cases of long standing. They may become attenuated, and project backwards in a curved or horn-like form, with a varying inclination upwards or downwards—a change apparently produced by the long continuance of irregular muscular action; or they may become flattened from above downwards by the mechanical pressure of the superincumbent weight, when from the severity of the curve, one or two of these processes belonging to the lowest vertebræ rest upon the crest of the ilium.

\* *Medico-Chirurgical Transactions*, vol. xvii. London, 1832. See a Paper on "*A Peculiarity in the Conformation of the Skeleton in Rickets*," by Alexander Shaw, p. 467.

#### CLASSIFICATION OF CASES OF LATERAL CURVATURE OF THE SPINE.

The arrangement and classification of these cases, with special reference to the treatment to be adopted, ought to be based, not so much upon any differences in the form, situation, degree of curvature, and its anatomical conditions, as upon the relative degrees in which the spinal affection can be traced to depend upon constitutional and local causes, with some reference also to the different periods of life at which the curvature may occur.

It is undoubtedly true that the immediate cause of lateral curvature is, as a general rule, purely mechanical, but the associated constitutional conditions are so variable and so important—acting as the most powerful predisposing causes—and so materially modify the indications for treatment, that these conditions appear to afford the best and most scientific basis for a general classification of these cases which, therefore, I propose to arrange in the three following classes, viz:—

1st Class.—*Cases essentially of constitutional origin, or in which the constitutional largely predominate over the local causes.*—In this class of cases the spinal curvature generally occurs under twelve years of age, is often hereditary, occurring in two or three generations, and several members of the same family are frequently affected. They are generally associated with the strumous constitution in a marked degree, and may be arranged in two series or subdivisions according to the period of life at which they occur, viz: *a.* Those cases occurring in infancy or early childhood, i.e. under three or four years of age; and, *b.* Those which occur in childhood from seven to ten or twelve years of age.

In the first series there is often no history of hereditary predisposition, and though a strumous diathesis may be feared, such is not clearly indicated; the only apparent cause being general muscular debility, which may have existed from birth, or have been induced by illness. The children are unable to support themselves in the sitting position, even when a year and a half or two years old, and a lateral curvature of the spine is very readily produced if the nurse should always carry the child on one arm.

In the second series there is usually a history of hereditary predisposition, and the children in their general aspect are decidedly strumous. The deformity often increases rapidly, and becomes very severe. These cases are sometimes, but erroneously, considered to depend upon rickets; the spine alone is affected, and there are no indications of rickets in the leg bones or in the other bones of the skeleton; no enlargement of epiphyses; no pelvic deformity, or rachitic conformation of the skull.

There can be no doubt that constitutional causes largely predominate in the production of spinal curvature when this occurs in children under twelve years of age; and these cases, from their natural tendency to terminate in severe and conspicuous deformity, are of a very unpromising character.

2nd Class.—*Cases depending upon constitutional and local causes in about equal degrees.*—In this class of cases, the spinal curvature generally occurs between the ages of twelve and sixteen years. Hereditary tendency is not often traceable, but



exists in some instances. The cases included in this class may be arranged in two subdivisions: *a. Cases depending upon induced constitutional or general debility, combined with local causes acting mechanically, such as described in Class 3; and b. Those clearly of a rachitic character.* *a. Lateral curvature of the spine, in the first series of cases, generally occurs between the ages of twelve and sixteen years, in quickly-growing girls, not of robust appearance, but without any well-marked strumous diathesis or hereditary predisposition; though occasionally one or both of these conditions will be found to exist. This is the class of cases generally described by authors on lateral curvature as depending upon muscular and ligamentous debility. They constitute the popular form of lateral curvature of the spine, not only from the frequency with which they occur, but from the alarm and often groundless apprehension of deformity which a little spinal weakness at this period of life occasions. In books it unfortunately happens that the descriptions of lateral curvature are nearly always taken from these cases, as if they were the universal type of this affection; and consequently we find one plan of treatment only recommended for all cases, a most serious practical error. In this series, also, are generally included that large class of cases which might be more properly described as *weak spines*, and which certainly have no claims to be considered as examples of lateral curvature of the spine. There can be no doubt that weak spines frequently pass into or become cases of confirmed lateral curvature, but, according to my observation and experience, such is rather the exception than the rule, and that certainly more than half the total number of cases of lateral curvature met with in practice are neither preceded nor accompanied by any such condition of general muscular debility.* *b. The second series includes cases of lateral curvature clearly of a rachitic character, i.e. associated with the general rachitic conformation of skeleton, and the curvatures of the long bones of both the upper and lower extremities invariably occurring in this affection; more especially the dwarfishness of stature and general arrest of development of the bones, most conspicuous in the legs and pelvis; the curvatures of the leg bones, and to a less extent of the bones of the upper extremities, with the enlarged epiphyses; the deformity of the pelvis; and the general conformation of the skull, &c.*

This rachitic condition is seldom hereditary, and is generally dependent upon imperfect lactation. The worst cases which have come under my observation have occurred either in the children of healthy parents, or of somewhat delicate but not rachitic parents; and generally only one child is thus affected in a family, the other children being perfectly healthy; occasionally I have seen two or three cases in the same family, and in a few instances all the children in the same family are more or less affected. In every instance, however, imperfect lactation has been clearly traceable, the mother's milk being insufficient in quantity, and poor in quality, the children have generally been half suckled and half fed, the food being of a farinaceous kind, such as *tops and bottoms*, various kinds of biscuits, &c., all of which are unsuited to the requirements of the child during its period of early growth and rapid osseous development. I believe rickets, therefore, to be an in-

duced and not an hereditary constitutional condition. Lateral curvature of the spine in these cases very rarely occurs at an early period, so far as my experience has gone. I have never seen rickety curvature of the spine in the child, and in several cases of rickets in its worst forms in children from four to ten or twelve years of age, the spines are still free from lateral deviation, though the older cases exhibit rather severe lordosis, yet in nearly all the rickety adult specimens in museums, severe lateral curvature forms a conspicuous part of the general deformity. I conclude, therefore, that in cases of rickets, the lateral deviation of the spine usually takes place towards the completion of growth, say from fifteen to eighteen years of age, and continues gradually to increase long after that period, perhaps even through life, when the equilibrium of the spine has been for a long time disturbed by the deformity of the legs, which are generally of unequal lengths, by the increasing deformity of the feet—rachitic valgus—and by the deformity of the pelvis.

It must be especially borne in mind that it is only in the class of true rachitic curvatures that any distortion of the pelvis takes place, and, therefore, it is only in these cases that any risk to life exists from pregnancy. The importance of clearly defining these cases, and the evidence upon which our opinion should be based in deciding upon the true rachitic character of any case of lateral curvature of the spine, has been already adverted to in connection with the question of special liability to lateral curvature, in consequence of the affection of the bones in rachitic cases; and also in connection with the question of pelvic deformity, and its influence on child-bearing.

*3rd Class.—Cases essentially depending upon local causes acting mechanically so as to disturb the equilibrium of the spinal column.*—Lateral curvature in these cases may occur at any period of life, though most apt to form in a severe degree previous to the completion of growth. The cases which it is proposed to include in this class are essentially unconnected with any constitutional affection, or hereditary predisposition, and frequently coexist with the full natural amount of muscular strength.

The local causes which most frequently produce lateral curvature of the spine in this class are the *long continuance of certain bad positions* which may be either acquired as bad habits, or rendered necessary by a defective educational system, or certain occupations. As examples of the former should be mentioned *standing on one leg*, which is frequently acquired as a mere habit by growing girls. This may produce curvature of the spine even in girls possessing the full natural amount of muscular strength, though it would do so more readily in those who exhibit some muscular debility, such as the cases included in the second class. *The long continuance of the sitting and stooping position during education; spinal curvature is frequently seen in young ladies who do not exhibit any want of muscular strength, but have been in the habit of sitting as much as eight hours a day to masters at school, and also in girls who devote most of the day to drawing and writing. The habit of sitting cross-legged* which some young ladies adopt for several hours a day whilst reading, with a book placed on the knee, one elbow

resting on the thigh, and the head inclined forwards and resting upon the hand; such a position must necessarily tilt the pelvis, and curve the spine in the lumbar and lower dorsal regions, and if long continued in a growing girl, will infallibly produce curvature of the spine. Also *excessive horse exercise*, which in delicate girls sometimes leads to spinal curvature in the lumbar region. Another series of causes may be traced to *certain occupations which render the long continuance of some particular position necessary*. From this cause we frequently see spinal curvature produced both in boys and girls, and though in many instances associated with muscular debility, which would place these cases in the second class, spinal curvature thus produced is frequently seen coexisting with the full amount of muscular strength. The occupations which most frequently produce spinal curvature in females are *needlework, envelope and book folding, flower making, ironing, nursing children, carrying heavy weights, &c.* From ironing, and also from nursing children, spinal curvature is often produced in girls of an unusually muscular and robust appearance, and in such instances many would contend that the excessive use of the right arm was the essential cause, but I believe the position alone, with its necessary result of irregular distribution of weight, to be a much more powerful and direct cause of the spinal curvature. As examples of spinal curvature produced by certain occupations in boys exhibiting great muscular strength, I would refer to the case of a boy who had long been in the habit of carrying heavy goods up a low ceiled spiral staircase at a pawnbroker's shop. This was a stout, muscular, and vigorous boy, but a severe lateral curvature was produced by his occupation. Also a healthy, muscular boy, who had been two or three years at a gold lace factory, and was accustomed to wind the lace, which obliged him to stoop sideways. In addition to the habits and occupations above referred to, may be mentioned—

*Inequality in the length of the legs, from any cause*.—By many writers on spinal curvature, especially those of the mechanical school, who undertake to prove mathematically that certain results must necessarily follow from any given mechanical deviations, inequality in the length of the legs has been greatly exaggerated as a cause of spinal curvature; but, in contradiction of those mathematical sequences, cases may be seen in which inequality in the length of the legs has existed for many years, without producing spinal curvature. The fact is, it does not always do so when associated with the full amount of muscular strength. Many patients who have recovered from *hip joint disease*, with some contraction of the limb, or who walk lame from contracted knee joint after disease, appear to have curvature of the spine when walking or standing; but when examined lying down or whilst standing with a book under the short leg, sufficient to bring the hip joints to a level, it will be seen that little or no permanent spinal curvature has been produced. The muscular power and active motion appear to prevent spinal curvature in many of these cases.

In cases of inequality in the length of the legs from *muscular paralysis and imperfect development of one limb*, lateral curvature of the spine in the lumbar region is always produced, but even in these cases it is not often of a severe form.

Inequality in the length of the legs from *congenital dislocation of one hip joint*, also certainly produces lateral curvature, but many years are required to bring about this result, and even then it is much less than the mathematical authorities would lead us to expect it must necessarily be.

The same may be said of the cases of *congenital shortening of one leg*. About six or seven years ago, a child was brought to me with congenital shortening of one leg, depending upon deficiency in the length of the tibia and fibula, to the extent of about an inch and a half; the foot was in the position of the valgus and the outer malleolus indistinct. I suspected the tibia and fibula were fused at their lower extremities, and that the outer malleolus was either deficient or very imperfectly formed. The leg below knee, in this girl, is now four inches shorter than the opposite leg; but she is strong and muscular, and very little curvature of the spine has been produced; she wears a high boot, with steel supports to the calf of the leg, and straps to keep the foot in a straight position. Dr. Little completely rejects inequality in the length of the lower extremities, as one of the causes certain to produce spinal curvature, and observes:—"I have examined no case in which, notwithstanding the shortening, other causes of lateral curvature did not exist. On the contrary, it is very remarkable, according to my experience, that difference in the length of the lower extremities is so rarely accompanied with deformity of the spine."\*

*The effect of a wooden leg* in producing spinal curvature has also been greatly exaggerated. Although by some authorities it has been attempted to prove mathematically that spinal curvature must result from this cause, I have examined several young men who have worn a wooden leg for five or six years without any spinal curvature being produced; nevertheless, a slight spinal curvature is sometimes seen in these cases.

Among the causes which act mechanically so as to disturb the equilibrium of the spinal column, though not themselves of mechanical origin, I would enumerate *diseases of the chest*, such as empyema, which, after the evacuation of the pus and the permanent sinking and collapsing of the lung, produces a most severe form of lateral curvature, not, I believe, by the tonic contraction and structural shortening of the muscles on the affected side, as has been explained by Dr. Little,† but in consequence of the position assumed by the patient, in part from the pain suffered, and in part to favour the increased respiratory action carried on by the healthy lung on the opposite side. Although a very marked loss of balance of muscular power exists in these cases, I believe position, which is only in part dependent upon this disturbed muscular balance, to be the more powerful and immediate cause of the spinal curvature.

Other diseases of the thoracic and abdominal organs, such as tumors, &c., might be enumerated in the same category, which would also include the cases of lateral deviation, not often severe, which result as consecutive curvatures in cases of caries of the spine after angular projection has taken place, and may occur either above or below the angular curvature.

The local causes which most frequently produce

\* "Little on Deformities," p. 363.

† *Op. cit.* p. 352.



lateral curvature of the spine essentially unconnected with any constitutional disorder or hereditary predisposition to this affection, have now been enumerated. The importance to be attached to the disturbed balance of muscular power—undoubtedly existing in many of these cases—as an active cause in the production of the deformity, will be differently valued by those who study these affections, according to the leaning they may have towards the different theories of the production of lateral curvature in its more ordinary forms; but according to the physiological views, already explained, I am induced to attach a higher degree of importance to the mechanical effect of the long continuance of certain positions, in the production of which, the muscles are often entirely passive.

In many positions assumed by healthy muscular people when certain muscles are called powerfully into action, the muscular force seems to be exerted rather to prevent or limit any curvature of the spine, than to produce or increase it, the muscles in the concavity of curves, as a rule, remaining soft and inactive, whilst those on the convexity of the curves are tense and prominent; and when curvature of the spine exists as a morbid condition, the muscles will, as a general rule, be found in the same state.

#### TREATMENT.

**1st Class.**—*Cases essentially of constitutional origin, or in which the constitutional largely predominate over the local causes, the spinal curvature generally occurring under twelve years of age.*

The treatment of these cases must be both constitutional and local. When occurring in infancy or early childhood, an abundance of good milk must be ensured, and cod-liver-oil may be rubbed externally over the entire body and limbs every night and morning. Three grains of the hypophosphite of lime may be given twice a day in milk, and a teaspoonful of wine once or twice a day in arrowroot. Fluid or solid animal food according to circumstances.

The local treatment should consist in the application of a strong leather support to the spine, moulded to the form of the back, and fastened in front by an elastic india-rubber belt. The child must never be nursed in the sitting position, but always be carried and nursed upon a pillow, or what is called a *nursing cradle* may be used. In a cheap form this kind of support may be imitated by gutta-percha moulded to the back and retained in position by an ordinary bandage. In slight cases this support need not be worn at night.

In children from seven to twelve years of age a light steel support should be worn, with crutches, and one or two lateral plates according to circumstances. The long continuance of the sitting and standing positions must be avoided as much as possible, and the reclining position enforced as far as it may be compatible with the general health. Ward's reclining chair should be habitually used, which, having a desk attached, will be found useful during the hours devoted to educational purposes.

Muscular exercises or gymnastics should also be combined with partial recumbency and mechanical support in these cases. In proportion as the curvature predominates in the lumbar region, the recumbent position should be enforced, and the gymnastic exercises conducted whilst the patient is in

the horizontal position, by means of an *exercising plane*, to which various contrivances may be adapted for exercising the upper and lower extremities, and also the spinal muscles.

These cases require a watchful care, and treatment according to the principles indicated for a lengthened period, it may be for three or four years, and in some cases even for ten years or more.

**2nd Class.**—*Cases depending upon constitutional and local causes in about equal proportions, generally occurring between the ages of twelve and sixteen years.*

The treatment in this class of cases must be both local and constitutional in most instances. The general health may be improved by the exhibition of cod-liver-oil, iron and lime, together with a nutritious diet amounting to *high living*, with wine or beer, and also change of air, either to the sea-side or country.

The local treatment should consist of partial recumbency, gymnastic exercises, and mechanical support, combined in various proportions, according to the severity and situation of the curvature, and the general condition of the patient as to muscular debility or otherwise. The *recumbent position* in proportion as the curvature predominates in the lumbar region, and in these cases gymnastic exercises should be conducted as much as possible in the horizontal position by means of the exercising plane. *Gymnastic exercises* in proportion to the evidence of general muscular debility; but I consider gymnastics to be essentially preventive rather than curative, and therefore recommend them more especially in cases of *weak spines*, or weak spines passing into confirmed curvature. *Mechanical support* in all cases in which the spinal curvature is confirmed, and more especially where it predominates through the middle and lower parts of the dorsal region.

The spinal instruments I recommend are of two forms, that for slight cases in young and delicate girls is a modification of the apparatus known as the Eagland spinal support, but strengthened and otherwise improved by the addition of a cog-wheel with lateral action by which the lever is moved, and the arm-pieces raised in front; the steel belt should also be made to close and fasten in front. The other form of instrument is of much stronger construction, having a flat circular pelvic belt, and one or two lateral plates attached to separate levers, the dorsal plate being made to move in several directions for the purpose of accurate adaptation, and especially having a horizontal circular cog-wheel, by means of which it may be moved in the direction of horizontal rotation. This latter instrument requires careful and frequent adjustment.

The cases included in the second class are generally the most curable, and if submitted to treatment before any obvious external deformity occurs, are generally cured within one or two years, whilst in the more advanced stages the curvature could certainly be arrested.

**3rd Class.**—*Cases essentially depending upon local causes, acting mechanically so as to disturb the equilibrium of the spinal column—occurring at any period of life.*

The treatment in these cases must be essentially

local. Acquired bad habits must be discontinued; occupations such as tend to produce spinal curvature must be given up; and any inequality in the length of the legs arising from congenital defects, contractions of the knee or hip-joint following disease, or any other cause, must be compensated for. In most cases a spinal instrument should be used during growth, either with the view of curing the curvature when it arises from removable causes, or of preventing its increase, when the mechanical cause producing it is incapable of removal.

Wm. Adams, F.R.C.S.

**SPLINTS.** Long thin pieces of wood, or tin, or strong pasteboard, employed for preventing the ends of broken bones from moving so as to interrupt the process by which fractures unite. They are sometimes used in other cases, for the purpose of keeping the joints motionless, particularly in certain dislocations, wounds, &c.

In simple fractures of the arm, forearm, or even of the thigh or leg, in young infants, it matters not whether the splints be made of wood, pasteboard, or tin. In this country, many surgeons keep sets of splints made expressly for the leg, which are of different sizes, excavated and shaped to the part, and furnished below with apertures or excavations for the projecting malleoli. When the limb is laid upon its outside, the foot is also usually supported and kept steady by the under splint extending towards the toes. Excellent splints for the legs of young children may be made of strong pasteboard accommodated in shape to the contour of the limb. Splints for the thigh, arm, and forearm, whether made of tin or wood, should always be slightly concave on the side which is to be applied to the broken limb. They should likewise be made as thin, and light, as is consistent with the degree of strength necessary for preventing the broken bone from bending. The sets of splints, which are used for fractured legs and thighs by such practitioners as still follow Pott's plan of treatment, are frequently furnished with straps, which have a great many small perforations in them at stated distances, and can thus be easily fastened by means of little pegs for the purpose. With the same view, a roller and tapes are also sometimes employed. Pasteboard, as a material for splints, has one advantage, viz., when wet, it becomes soft, and admits of being accurately applied to every point of the surface of the limb; consequently, as soon as it dries and recovers its firmness again, it retains the exact shape of the part, and makes everywhere equal pressure on it, without incommoding the patient. Pasteboard, however, is hardly strong and durable enough for many fractures; nor will it answer when there is a discharge, nor when the surgeon wishes to employ fluid applications. But it is generally allowed, that no substance is better calculated for fractures in children, and the broken lower jaw in adults. It admits also of being cut and adapted to cases, for which we have not the exact apparatus at hand. Thus it is convenient for fractures of the lower part of the humerus, requiring angular splints, for which it may be converted into an excellent substitute. If wet before being applied, it forms, when dry, a solid covering, most accurately corresponding to the shape of the parts. [For soft splints, which mould themselves to the form of the limb, no material answers better than folds of linen or cotton texture, cut of a length and width suitable to each case, and then soaked

in the starch or gum-and-chalk solution. These, applied in their semi-moist state by an ordinary bandage to the limb, will in twenty-four hours, when dry, form a very complete support for a fractured limb, or for a diseased joint. Gutta-percha also, in consequence of its peculiar property of being rendered temporarily soft and pliable when placed in hot water, or otherwise subjected to heat, will be found very useful in some cases, especially in fractures implicating joints. The rapidity with which it hardens renders the gutta-percha more fit than the soft starch splint in many instances.]

Whatever may be the substance of which splints are made, they ought always to be at least as long as the fractured bone; and if the situation of the limb will allow, they ought, says Boyer, to extend its whole length. "For instance (says he), for simple fractures of the thighs of very young children, the pasteboard splints, which I employ, reach from the upper part of the thigh, to the lower part of the leg. Generally speaking, the longer splints are, the better they fix the limb, and keep the fracture steady." (*Mal. Chir.* t. iii. p. 50.)

The number of splints must depend upon their breadth and the thickness of the limb. For the forearm, two are sufficient; for the upper arm and thigh, four are often used; and for the leg, two, and sometimes three.

In cases of fractured thighs, when the straight position is preferred, the external splint should extend from three or four inches above the crista of the ilium to some little distance beyond the sole of the foot; while the inner one, if it be employed, should reach from the upper and internal part of the thigh also beyond the sole of the foot. With respect to an anterior splint, this is now less frequently used than formerly, and it need only reach from the groin to the knee.

The lateral splints for a broken leg ought to be sufficiently long to embrace the knee and confine the motions of the foot and ankle. When the straight posture is adopted, a splint is sometimes laid along the front of the leg, from the patella to the lower part of the tibia; but if the other splints be of good construction, this plan is seldom of any real use.

[Amongst the numerous improvements and inventions appertaining to solid splints, two ingenious contrivances may be mentioned, by which solid splints may be made to follow the outline of a limb. The first was invented by the late Mr. Neville of Esher. It consisted of splints made of narrow bars of flexible metal, but of sufficient resistance, when once bent to suit the outline of the limb, to retain their form. The other is the invention of Mr. Winchester, the principle of which is, that a metal splint of any desired length fitting the form of the limb may be made by fixing together short separate pieces of metal by means of slides and screws. Either of these splints answer the purpose in view, but have not come into general use.]

In University College Hospital, fractures of the leg are generally placed on M'Intyre's apparatus, or the modification of it, suggested by Mr. Liston; while fractures of the thigh are mostly kept in the extended posture, with a single very long splint reaching from the lower part of the chest to some way beyond the outer edge of the foot, and applied according to the principles explained in the



article FRACTURE. The use of these kinds of apparatus has here superseded common splints, and the eighteen-tailed bandage in the treatment of such accidents.

As splints are generally composed of hard materials, the bad effects of their pressure upon the skin must always be counteracted by placing a sufficient quantity of tow, wool, oaten chaff, bran, flannel, or other soft substance, between them and the limb.

In order to understand, however, the principles which guide the surgeon in the choice and application of splints, many remarks, offered in the article FRACTURE, may be consulted.

**SPONGIA PRÆPARATA.** (*Prepared Sponge: Sponge-tent.*) Formed by dipping pieces of sponge in hot melted emplastrum ceræ compositum, and pressing them between two iron plates. As soon as cold, the substance thus formed may be cut into pieces of any shape. It was formerly much used for dilating small openings, for which it was well adapted, as, when the wax melted, the elasticity of the sponge made it expand and distend the opening. However, the best modern surgeons seldom employ it.

**STAFF.** An instrument of considerable importance in lithotomy, being in fact the director for the gorget or knife. It is made of steel, and its handle is generally rough, in order that it may be more securely held. As it is intended to be introduced through the urethra, its shape ought to be principally determined by the natural course of that passage. English surgeons generally employ a staff, the curvature of which forms the segment of a larger circle than that formed by the curvature of a staff used by French practitioners. (See *Roux, Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie Angloise, &c.* p. 319.) In other words, the French staff turns more upwards than ours, as it approaches and enters the bladder. There may be some advantage in this construction, inasmuch as it tends to make the gorget enter in the direction of the long axis of the bladder; yet, a great deal more seems to me to depend upon the position in which the staff is held than upon its shape. Lithotomists should always employ as large a staff as can be easily introduced, because the operation will thereby be facilitated. The groove, the most important part of the staff, is of course situated upon the convexity of the curved part of the instrument, or upon that portion, which, when introduced, lies in the membranous part of the urethra, prostate gland, and the bladder. It should always be made very broad and deep, as recommended by Langenbeck, Martineau, and others. (See LITHOTOMY.) The termination of the groove, at the end of the instrument, should be closed, so as to stop the further entrance of the gorget, and prevent the beak of the latter instrument from doing mischief. Some former surgeons, who neglected this precaution, have been censured by Desault and Sabatier, for certainly the most fatal injury may be caused by the gorget slipping beyond the end of the staff. (See LITHOTOMY, in which article the various kinds of staff have been fully described.)

**STAPHYLOMA** signifies an anomaly of curvature of the tunics, or an abnormal bulging of some portion of the eyeball perceptible to the naked eye. Most portions of the tunics of the eyeball have been observed to become staphyloma-

tous. Of the numerous varieties of staphyloma, those of the cornea, or occupying the place of the cornea, are the most frequent.

A fresh protrusion of one of the tunics, e.g. of the posterior elastic lamina of the cornea, or of the iris or retina, &c., through an ulcer or a wound, is termed a hernia or prolapse. If coated over with lymph, or if cicatrised and still protruding, it is termed a staphyloma.

Among anomalies of curvature of the cornea, we distinguish: 1. The globular cornea. 2. The conical cornea. 3. A staphylomatous condition of an opaque or nebulous cornea, caused through inflammatory changes, ulcers, &c. 4. Staphylomatous cicatrices occupying the place of portions or of the entire cornea, caused through a cicatrised prolapse of the iris.

In the sclerotic we distinguish—the ciliary, the equatorial, and the posterior staphyloma. The first may occupy any portion of the ciliary region, i.e. of the tunics of the eyeball between the margin of the cornea and a line passing through the ocular insertion of the recti-muscles.

The posterior staphyloma generally occupies the region of the yellow spot, or of the tunics surrounding the optic disc.

Staphylomatous conditions of an opaque or nebulous cornea may be caused through inflammatory changes, ulcers occurring in the course of inherited syphilis, measles, scarlatina, variola, &c., or following injuries or operations on the cornea. Syphilitic corneitis and pannus may give rise to rapid staphylomatous changes, the whole of the softened corneal tissue giving way under the pressure of the aqueous humour.

Vision in these cases varies according to the degree of opacity, of alteration of curvature of the cornea, and especially of disturbance of the nuda and of the retina.

Some patients, if the opacity is but slight, complain of weakness of sight; others of being near-sighted; others of objects appearing distorted. Only distinction of colour or quantitative perception of light may exist, though the staphylomatous cornea may seem but slightly nebulous. (For treatment, see CORNEA.)

Staphylomatous cicatrices occupying the place of portions or of the entire cornea. They generally originate in the following manner:—A portion of cornea of varying size having been destroyed by ulceration, suppuration, &c., the iris, after the escape of some aqueous humour, comes to lie against the opening in the cornea, and undergoes adhesion with its margins; while the granulations, lymph, &c., thrown out on the exposed surface of the iris change into more or less opaque tissue. Thus part of the place of the cornea is occupied by iris covered with a cicatrix.

The rapidity with which this cicatrix forms, its strength, and the nature of the treatment, influence the formation and size of the staphyloma. Its surface is frequently uneven or sprinkled with portions of urea. It may be extremely thin, portions of it may be nearly transparent, and appear black—myocephalon—from the interior of the eye shining through. In other cases it may be considerably thicker than the cornea. Its surface, if too much exposed to the air, especially during sleep, becomes covered with dry epithelial scales. Beneath the epithelium we may find connective tissue, or tissue resembling that of the cornea, but

most frequently white fibrous tissue, intermixed with blood-vessels.

It may become inflamed, or ulcerated, or thin portions may burst, the "aqueous" escape, and the staphyloma temporarily collapse, or the lens, the "vitreous," or all the contents of the sclerotic may escape. The collapsed tunics may become distended again by fluid. In some cases bleeding from the choroidal veins between the sclerotic and choroid, sometimes to a considerable extent, or ophthalmitis, follows the rupture of the staphyloma.

The basis of the staphyloma gradually, or abruptly, goes over into adjoining cornea or sclerotic. Its posterior surface may be smooth or uneven. At the portions covered by the posterior elastic lamina, no adhesions of the iris are found. The debris of black or brown pigment on the posterior surface of the staphyloma belong to the distended iris. An instrument thrust through the staphyloma into the eye at once enters the posterior chamber, provided there be fluid intervening between it and the lens. The latter may have escaped, together with the capsule, or it may be opaque or adherent to the staphyloma, or more or less displaced, though not adherent.

Recurrent attacks of ophthalmia or of iritis from partial adhesions of the margin of the pupil to the staphyloma from disturbances caused by displacement &c. of the lens, with or without sympathetic changes in the fellow eye, may occur. We frequently find that if the staphyloma appeared some time after "some inflammation of the eye," glaucomatous changes exist which, adding themselves to those caused by the cicatrix in the cornea, produce a degree of impairment of sight which is not proportionate to that which would be caused by the staphyloma alone. In these cases, if abscision be performed, we often have intra-ocular hæmorrhage or suppuration follow the operation.

*Treatment.*—A staphyloma, if not treated, may remain stationary for years. It may burst frequently and occasionally give rise to the changes mentioned above. The bursting relieves the patient temporarily, and many patients to ease themselves soon learn to puncture the thinnest part, or the one they observe giving way spontaneously. They thus for years alleviate the distress caused by the size of the staphyloma. In patients with a fresh prolapse of the iris, or with sloughing of portions of cornea where a staphyloma is likely to follow, we should never neglect to apply a bandage over the closed eyelids, to order instillations of atropia, so as to lessen the tension of the eye during cicatrization.

An iridectomy done at this stage, followed by gentle pressure, will be found of great service. The eyelids are kept bound up, until a firm cicatrix has formed and are kept closed again if any tendency of the cicatrix becoming staphylomatous shows itself.

A staphyloma of long standing, part of the cornea being clear and the retina sensitive throughout, is treated by iridectomy with removal of the lens, and with abscision of the staphyloma.

If its walls appear thin, a non-staphylomatous cicatrix may be obtained by puncturing the staphyloma, to allow the fluid accumulated behind to escape, and then by making with scissors a vertical incision through the staphyloma from its apex to its base. Its walls, by properly applied

pressure, if necessary assisted by a suture, are then made to overlap each other, and are expected to undergo adhesion (the anterior surface of the one with the posterior surface of the other half). The eyelids are kept bound up until all vascularity of the conjunctiva and sclerotic have subsided.

Excision or abscision of the eyeball with insertion of an artificial eye are indicated if the staphyloma causes pain or sympathetic irritation of the fellow eye.

The patient, if he wishes the operation performed for cosmetic reasons, though there be perception of light with the staphylomatous eye, should be informed of the probability of losing the perception of light by the operation, and also of the trouble connected with the wearing of an artificial eye. A better result, as regards appearance, is obtained by abscision, but the repeated occurrence of suppuration of previously abscised eyes, or the non-cessation of sympathetic irritation, recommend in poor persons excision, as the quicker and safer treatment. Abscision should, however, always be performed in staphyloma following purulent ophthalmia.

#### STAPHYLOMA OF THE SCLEROTIC.

When meeting with this kind of staphyloma we must bear in mind that the sclerotic is not the only tunic altered in curvature, but that the staphylomatous condition extends also to the deeper tunics, e.g. in a posterior staphyloma, in the region of the yellow spot, also to the corresponding choroid, retina and vitreous substance.

The portions of the sclerotic over the ciliary processes, round the optic nerve, especially over the yellow spot, and of the equatorial part of the eyeball, frequently become staphylomatous. The first is termed ciliary staphyloma, the second posterior staphyloma, and the third equatorial staphyloma.

The entire ciliary region may be altered in curvature, or the entire sclerotic be changed in shape, causing protrusion of the eyeball.

A large staphyloma in the region of the yellow spot may exist without any protrusion, though it impair the mobility of the eye.

The spots of the sclerotic through which choroidal veins pass, become staphylomatous more frequently in the course of chronic morbid changes accompanied by increase of tension. The size, shape, and colour of the staphyloma varies. Small ciliary staphyloma appear as blueish-black bulging smooth spots or streaks, alternating with more healthy (white) portions of the sclerotic, and radiating from near the margin of the cornea.

These formerly were thought to be varicose veins of the choroid. They are caused by atrophic and staphylomatous portions of the tunics of the ciliary region separated from each other by more healthy parts, these latter corresponding to the non-staphylomatous (white) parts of the sclerotic.

Ciliary staphylomata lead to displacement of the cornea, the distance between the insertion of one or several of the recti-muscles and the margin of the cornea being altered.

The equatorial staphyloma we often find behind or at the side of the sclerotic insertion of the superior rectus muscle. It has been mistaken for intra-ocular tumor, of which, however, it may be a complication. All staphylomata of the sclerotic



rotic are complications of morbid changes of other tunics. In the discovery of these we are assisted by the ophthalmoscope, by light concentrated upon the tunics by means of a strong convex lens, by ascertaining the tension of the eye, the function of the ciliary nerves, e.g. as regards the sensibility of different parts of the cornea, and the functions of the retina, &c. The tunics are adherent to each other, and most altered at and near the most prominent part. On minute examination after excision frequently no vessels or nerves are found in the staphyloma. Of the retina, only the fibres of the framework, forming large irregular meshes, are left, while in less staphylomatous portions only the ganglion cells may be missing. The choroidal pigment (stellate pigment cells) may be missing or appear very pale. The hexagonal cells are either missing or have lost their characteristic shape. Their pigment granules may be present. Their place is occasionally found occupied by transparent globules.

Severe pain, intolerance of light, fiery circles, often trouble the patient while the equatorial staphyloma is increasing rapidly. Its progress is generally slow, and sometimes accompanied by intermittent dull pain, and by attacks of ophthalmia.

Vision varies according to the locality and complications of the staphyloma. Large ciliary or posterior staphylomata admit of excellent sight, while with equatorial staphylomata there may be none, or bare perception of light. This is readily explained by the alterations of the other tunics, and of the optic disc, which alterations are the result of glaucomatous changes.

*Causes.—Injuries.*—A blow may rupture the choroid and retina and leave the sclerotic intact, and some time after be followed by staphyloma of that portion of the sclerotic. Sclerotic staphylomata from injury more commonly occur in the ciliary region. Loss of substance of the sclerotic from wounds or ulcers may be followed by staphyloma, not only of the cicatrix, but also of some of the adjoining sclerotic.

Inflammation of several or of all the tunics mostly of syphilitic origin.

Staphyloma often appears in circumscribed portions of the ciliary region successively. Some portion of the conjunctiva, sub-conjunctival tissue, and the sclerotic appear vascular, swollen. This gradually subsides, and one or several staphylomata appear instead, as is supposed from the tunics not being able to resist the natural intra-ocular pressure.

For posterior staphyloma see MYOPIA, and the affections of the various tunics.

*Treatment.*—Attacks of inflammation or pain caused by the staphyloma, or the wish to arrest the sympathetic irritation of the fellow eye, or as regards reasons of appearance, may render an operation necessary. Excision of the eye is the quickest and safest treatment, and should be recommended to poor persons where the loss of time is of consequence. Iridectomy should previously be tried if the external appearance of the eye is satisfactory.

Abscission succeeds best in sclerotic staphyloma following purulent ophthalmia. The removal of iris and lens have in some cases been attended with good results.

The observation that suppuration of the vitreous substance and choroid lead to shrinking of the eyeball, have led to the treatment of drawing a silk thread through the tunics of the eye and through

the vitreous chamber, close behind the insertion of the inner and outer rectus muscle, leaving the thread until well-marked chemosis is produced, when the silk is withdrawn. The eye gradually shrinks, and, as in abscission, admits of the insertion of a more natural-looking artificial eye.

C. Bader.

**STEATOMA.** (from *στέας*, fat.) A wen or encysted tumor, containing fat. (See TUMORS, ENCYSTED.)

**STELLA, or STELLATED BANDAGE.** A bandage so named because it makes a cross, or star, on the back. It is a roller, applied in the form of the figure 8, so as to keep back the shoulders, and often employed in cases of fracture of the clavicle.

**STETHOSCOPE.** (from *στήθος*, *pectus*, and *σκοπεω*, *exploro*.) An instrument consisting of a cylinder, originally employed by Laennec, to elucidate the diagnosis of certain diseases of the chest, but now indeed used to throw light on the nature of many other cases. See *Auscultation*. "A very few words suffice to state (as Dr. Forbes observes) in what way the stethoscope becomes, in the hands of an expert auscultator, the means of an accurate diagnosis. By it we learn, that the motions of the lungs and heart, in a state of health, produce certain determinate sounds in certain parts of the chest; and that these sounds are modified in certain determinate ways, and certain other determinate sounds superadded in states of disease. By the study of the symptoms during life, by dissection after death, and by considering the principles of the generation of sound, we are able to connect, as cause and effect, particular forms of disease with particular sounds: hence, the indications of the stethoscope, in certain diseases, become positive physical signs of these diseases." (*Cyclopædia of Pract. Med. art. Auscultation*.)

**STRAMONIUM.** A series of interesting experiments were detailed, in illustration of the properties of stramonium, in a Dissertation, which was read to the Medical Faculty of the University of Pennsylvania, on the 12th of May, 1797, by Dr. Samuel Cooper. The experiments, Nos. 15 and 16, merit particular notice in this Dictionary, as being, perhaps, the earliest discovery of the effect of the local application of powerful narcotics in dilating the pupil. A drop of an infusion of the powder of stramonium was let fall into the left eye. In half an hour the pupil began to enlarge, and attained its greatest dimensions about twelve hours after the experiment, at which time it was viewed in a considerable light, and seemed thrice as large as the other. It continued dilated two days. In a strong light, objects were seen more distinctly with the right eye; but, in a weak light, with the left. Some other gentlemen, however, on whom the experiment was tried, experienced no increased power of seeing in the dark. A drop of the expressed juice, dropped into the eye of a cat, soon converted the whole of the coloured part of the eye into pupil. (See *Cutwell's Medical Theses*, p. 173, 8vo. Philadelphia, 1805.) Stramonium then resembles belladonna and hyoscyamus in its action upon the iris. It has been exhibited internally, in epilepsy, tic douloureux, and severe chronic pains, and used in poultices for dispersing indurations of the breast, and in ointments, for allaying the pain of piles. The doses should at first be only gr. ss. of the extract, twice a day, but they may be gradually increased to five grains.

**STRICTURE.** (from *stringo*, to bind.) A contracted state of some part of a tube, or duct. (See URETHRA, STRICTURES OF; ESOPHAGUS, &c. RECTUM, &c.) Stricture also means, in cases of strangulated hernia, the narrowest part of the opening or passage through which the bowels protrude. (See HERNIA.)

**STRUMA.** (from *struo*, to heap up.) Scrofula, or Scrophula. The King's Evil. (See SCROFULA.)

**STRYCHNIA.** Its salts, and the extract of *nux vomica*, have been found useful in paraplegia, amaurosis, some forms of deafness, and a few other paralytic affections, from disease or external injury. The endermic use of strychnia is noticed in the article AMAUROSIS. "Strychnia in all its forms, pure or combined (says Dr. A. T. Thomson), is a powerful excitant, displaying its influence, first by an increasing energy of the whole system; and next chiefly on those tracts of the medulla spinalis which give origin to the motor nerves. The nerves of sensation, however, are also involved in this action; for, along with the muscular contractions and convulsions which supervene, the surface of the body is so morbidly sensitive, as to be sensible of the slightest impressions; even the motion of the air becomes a source of uneasiness, nearly as considerable as in hydrophobic cases." (See *Elem. of Materia Medica*, &c., p. 186, edit. 2.) [Strychnia is supposed by Brown-Séquard to act as an excitant by increasing the vascularity of the nervous centres, and especially the spinal cord. It is, therefore, to be avoided in cases where the symptoms have an inflammatory character, and which may be assumed to be already hyperæmic. The dose of strychnia is from  $\frac{1}{30}$  to  $\frac{1}{12}$  of a grain. The British Pharmacopœia contains a liquor strychnæ, strength  $\frac{1}{12}$  of a grain in 10 minims.]

**STUMPS.** P. G. Van Hoorne, in 1803, published a valuable work giving an account of the changes which occur in the texture of stumps after amputation, and particularly in the bone. *De his, quæ in partibus membri præsertim osseis amputatione vulneratis, notanda sunt.* (Lugd. Bat. 1803, 4to.) In the 16th vol. of the *Med. Chir. Trans.*, Mr. Langstaff has published many interesting remarks on the healthy and morbid condition of stumps. According to his investigations, after the effusion and organisation of lymph in the healing process, "the absorbents remove such superfluous parts of the muscles as are likely to retard the progress of cicatrisation of the integuments. After this period, the nutrient arteries of the periosteal covering of the divided bone, or bones, and the medullary parts, deposit lymph; a medium of cellular tissue is produced, which unites to the organised integumental surface, and these together form a cushion, as a protection to the end of the stump." The asperities occasioned by the division of the bone are removed by absorption; a deposit of osseous matter takes place round its edges, forming a junction with the new bony substance thrown out by the vessels of the medullary texture; and the absorbents, if not interrupted by a diseased state of the stump, produce a regular rounded appearance of the extremity of the bone, in which merely apertures are left for the communication of the nutrient arteries, veins, and nerves of the shaft of the bone, with its coverings.

"Should the surfaces of the amputated part not regularly unite by the first intention, nor by the

second, and there be inflammation affecting the divided nerves, then a morbid action is established, which occasions the face of the stump to ulcerate or mortify; frequently causing a portion of the extremity of the bone to project, which occasionally becomes carious, and should be taken off." In other instances, osseous deposit takes place round the edges of the sawn bones in a degree amounting to exostosis; and "sometimes a spiculum of bone projects horizontally, generally taking the direction of the artery, vein, and nerves of the limb, which thus become implicated with the bony deposit; and sometimes (adds Mr. Langstaff) I have found a large spiculum of bone, with a very sharp point, taking an oblique direction, and connected with a muscle, occasioning morbid changes in its fibres, and being a source of great suffering to the patient. In all such stumps, I have invariably found the nerves greatly enlarged at their extremities, giving them a ganglionic appearance, and generally firmly adherent to the surface of the stump, and frequently in union with spicula of bone." On cutting through these bulbous extremities of the nerves, Mr. Langstaff did not notice any marks of enlargement of their natural structure, the thickening appearing to have been occasioned wholly by the deposition of lymph, the effect of inflammation in the cellular tissue covering the neurilemma. Mr. Langstaff gives the particulars of numerous preparations and cases in confirmation of his statements. In amputation, he prefers the flap operation to the circular, cutting obliquely through the integuments, muscles, vessels, and nerves, and taking especial care to preserve a sufficient quantity of skin to cover the end of the bone. He notices the bad consequences of leaving too much muscle in the circular operation, in impeding the adhesive process. "If (says he), in performing the flap operation, a sufficient quantity of skin be not preserved to cover the stump, and the ends of the nerves are likely to be included, while cicatrisation is going on, I should have no hesitation in shortening them by cutting off a portion of each."

The frequent necessity, however, for cutting the large nerves twice, is considered by many surgeons—in which number I wish to be included—as one of the principal objections to flap amputations, more especially of the arm. Thus, Sir Charles Bell observes, "Of all the conditions to which man is subject, there is no state of suffering more severe than that produced by the engagement of a nerve in a stump; and therefore I say, that it is most important that the nerve should be directly divided across, and not obliquely torn out. You cannot secure this effect, unless you make a free and decided division of the muscles. When you pierce the limb with a great cutting knife, and put it close on the bone, and draw it out obliquely, to make the flap, you cut the nerve longer than the other parts. The nerve is firm, but very elastic; it is not so easily cut through as muscles. Being elastic, it goes before the edge of the knife; and, if you look carefully to an amputation performed in this way, you will find that the nerve hangs out, that it becomes necessary to draw it out, and cut it again. What do you say to cutting the nerve a second time, by way of proof that this operation is attended with less pain?" (See *Lond. Med. Gaz.* vol. xv. p. 95.) In *post mortem* examinations, Molinelli and Morgagni long ago found the ends of nerves, which had been cut through, enlarged. Lower and Arnemann



noticed the same occurrence in animals, and Proschaska gave an instructive description of such a case.

In Van Hoorne's work are excellent engravings of this condition of the nerves, as well as of the osseous deposition at the end of the bones of stumps, and of necroses in various degrees and stages. In Froriep's *Chir. Kupfertafeln*, pl. 113, the same things are represented, accompanied by an account of two preparations of stumps, preserved in the Museum of the University of Bonn by Professor Mayer, the particulars of which merit the attention of all who are investigating the present subject. Cruveilhier has published a representation of a shoulder-stump, after an amputation, performed many years previously by Larrey. The changes in the muscles, and ends of the vessels, are carefully drawn and explained, as well as the ganglionic enlargement of the nerves. (*Anal. Pathol.* t. i. livr. vi. pl. 5.—Paris, 1829, 35 Fol.)

When the severe neuralgic affection of a stump, sometimes attended with convulsive twitches, is dependent upon the bulbous enlargement of the end of a nerve, it may sometimes be cured by the repetition of amputation, or even by the mere excision of the extremity of the nerve. The latter operation, I think, with Mr. Mayo, is to be preferred if the symptoms are clearly attributable to an affection of one nerve. (*Human Pathology*, p. 139.) In support of this advice, Mr. Mayo gives an interesting example of the success of the practice. He likewise adds the particulars of a case, in which the source of the painful affection of the stump was not confined to the cut extremity of the nerve. A second amputation had been performed. "On examining the amputated part, the sciatic nerve and the saphenous nerve were found to terminate in large callous bulbs. In the second operation, care was taken to draw out and remove a considerable portion of the sciatic nerve, which retracting lay well covered among the muscles. Nevertheless, when the stump had nearly healed, the old pain again commenced;" but was more circumscribed. Mr. Mayo now cut down to the sciatic nerve, where covered by the lower fibres of the glutæus maximus, and divided it. A portion of it was then removed. The benefit was only temporary. Mr. Mayo suspects that amputation at the hip might cure this patient, though loth to recommend this formidable proceeding; and refers to a case, in which a neuralgia, which had followed an amputation above the wrist, had returned after a second amputation, but been permanently cured by amputation of the shoulder. Sometimes the relief, afforded by excision of the bulb of the nerve, is not complete, as we find exemplified in the case under Mr. Palmer, who removed from a stump a portion of the fibular nerve. "The stump is still occasionally agitated by slight spasms, and the nerve, for above two inches above the cicatrix (as may be perceived by feeling through the integuments), is still enlarged and very sensitive. Unquestionably the relief afforded has been immense; but I now regret, that I did not in the first place remove a greater length of the nerve, so as completely to obviate the possibility of its being again involved in the new cicatrix." (*Palmer*, in *Lond. Med. Gaz.* vol. xvii. p. 220.)

When the soft parts are deficient, and the bone prominent on the face of the stump, forcible attempts are often made to bring the integuments

together by adhesive straps. These endeavours (as Mr. James correctly observes) commonly fail, and are indeed mischievous; for, if the straps are brought over the surface of the bone, then they bind down this thin and irritable covering upon a broad surface, which is sure to indispose them to unite; and, if applied at the sides, although they may bring the edges together, yet they will force the soft parts still more back than the bone. The only remedy for such stumps, according to Mr. James, is to be found in the skilful application of a bandage, and a proper position; and these failing, in sawing off the bone higher up. (*See Provincial Med. and Surgical Trans.* vol. iii. p. 228.)

Mr. Benjamin Phillips has written some good remarks on inflammation of the medullary membrane succeeding to amputation; one of the most serious, and, as it appears to this gentleman, not the least frequent of the accidents, which follow this operation. It is from this cause that necrosis of the whole thickness of the sawn bone mostly arises. The several stages of the case are well described by Mr. Phillips, as that of simple congestion of the medullary membrane; another, leading to osseous deposit; a third, attended with the formation of pus; and a fourth, with gangrene of the texture in question. Mr. Phillips ascribes the disorder to the violence inflicted upon it by the saw. An anxiety, he observes, is felt to prevent such action of the saw upon the periosteum; "but the action of the instrument upon this membrane would not bring about those formidable consequences, with which such injuries to the medullary membrane are pregnant." He notices the custom, followed in many parts of the continent, of applying a very tight bandage round the stump, for the purpose of preventing the retraction of the muscles. This system, he states, exists at La Charité in Paris, where the proportion of unfortunate terminations in cases of amputation is very great. Dr. Carswell thinks it probable, that the tight bandages there used, produce congestion, and a tendency to inflammation of the medullary texture of the sawn bones. (*B. Phillips*, in *Lond. Med. Gaz.* vol. xiii. p. 189, &c.)

When the end of the femur, tibia, or other bone of a stump, is affected with necrosis of its whole thickness, and this for some extent, the excision and removal of the sequestrum is the most expeditious means of cure. [Further information on this subject will be found in art. AMPUTATION.]

STYE. A little inflammatory tumor on the eyelid. (*See HORDEOLUM.*)

SUBCUTANEOUS INJECTION. — *Local Narcotic Injection of Wood. The Subdermal Method. The Hypodermic Method of Treatment (Hunter).*—It is but a few years since injections into and beneath the skin were employed with an object very different from that for which they have now come into extensive use. Formerly they were only employed to produce local irritation and coagulation of tissues beneath the skin—to inflame perhaps a serous membrane, to obliterate veins, and coagulate blood in nævi and aneurismal tumors—in a word, these injections were simply used for their local effects.

In 1843, Dr. Wood, of Edinburgh, pointed out another local use for the syringes then employed for injecting caustics into nævi, namely, "a new method of treating neuralgia by the direct applica-

tion of opiates to the painful part,"\* and in 1844 the same idea seems independently to have been originated by Mr. Rynd, of Dublin, for the treatment of sciatica and neuralgia. The virtue of the treatment was considered by both Rynd and Wood to be due to the injection being localised to the painful part. Wood especially mentioned that the anodyne should not only be put into the neuralgic part, but, in his opinion, to be *really* efficacious, "into the spot where you find you can awaken the pain upon pressure." (*Brit. Med. Journ.*, August 28, 1858.) Localisation of the injection being thus deemed so necessary for benefit to accrue, the employment of this method was limited for many years to the treatment of but few forms of pain. In 1858, however, I made a number of comparative observations concerning the action of the anodyne injected locally and remote from the seat of pain. These observations were witnessed by many interested in this "new therapeutical method," and the experiments were performed in the wards of St. George's Hospital. My chief results are thus condensed by Dr. Brown-Séquard in the *Lancet* of March 10, 1866. "To him (Mr. Hunter) more than to any other investigator we owe the solid grounding, if not a complete demonstration, of these three propositions. 1. That equal effects follow distant and local injections in neuralgic cases. 2. That by distant injections (in various places) the ill effects of repeated local injections are avoided. 3. That diseases can be treated by this plan which are neither local nor neuralgic." (*Lancet*, March 10, 1866.) I exemplified this last conclusion by treating delirium tremens, acute mania, melancholia, chorea, lockjaw, &c., by injections into the cellular tissue of the body, and I employed the term hypodermic method of treatment—which has since been adopted by most foreign countries—to signify the site of the injection.

What, it may be asked, are the advantages of this treatment? They are many, and they vary according to the nature of the case for which the treatment may be advisable.

One chief advantage is *rapidity of action*. By no other plan can a soluble drug be made to influence the system more rapidly (unless it is injection into the veins, which is an operation fraught with danger) than when injected into the cellular tissue of the body, nor can it be denied that patients have often been brought under the full influence of a remedy thus administered long before any decided effect would have been produced by a stomachic dose. Pain may thus be perfectly relieved in a few minutes, the excitement of delirium tremens arrested, and sleep even in this intractable complaint be sometimes produced in ten or fifteen minutes. In one patient who with puerperal mania had not closed her eyes in real sleep for a fortnight, sleep was thus brought about by a quarter of a grain of morphine in eight minutes. The patient began from that moment to improve. (*Case in Queen Charlotte's Hospital*.)

2. *Certainty of action* is another advantage. The drug thus fairly introduced into the cellular tissue of the body becomes absorbed into the general circulation, and the pure effects of the absorbed drug follow. By the stomach there is no certainty.

The medicine may be unabsorbed; it may be vomited, it may be partly absorbed, and partly perhaps follow the egesta through the alimentary canal.

3. The medicine is not *chemically* acted on by the gastric juice; it is not submitted to digestion as it is when given by the stomach.

4. This plan can be used when the stomach is too irritable to retain any medicine, or food.

5. It can also be used when patients *refuse* to swallow, as in delirium tremens.

6. And when medicines disagree, and cause headache, sickness, &c., by the mouth, they will sometimes not do so given by the skin.

7. A small hypodermic dose is often equivalent to a much larger one by the stomach. This is the case with strychnia.

8. Larger doses of a remedy can be with safety given hypodermically than by the mouth, because by the latter plan we know not when or whether the whole amount given is absorbed.

The class of cases for which this plan of treatment is most valuable are those especially of functional derangements of the nervous system, and may be thus generally arranged:—

I. Those of *the cerebral nervous system*, where insomnia is the chief evil to be combatted, in such diseases as delirium tremens, mania, hysteria, melancholia, &c., these and other cerebral derangements may often be at once checked by a few injections of some anodyne drug. The *dose* much depends upon the amount of insomnia, or excitement, or irritation, or depression existing, and also its duration. Morphine, codeine, and narceine will be found to act, not only as hypnotics, but even as nerve tonics in these cases. Morphine may be injected in quarter-grain doses for a mild case of insomnia, whilst as much as one grain may be injected in urgent cases of delirium tremens. The stomach is usually in a most vitiated state in delirium and mania-a-potu, and often quite refuses to absorb and digest either medicine or food, and, as opiates do when given by the mouth, constantly derange the digestion and diminish the appetite. We gain by the cellular absorption a double advantage: we rapidly produce the desired effect upon the brain, and do not interfere with the stomach or the rest of the alimentary canal. In these complaints, melancholia and others, morphine hypodermically given does not produce the subsequent general depression of the nervous system which is so often manifested after it has been taken by the mouth. In delirium tremens and similar cases much time—often days—can be saved of sleeplessness and of *exhaustion*, and life is often thus preserved.

II. For affections of the *spinal nervous system* it is impossible to do more than just indicate the class of cases which may and have received relief and been cured by this plan. Painful affections of particular nerves, whether superficial or deep, of neuralgia, of sciatica, of colic, &c., are but instances. The pain of inflammation, as of peritonitis, may often be checked at once by a full subcutaneous dose of morphine; for, as shown by my experiments, the action of this drug is not localised to the part into which it is injected, nor, as Mr. Moore, of the Middlesex Hospital, has confirmed, "is the action chiefly local, but general." For this reason the injection is equally available in cases of spasm, whether local, as in retention of

\* Dr. A. Wood, *Edin. Med. and Surg. Journal*, 1855.



urine, or general, as in tetanus; and in this last and serious malady very happy results have already been obtained. (MM. Vella, Briquet, Courty, Cl. Bernard, Spencer Wells, &c.)

In obstinate vomiting the hypodermic injections of morphia will sometimes act almost instantly in arresting the spasmodic contractions and irritability of the stomach. Three cases of this kind have come under my care due to pregnancy; they had all resisted for months the usual remedies, as well as morphia given by the stomach.

The passage of renal calculi, of gall stones, cases of severe colic, spasmodic strictures, even of intussusception, are all well-marked instances of either intense spasm and of pain, which may be and has been instantly relieved by this rapid mode of influencing the system at large.

Much more may yet be done than has been done in cholera by this mode of treatment, and even in hydrophobia.

That there are various objections to the use of opiates in cholera when given by the mouth there can be no doubt, the chief of these being, perhaps, the uncertainty of the stomach retaining it, and, supposing it did, the probability of its effect being bad upon the liver and the digestive surface of the alimentary canal, which ought not to be interfered with in their attempts to eliminate the choleraic secretion, and which are much better without than with the topical influence of an opiate, if nourishment is to be absorbed.

But nearly all the other phenomena, the urgent symptoms of cholera, are benefited by opium when injected. At the temporary Wapping Cholera Hospital, and at St. George's Hospital, the marked beneficial effects of the injection were manifest with each injection. The cramps subside, the pains diminish, the frequency of the evacuations and of the vomiting becomes less, exhaustion of the nervous system is obviated, and the tendency to a healthy state in every way strengthened. In St. George's, during the last epidemic, the only case of the three admitted that recovered was thus treated with the puncture several times a day.

Of the other applications of this treatment it is impossible to enter into, partly because the plan is constantly being used with some new object in view. It is right, however, to allude to the treatment of fevers and of ague by the injection of quinine. This has been extensively had recourse to by Drs. Desvigne, McCraith of Smyrna, Moore of Bombay, Saemann, Pihan Dufellay, Dodeuil, &c., and, as a general result, these authors find the same advantages to attend this mode of employing quinine as I had shown to follow the morphia injection, and they consider a great saving of the amount of quinine is thus gained. Scarenzio has just recently proposed and carried out the injection of mercury in syphilis, upon the same principle of being thus able to eradicate the disease with a far smaller amount of that drug.

#### THE AGENTS TO EMPLOY FOR HYPODERMIC INJECTION.

So long as these injections were presumed to act simply by their local introduction, anodynes were alone employed. Nепenthe was chiefly used in Scotland; morphia dissolved in creosote (!) in Ireland; but, as the action of the method is now proved to be generally upon the system, tonics, stimulants, and other medicines besides anodynes

are constantly thus administered. Thus quinine is found quite effectual in far smaller hypodermic than stomachic doses (Moore). Syphilis has thus been treated by Scarenzio, &c. As a rule, the solutions of the alkaloids should be employed—not the tinctures, as they inflame and irritate the cellular tissue. The alkaloids and other preparations which are now coming into regular use by this plan are morphia, atropine, strychnine, codeine, narceine, nicotine, hydrocyanic acid, aconitina, woorali, curarina, cineine, veratrine, digitaline, caffeine, calabar bean or eserine, daturine, &c.; also various agents like acetic acid, to act upon cancerous and other growths (Broadbent), &c. The hypodermic effect of atropine deserves a short notice here. I first employed it in 1859 (*Medical Times and Gazette*, 1859), and have found it to be a medium of extraordinary power in a large class of affections, both neuralgic and spasmodic. Although more rapid in its action when injected than when given by the mouth, it produces less powerful signs of irritation—it does not cause retention to the same extent as when given by the mouth. Two or three atropine punctures will often cure a sciatica which had for months defied the internal administration of belladonna, quinine, &c. By this mode of giving belladonna, its permanent tonic effects are more pronounced, and the unpleasant effects on the digestive canal go off much sooner. The dose should vary for the adult for neuralgia from the one-hundredth of a grain up to the one-twentieth, and for epilepsy up to the one-tenth. The thirtieth of a grain is often a most efficient dose. It may also be well combined with morphia in the proportion of one-eighth to an eighth, or the sixtieth to a sixth of a grain with advantage, each modifying the excessive symptoms of the other.

*Strychnia* is one of the most valuable hypodermic tonics we possess, the more especially in affections of the nerves, in certain reflex paralytic affections or in chronic paralysis, after all activity about the clot has subsided in the nerve centre.

The chief advantages to be derived from the hypodermic use of strychnia are—

1st. As a *therapeutic test*, for three or four injections will almost always show if strychnia has any power or not over that particular palsy. If they have no effect it is almost useless to continue their employment.

2nd. It is economical, both as regards amount of (a) alkaloid to be used, and (b) time required for it to affect the system.

(a) There is a great saving of the amount of strychnia required by this means over the stomachic employment of the same drug. The saving may be put at five-sixths of the amount which would be given by the mouth. For, so far as my observation goes, the one-thirtieth of a grain, injected every other day for thirty times, will consume just one grain of strychnia in sixty days: now, if the somewhat ordinary dose of one-twentieth of a grain is given twice a day—and some physicians order the one-sixteenth and even the one-twelfth of a grain for a dose, it is evident that, in the sixty days, as much as six grains of strychnia are taken into the stomach. But, in cases of paralysis, where its continuance seems necessary, I do not, as a rule, inject the strychnia more often than twice a week, so that the saving is nine rather than six times less than the amount which expe-

rience shows us has to be given by the mouth for a reasonable amount of benefit to ensue.

**Cautions.**—Simple as this little operation is, it may be most disastrous in its results if performed in inappropriate cases, or carelessly as to the amount injected. The fluids to be injected must be concentrated, and a miscalculation of two or three minims may, therefore, be productive of most serious results. It is impossible to be thoroughly accurate unless a syringe is employed which works by a screw piston, each turn of which should be equivalent to a known quantity of the alkaloid in use. Thus each half-turn of the syringe I use, known as the "Hypodermic" or "Hunter's Syringe," introduces one-eighth of a grain of morphine beneath the skin, or one-ninetieth of a grain of atropine. No fluid with irritating properties should be injected; no tinctures (unless evaporated); no resinous substances, such as cannabis indica, colcynthis, croton oil, creosote, chloroform, &c. These have been tried, and local inflammation and abscesses resulted. Solutions of the alkaloids should be as neutral as possible. The quinine injection has in the hands of many produced abscesses, and even worse results, such as extensive sloughing of the part, as happened with some fever cases in Italy, and lockjaw in one or two cases was in America attributed to it.

I believe the sulphate or nitrate of strychnia was used in those cases. All irritation may, in my opinion, be avoided by using a basic salt of strychnia, the bibasic, the hypophosphate, or the oleate, which preparations have been made for me by Messrs. Bullock and Reynolds. Very often the mischief has doubtless been due to either force employed in the injection, or the clumsiness of the syringe. The most simple fluid may, when injected without manipulative dexterity, cause a local induration or gathering, but I have never myself seen diffuse abscess of the cellular tissue produced in the human being. Dr. Ruppaner, late of Boston (now of New York), has lately proposed and has injected many cases of sciatica with irritants to cause deep abscesses to relieve chronic pains; he uses strong solutions of common salt or nitrate of silver. In doing the operation, the syringe should be introduced with a sharp quick movement whilst the skin is made tense; but the piston should be turned slowly. All fluids should have such a strength that five minims should contain or exceed the medium dose. Injections of morphine should not be made too frequently in the day. Six hours, even in severe neuralgic cases, should intervene between the repetitions. The only fears of general ill effects from narcotic injections are vomiting and super-narcotism; regulation of the dose usually avoids these evils. Locally, a minute vein may at times be injured, or an abscess or hard condensation of the cellular tissue caused. Careful observation avoids the first, and careful preparation of the fluid the second. The same spot should never be twice punctured. I have never seen general or diffuse inflammation of the cellular tissue from the injection of any agent, although I have performed the operation many thousand times, and in one patient, with morphia over 1200 times.

It should here be mentioned that the views put forth by the author in this article have been much criticised and differed from the time they were first promulgated. Behier and others in

1860, taking the original view of Wood; but Scanzoni, Moore, Brown-Séguard, and hosts of other observers, have now entirely coincided with me as to the general action of these injections. Dr. Anstie, who has written latest upon this subject, confirms the author's views in a most comprehensive paper. Perhaps, chief stress should be laid upon the labours of the Hypodermic Committee, ten in number, who, after about two years' investigation, have come to identical views as to the physiology and therapeutics with those advanced by the author of this paper in 1859. *Charles Hunter.*

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**SULPHURIC ACID.** The strong sulphuric acid is used as a means of extricating from the nitrate of potash, or chloride of sodium, certain gases for the purpose of purifying the air of sick rooms, or infected places. A few practitioners have also sometimes employed it, blended with sixteen times its weight of lard, as a local application for the cure of scabies. One drachm of it, mixed with an ounce of lard, is sometimes rubbed upon diseased joints, and with considerable effect, when the right cases are selected. (See JOINTS.) As a caustic, this acid is not generally eligible, because it is difficult to limit its operation exactly to the parts which are intended to be destroyed. A few years ago, a proposal was made to apply it along the outside of the eyelid, in cases of trichiasis, so as to produce a slough and subsequent ulcer, the cicatrization of which would draw out the inverted tarsus. In this way, an instantaneous amendment in the position of the eyelid is sometimes produced. I have seen cases, in which the experiment was tried; but, whether it was owing to the acid not having been sufficiently applied, or other causes, the method did not answer so well as the usual plan of removing a part of the integuments with a cutting instrument. Sulphuric acid has also been employed in the cure of ectropium.

Diluted sulphuric acid is frequently employed as an ingredient in gargles. It is also commonly exhibited with the view of checking passive hæmorrhages, and profuse nocturnal sweats in hectic fever. The dose is from ten to thirty drops.

In cases of poison by sulphuric acid, the most successful treatment consists in making the patient drink large quantities of water, in which calcined magnesia is suspended. Should this last medicine, however, not be at hand, soap, blended with



water, is the best substitute. While these remedies are preparing, copious draughts of some mucilaginous beverage, milk, or even of common water, should be administered without delay; for the practitioner should ever be mindful, that so rapidly does sulphuric acid operate upon the texture of the parts with which it comes into contact, that all chance of saving the patient must depend upon the quickness with which the means to counteract this poison are applied. (*Orfila, Traité des Poisons*, &c., vol. i. p. 434, ed. 2.)

**SUPPRESSION OF URINE.** A stoppage of the secretion of urine. (See URINE, RETENTION OF.)

**SUPPURATION.** A process by which a peculiar fluid, termed *pus*, is formed in the substance, or on the surface, of parts of the body.

When purulent matter accumulates in the part affected, whether in a natural cavity or in the substance of an organ, there is said to be an *abscess*, which is distinguished into several kinds—*acute*, *chronic*, *scrofulous*, &c. (See ABSCESS.)

#### SYMPTOMS OF SUPPURATION.

When matter is fully formed there is a change, or even a remission of some of the symptoms. The throbbing pain, which was experienced so severely on the approach of suppuration, from acute phlegmonous inflammation, now subsides, and the patient complains of a more dull, constant, and heavy pain in the part. A conical eminence, or *pointing*, as it is termed, mostly takes place at some part of the tumor, generally near its middle. In this situation, a whitish or yellowish appearance is observable, instead of a deep red, which was previously apparent; and a fluctuation under it may be discovered, on a careful examination with the fingers. Sometimes, indeed, when an abscess is thickly covered with muscles and other parts, the fluctuation cannot be easily distinguished, though, from other concurring circumstances, hardly a doubt can be entertained of there being even a very considerable collection of matter. An cedematous swelling, over the situation of deeply situated abscesses, is a symptom which sometimes throws light on cases of this description.

Skill in detecting the existence of deep abscesses is a circumstance of the highest importance in practice, and one, which greatly contributes to the practitioner's reputation. In no part of surgery is experience of greater use to him than in the present; and however simple this part of his duty may appear, yet nothing, it is certain, more readily distinguishes a man of observation and extensive practice, than his being able easily to detect collections of deep-seated matter. On the contrary, nothing so materially injures the character and professional credit of a surgeon, as his having in such cases given an inaccurate prognosis; for their nature is at last clearly demonstrated to all concerned.

When matter is formed upon the natural surfaces of the body which are connected with vital organs, much irritation and disturbance take place; but, when matter is produced upon the surface of a wound, or upon parts of little vital importance, then its formation is often unpreceded by irritative fever. (See *Sir Astley Cooper's Lectures*, &c. vol. i. p. 113.) Pus may continue to be produced from the mucous membrane of the urethra, or from a chronic ulcer, for an indefinite

period, without any perceptible disturbance of the constitution.

The constitutional symptoms, which attend the formation of pus in the progress of chronic suppurations, are generally comprehended under the name of hectic fever. (See ABSCESS; FEVERS.)

[The signs and symptoms by which the existence of suppuration may be known, are of three kinds: 1st, the touch, or other physical signs; 2ndly, by inference from certain symptoms; 3rdly, by inference from certain interferences with the functions of organs. The touch, the education of which into a *tactus eruditus* is a prime point in surgical education, detects in the seat of inflammatory pain an unusual fulness, owing to the presence of fluid. If this fluid be confined in a tolerably firm envelope, *fluctuation* may be produced by alternate pressure of the fingers of either hand. If the boundaries of the abscess offer no resistance, there may be, instead of fluctuation, a doughy or boggy feeling. When fluctuation succeeds inflammatory hardness, the evidence of suppuration is irresistible. If the suppuration be very deep-seated, it may be judicious to confirm the diagnosis by the aid of an exploring needle. The physical signs of fluid in the chest, pericardium, and joints will often lead the practitioner to diagnose suppuration, when the preceding and accompanying symptoms are such as to render such diagnosis probable.

The symptoms of suppuration vary according to local circumstances. Sometimes it is attended with a remission of pain, as in the very common abscess of the gums accompanying decayed teeth. On the other hand, if the matter be so circumstanced as to create great tension:—under any thick cuticle, for instance, on the sole of the foot, under fascia or periosteum—the pain and constitutional disturbance are greatly increased.

The diagnosis of abscess in the deep-seated internal organs, and especially the brain, from the existing disturbance of functions, is one of the most difficult points in medical practice.] (See HEAD, INJURIES OF.)

Together with the several local symptoms of the presence of pus may be mentioned the frequent shiverings to which patients are liable, especially on the first formation of acute abscesses. However, these rigors seldom occur so as to be distinctly observed, unless the collection of matter be considerable, suddenly produced, or deeply situated in some of the viscera. "In the progress of the fever, accompanying acute inflammation (says Professor Thomson), rigors, or cold shiverings, not unfrequently take place, which recur at irregular intervals, and are in general followed by a hot fit, and slight increase of the febrile symptoms. These rigors, or cold shiverings, in general indicate, when they occur in the progress of inflammatory diseases, that pus either is formed, or is about to be so. In inflammation, succeeding to injuries of the head, these rigors are often the first constitutional symptoms which give alarm to the well-informed practitioner; for they are generally, though not always, an indication that inflammation has already made a dangerous, if not fatal progress. These rigors also accompany the formation of pus in the viscera contained within the cavities of the chest and belly; and are often the first symptoms which inform the practitioner that his endeavours to procure resolution have not

been successful." (See INFLAMMATION.) Rigors, as Mr. Hunter remarked, are more common at the commencement of spontaneous inflammations, than of inflammations from external injury. They seldom precede the suppuration which follows operations.

[Rigors, i. e. sense of coldness, with muscular tremors (which always, as Hunter said, indicate some serious change in the composition of the blood), have always been considered important symptoms of suppuration; but we now are able to determine their relations to the general order of phenomena more minutely than was done by the authors just quoted. Rigors are no necessary part of any inflammation in suppuration. They almost always accompany the incipient stage of inflammations of idiopathic origin; but they have no necessary connection with suppuration, until the pus be pent up and absorbed into the blood, and, in other words, begin to create *hectic*. Rigors, then, are not symptoms of suppuration *per se*, or its elements, but of an accidental suppuration when the pus is absorbed into the blood.]

The texture, in which suppuration is most readily produced, is mucous membrane, whether this lines excretory ducts, or canals, or covers the inner surfaces of the respiratory, or urinary organs. In a few hours after an irritating cause has been applied to these surfaces, the physical and chemical qualities of the fluid, which they secrete in their natural state, are changed. From being a tough viscid substance, not easily miscible with water, the mucus of the nose and bronchi becomes, during an attack of inflammation, very readily miscible with water, of a yellowish white colour, and fluid consistence. If, in this state, the secretion from these membranes be examined with the microscope, it will be found to contain small globules; and these are found to increase in number in proportion to the degree and continuance of the inflammation. We have examples in the respiratory organs of persons affected with catarrh, and in the urinary organs of those who labour under gonorrhœa. In the progress of these diseases, we can generally trace the changes which take place by slow, but sensible degrees, in the nature of the secretion, from mucus to pus, and from pus back again to the state of mucus. This puriform discharge from mucous membranes, in a state of inflammation, may be kept up for months without these membranes appearing to undergo any other morbid changes, than a slight degree of redness and swelling. A loss of substance, or ulceration, is found not to happen oftener than in one case out of ten examples of suppuration from mucous membranes. (See Thomson, *On Inflammation*, pp. 305, 306.)

Suppuration may be readily produced in the skin, by whatever excites inflammation in that texture, or causes a separation of the cuticle. We have examples of this fact, in blisters for cantharides, and in vesications from superficial burns. If the cuticle, covering a recent blister, or burn, be removed, and the cutis exposed to the irritation of stimulating substances, pus will soon be discharged from the abraded surface. Suppuration can be kept up in the skin for an indefinite length of time, as we see done every day in the management of perpetual blisters. Here ulceration is seldom observed, and, consequently in the skin, loss of substance is by no means necessary for the production of pus.

If the cutis be divided, as in a wound, or a portion of it removed, as in the extirpation of tumors, and either the air or any other external body be permitted to remain in contact with the divided surfaces, the process of suppuration is speedily induced in the subjacent cellular texture. After the hæmorrhage, which takes place from the small vessels, has ceased, an oozing of a fluid, at first resembling serum, occurs, which is gradually changed into pus. But in this case, as Dr. Thomson has correctly observed, the surface of the wound is previously covered with a layer of coagulable lymph, which is penetrated with blood-vessels, and gradually raised into the little red eminences, termed granulations.

The surface of an inflamed serous membrane soon becomes covered with a very thin layer of an albuminous substance, and when this is removed, the membrane is found to have lost its smooth polish. This deposit gradually becomes thicker and more adherent, and forms the rudiment of a false membrane. It constitutes what is usually termed coagulable, or coagulating lymph, and, by undergoing certain modifications, it appears to several pathologists of the present day to be converted into pus. Thus Laennec states, that when adventitious membranes do not become organised, they are generally softened down into pus.

Although, with the exception of the epidermis, nails, and hair, there is no structure in the human body exempt from the attack of inflammation, yet abscess does not form in every texture. Thus it never takes place in a dense, fibrous, or cartilaginous texture, nor in that of a serous membrane. It would appear that only those organs are liable to abscess, which have cellular tissue as one of their constituents. Certain it is also, that of all tissues this is most frequently the seat of suppuration and abscess. John Hunter noticed the fact, that suppuration takes place oftener in superficial than deep-seated cellular tissue; a fact, perhaps correctly attributed to the cellular tissue near the surface of the body being more exposed to the exciting causes of inflammation, than that which is deep-seated. Yet, the difference in the effects of foreign bodies deeply placed, from those which arise when such bodies approach the skin, as referred to by Mr. Hunter, cannot fail to attract the notice of every experienced surgeon.

Pus is sometimes formed within a muscle; and here it seems to be deposited in the intermuscular cellular tissue; the muscular fibre itself being apparently incapable of suppuration.

Purulent matter is met with in all the parenchymatous tissues, either in the form of abscess or of purulent infiltration; as, for instance, in the lungs, liver, spleen, pancreas, and kidneys. A circumscribed, or encysted abscess is more common in the liver; a purulent infiltration in other organs. With respect to suppuration in nerves, M. Andral considers it an undecided point, whether the nervous tissue itself, or the cellular membrane, which enters into its composition, is the real source of the purulent matter.

Mucous membranes are more prone to suppuration than the serous, in which last there is a far greater tendency to the adhesive inflammation. (See INFLAMMATION.)

Pus is also sometimes met with within the blood-vessels and lymphatics, and even in the centre of clots of blood in the vessels, or heart itself. It



has been detected in veins which return the blood from parts in which pus has been collected; as well as in lymphatics, originating in textures in the state of suppuration. In phlebitis, its presence in the veins, and its mixture with the circulating blood, are believed to be the principal causes of the frequently fatal termination of this dangerous affection.

#### THEORY OF SUPPURATION.

The dissolution of the living solids of an animal body into pus, as an essential part of the process of suppuration, and the power of this fluid to continue the dissolution, are opinions which are no longer entertained; and the phrase "*pus corrodes*," is at present rarely heard. If these notions were true, no sore, which discharges matter, could be exempted from a continual dissolution. Such ideas probably arose from the circumstance of an abscess being a hollow cavity in the solids, and from the supposition, that the whole of the original substance of that cavity was now the matter, which was found in it. This was a natural way of accounting for the formation of pus by one entirely ignorant of the circulation, the powers of the arteries, and what takes place in an abscess after it is opened. The knowledge of these three subjects, abstracted from the knowledge of the abscess previously to its being opened, Mr. Hunter thinks, should have led surgeons to account for the formation of pus from the blood by the powers of the arteries alone. According to the above erroneous principle, abscesses would continue to increase after being opened as fast as before. Upon the principle of the solids being dissolved into pus, was founded the practice of bringing all indurated parts to suppuration, if possible, and not making an early opening. This was done for the purpose of giving time for the solids to melt down into pus; but it was apparently forgotten that abscesses formed matter after they were opened, and, therefore, the parts stood the same chance of dissolution into pus as before. Blinded with the idea that the solids entered into the composition of pus, the partizans of this doctrine could never see pus flowing from any internal canal, as from the urethra, in gonorrhœa, without supposing the existence of an ulcer in the passage. Such sentiments might be forgiven while it was not known that these surfaces could, and generally did, form pus, without a breach in the solids; but, the continuance of this way of thinking now, Mr. Hunter pronounces to be, not mere ignorance, but stupidity. The formation of pints of matter in the cavities of the chest and abdomen, without any breach in the solids, could not have been overlooked by the most zealous advocates for the doctrine of dissolution.

The theory of suppuration now most extensively adopted, is, that pus is separated from the blood by the secreting power of the vessels of the inflamed part, which acquire a new mode of action.

That pus is formed in the vessels from which it exudes, by an action of these vessels analogous to secretion (according to Professor John Thomson), was first distinctly suggested by Dr. Simpson of St. Andrew's, in his "*Dissertationes de Re Medica*," published in the year 1722. An opinion similar to that of Dr. Simpson's, suggested itself about the year 1756, to De Haen, from the consideration of what takes place in some cases of

phthisis pulmonalis. This author observed, that pus was often expectorated, for a great length of time, by patients affected with phthisis, in whom, after death, no mark of ulceration could be perceived, not even the place in which the pus had been formed. The hypothesis of pus being a secretion was afterwards more fully considered by Dr. Morgan of Philadelphia, in his inaugural thesis, printed at Edinburgh in 1763, entitled "*Puopiosis, sive Tentamen Medicum de Puris Confectione*." The belief that pus is a secretion, or formed at least by an action of the vessels analogous to secretion, was adopted by Mr. Hunter. Indeed, the merit of the original suggestion of this hypothesis has been ascribed to him, though improperly. Bruggman, at Leyden, maintained the same doctrine in an excellent thesis "*De Puogenia*," published in 1785; and it is that which is now very generally taught all over Europe. (See Thomson, *On Inflammation*, pp. 316, 317.) With respect to suppuration from exposed surfaces, however, it is more proper to say, that the vessels secrete a fluid, which becomes pus; for Sir Everard Home has proved, that this fluid has not the purulent appearance, when first secreted, but acquires it while it remains on the inflamed surface, and does not acquire it the less readily, when removed from that surface in a colourless state, provided its proper temperature be preserved, and it be kept exposed to the air, which promotes the change.

The opinion, that suppuration is a process analogous to glandular secretion, was at first hastily rejected by many, who were swayed by the belief that pus is never found blended with the blood in the circulating system. By this mode of reasoning, however, such thinkers must be led to deny the universally received and undoubted doctrine that the bile is a secretion; and, yet, it is well known, that nothing like this fluid can be detected in an analysis of the blood; and, indeed, a very small quantity would be sufficient to tinge the whole mass of circulating blood with a yellow colour, the same as we see in cases of jaundice. No one would wish to defend the idea of there being either pus, or bile, actually in the circulation; but, only the matter, or modifications of the matter, which, by the combinations, or whatever changes we may choose to term them, produced by the action of the secreting vessels, are converted into one of the particular fluids in question. According to Mr. Hunter, in the commencement of what he terms the *suppurative disposition*, the vessels of the cellular membrane, and circumscribed cavities, are but little changed from the state in which they are in the adhesive state of inflammation; but, afterwards, their condition is altered, and the discharge is also every instant "varying and changing from a species of extravasation, to a new-formed matter peculiar to suppuration. This matter is a remove further from the nature of the blood, and becomes more and more of the nature of pus. It becomes whiter and whiter, losing more and more of the yellow and green" and becoming also more viscid and creamy. He adds, "Pus is not to be found in the blood, similar to that which was produced in the first stage; but is formed from some change, decomposition, or separation of the blood, which it undergoes in its passage out of the vessels; and for effecting which, the vessels of the part have been formed." He further states, "We must look upon it as a new combination of the blood it-

self, and must be convinced, that, in order to carry on the decompositions and combinations necessary for producing this effect, either a new or peculiar structure of vessels must be formed, or a new disposition, and, of course, a new mode of action of the old, must take place. This new structure, or disposition of vessels, I shall call *glandular*, and the effect, or pus, a *secretion*." However, as Professor Carswell justly observes, this glandular structure to which the French pathologists give the name of *tissu pyogénique*, is by no means necessary for the production of pus. (See *Illustrations of the Elem. Forms of Disease*, fasc. 8.)

Gendrin has entered into a minute account of the process of suppuration. He excited inflammation in the web of the frog's foot, and in the mesentery, by means of boiling water, the actual cautery, and the seton, and followed with the microscope the gradual development of pus from the globules of the blood. He affirms, that he distinctly saw the globules of the blood, after they had become stagnant in the capillaries, lose their colouring envelope, become opaque, and assume a yellowish grey colour, approaching to that of pus. He traced them moving slowly in the capillaries, or in new formed vessels; and, as they advanced towards the edge of the ulcer, or eschar, occasioned by the violence of the inflammation, gradually acquiring all the physical characters of perfect pus. Previously to the investigations of M. Gendrin, Kaltenbrunner arrived at nearly the same results. "The microscopical researches of this author, however, would seem to show, that not only is the blood, which is carried into the inflamed tissue, but likewise a portion of the solids, converted into pus; for he states, that small granular bodies are seen to separate from the parenchyma, to pass into canals which are formed for their reception, and to mingle with others of a similar kind coming from the blood, both of which are converted into true granules of pus." The facts elicited, appear to Dr. Carswell to leave no doubt, "that the formation of pus is a consequence of a modification of the blood, manifested more especially by a change taking place in the colour, transparency, and bulk of the globules of this fluid, *after its circulation has been arrested in the capillaries by inflammation; that this change in the globules takes place in the capillary vessels; and that these vessels conduct the globules in this state to the exterior, where they appear to be combined with the serum of the blood, under a peculiar liquid form, or that which we call pus.*" (R. Carswell, *Op. cit.*)

Dupuytren's views of suppuration concur with those of Kaltenbrunner, in respect to its consisting in part of a dissolution of the solids. "If," says he, "the inflammatory action is not stopped, or diminished, the tissues affected soften, and, being destroyed, mix with the blood, which penetrates them; forming a pulpy substance, which, by further elaborations, is gradually converted into pus. This fluid is originally formed both of the wrecks of the solids of the inflamed organs and of the elements of the blood, which have entered into new combinations. These two kinds of materials are readily distinguishable in the commencement of suppuration, which is at first bloody, and, in certain organs, the texture of which presents very marked qualities, difficult to annihilate, carries along with it manifest vestiges of portions of their parenchyma.

For example, suppuration of the liver is almost always of a brownish red colour, and contains particles of the substance of that organ, imparting to the pus the consistence and appearance of the lees of wine." It is only, however, in the early stage of suppuration, that the colouring matter of the blood, and the wreck of textures, are represented by Dupuytren to be discernible. (See *Dict. de Méd. et de Chir. t. i. p. 5.*)

Whatever may be thought of this doctrine, with regard to suppuration in some situations, it does not appear to me at all applicable to suppurations from inflamed mucous membranes, or even to those common cases where abscesses are furnished with a distinct membranous cyst, resembling a mucous membrane. Here certainly we cannot suppose that the solids are softened, or any particles of the inflamed texture commixed with the pus. The same observation may be extended to a serous, or any other free surface, in a state of suppuration, but not attended with ulceration, or loss of substance.

Besides the formation of pus by a process compared to those of secretion, some pathologists admit another mode, whereby pus appears as if it were produced in the blood, "under circumstances in which the influence of the capillary system, as exercising a function of secretion, can have no part." This mode of formation, Dr. Carswell proposes to call *extravascular*, some evidence of which, he remarks, is manifest in the observations delivered by him in the notice of the microscopical observations made by Gendrin and Kaltenbrunner. "Thus we have seen that, besides the conversion of the globules of the blood, contained in the capillaries, into pus, there was also observed a similar change in those of the blood, effused into the cellular tissue around these vessels. In fact, the whole of the blood, *intra and extravascular*, was seen to undergo the same gradual change of colour from red to yellowish grey; the globules in both situations became opaque, acquired an increase of bulk, and passed slowly towards the surface of the part, either in the original, or new-formed capillary vessels in the form of pus." Dr. Carswell has, on several occasions, been able to satisfy himself, that this mode of formation of pus often takes place to a considerable extent in blood effused into the cellular tissue from external violence, and followed by acute inflammation; but he has most frequently observed it in the blood which has ceased to circulate in inflamed veins. (See VEINS.) He considers Gendrin's experiments a complete proof of this fact. "If," observes this last author, "after having injected a great quantity of blood into the subcutaneous cellular tissue, a seton is passed through the same tissue, in order to excite a certain degree of inflammation, the blood is rapidly converted into pus, as if it had escaped from the vessels themselves of the part." (See *Carswell's Illustrations of the Elementary Forms of Disease; Gendrin, Hist. Anat. des Inflammations, &c.*)

The doctrine of the conversion of the blood into pus in inflamed vessels of large dimensions, seems to be confirmed, not only by what happens in phlebitis, but by the following experiment performed by Gendrin. "If (says he), after the circulation in an artery or vein has been interrupted for an instant, a solution of nitrate of silver, or caustic potash be injected, and soon withdrawn,



and the blood again admitted and retained in the vessel by means of two ligatures, suppuration ensues; the blood, at first coagulated, afterwards becomes discolored, and is progressively converted into pus."

In the experiments and observations here referred to, Dr. Carswell notices three striking circumstances, which, from their constancy, and the uniformity of their results, must be regarded as having a common origin, and as consequences the one of the other. "These are the cessation of the circulation, the coagulation of the blood, and the conversion of the fibrine or globular structure of this fluid into pus." But these changes were always preceded by inflammation of the tissue in which the blood was contained, and the pus that was immediately derived from this fluid. "That inflammation was the common origin of these changes cannot, therefore, admit of a doubt; and as it has been proved that they constitute the process of suppuration, the legitimate conclusion at which we arrive is, that this morbid process is essentially dependent upon inflammation as its efficient cause."

Dr. Carswell makes a distinction between the process of suppuration, considered as a vital act, and the mere presence of pus as a product of that process. "If," says he, "pus is found in an organ, in which neither the physical nor physiological characters of inflammation are to be detected, either during life, or after death, the necessity of establishing a distinction between the mere presence of pus, and suppuration, must be obvious." That pus is formed under such circumstances, he endeavours to prove; first, from this fluid being found in the blood, where inflammation could have exercised no direct influence in its production; and secondly, from its being found in organs where no traces of inflammation are perceptible during life, or after death. He adverts to examples, in which pus was found in coagula, contained in the cavities of the heart, and, as the particulars demonstrate, without any inflammation of that organ. After alluding to facts of this kind, recorded by Andral, Reynaud, and others, he observes: "But, there is another most important fact, which requires to be established, before we can understand how pus can be formed in coagula in the cavities of the heart, and that is the coexistence of suppuration in some other organ. I have never met with a case of anomalous formation of pus, either in the cavities of the heart, in the cellular or parenchymatous structure of organs, or in the cavities of serous membranes, without finding, at the same time, inflammation and suppuration to a greater or less extent in some remote organ. It may indeed be asserted that this is also the almost uniform result of the researches of other pathologists; although Andral, Maréchal, and some others have rather vaguely stated, that they have met with puriform matter in fibrinous concretions of the heart, without the presence of pus being detected in any other organ of the body." But, so far as Dr. Carswell's observations extend, the fluid matter of these concretions never resembles pure pus, but is a thin grumous grey, or reddish coloured fluid; and probably puriform in its nature, as it resembles the contents of those concretions which are formed during life in the cavities of the heart in some cases of inflammation of the internal membrane of this organ, succeeding to rheumatism

of the joints. "If such be the origin of puriform collections of this kind, they of course come under the head of suppuration, and do not form an exception to the law, that the formation of pus in the blood, and in other parts of the body, under circumstances which disprove its connection with inflammation, as cause and effect, has never been shown to take place, *without being preceded by suppuration in a remote organ.*" This important fact being admitted, Dr. Carswell considers the principal circumstances under which suppuration has been observed to precede these anomalous formations of pus; for instance, external suppurating sores, wounds, amputation, lithotomy, operation for fistula in ano, the excision of portions of diseased bone, fractures, phlebitis after external injuries, and parturition, &c. Then the situation of the pus in these cases appears to Dr. Carswell to deserve particular notice. "In the great majority of cases, this morbid product is found in the veins of the affected part. In idiopathic phlebitis; in phlebitis of the uterus following delivery; and even in phlebitis after blood-letting; it is sometimes found only in the veins; whereas in phlebitis succeeding to external injuries or operations, it exists often extensively, at the same time, in the intermuscular cellular tissue, in the canals and in the cancelli of the bones; it is found also in the smallest veins that can be traced by dissection, in the largest trunks of the extremities and pelvic viscera, and even in the vena cava. In some cases, the quantity of pus does not amount to a drachm; in others, it measures several ounces. The number of veins in which it is found, varies from a very few, small or large, to the whole of those of the arm, or forearm, or of the uterus. The arteries, in such cases, never contain any pus; nor have I met with it to any extent in the lymphatics, except in uterine phlebitis, in some cases of which these vessels were distended with it, the veins being in a similar state, or containing only a very small quantity."

With all these facts presenting themselves, Dr. Carswell joins Dance, Blandin, and Cruveilhier, in attributing the formation of anomalous collections of matter in remote parts of the body to the transmission of the pus from the veins in which it is formed, directly into the circulation, and not through the medium of the lymphatics. He believes also, with Velpeau, Maréchal, and Rochoux, that purulent deposits may be formed as a consequence of the separation of pus from the blood, and its subsequent accumulation in the capillaries, or cellular texture. (See *Carswell's Illustrations of the Elem. Forms of Disease*, fasc. 8.) For other remarks connected with this subject, see BLOOD, ABSCESS, PYÆMIA.

As every injury, or effect of outward violence, is more or less exposed to the surrounding air, the application of air to internal surfaces has been assigned as a cause of suppuration; but, certainly, the air has not the least effect on parts circumstanced as above, for a stimulus would arise from a wound, were it even contained in a vacuum. In circumscribed abscesses, the air cannot possibly get to the parts, so as to have any share in making them suppurate.

In emphysema, when air is diffused over the whole body, no suppuration is the consequence, unless an exposure, or imperfection of some internal surface, should be made, for the purpose of

allowing the air to escape. A stronger proof, that it is not the admission of air, which makes parts inflame, is, that the cells in the soft parts of birds, and many of the cells and canals of their bones, communicating with the lungs, and always containing air, never inflame; but if these cells are exposed in an unnatural way, the stimulus of imperfection is given, these cavities then inflame, and their surfaces either form adhesions together, or produce pus. (*Hunter.*)

When the interior of an abscess is examined, the cavity, which contained the matter, is observed to be lined with a smooth, membrane-like substance, which is of a whitish ash colour, and, in a recent case, has a strong resemblance to coagulating lymph. In examples of longer standing, and in old fistulæ, it assumes an appearance very much like that of mucous membrane, from which it differs, however, in containing no follicles; though, as Andral remarks, there are some mucous membranes in which the presence of follicles has not yet been demonstrated. (*Anat. Pathol. t. i. p. 257.*) Nor, as this distinguished pathologist has explained, are these cysts, resembling mucous membranes, only met with in abscesses of the loose cellular tissue. He has met with similar productions in the parenchyma of different organs, as that of the liver (see *Clin. Méd. t. iv.*), and once in the hemispheres of the brain, two cavities which were filled with pus, and united by a fistulous track, the cavities and the latter passage being all invested by a thin, greyish red smooth membrane, readily separable from the subjacent texture. (See *Andral, Anat. Pathol. t. i. p. 263.*)

The membrane-like investment of an abscess has been termed its *sac* or *cyst*. It seems in general to adhere by a vascular union to the surrounding cellular membrane, which is itself likewise denser in texture, and more vascular, than in the natural state (*Thomson's Lectures, p. 310*), its cells being closed by coagulating lymph, effused, in consequence of that species of inflammation which Mr. Hunter termed the adhesive. Thus, by the formation of a cyst, and the effusion of coagulating lymph in the cellular tissue around the abscess, the collection of matter is bounded, and cannot become diffused, as it otherwise would do, in the communicating cavities of the cellular texture, like the water in oedema.

Something like this diffusion of pus seems to occur in phlegmonous erysipelas. "But, in this case (says Professor Thomson), the vitality of greater or less portions of the cellular substance is destroyed; the deadened portions are converted into dirty, whitish, ash-coloured sloughs; and it becomes extremely difficult to say, whether any part of the pus, contained in the deadened cellular membrane, has been formed in the cells in which it is contained, or has been absorbed into these cells, after being separated from the parietes of the cavities containing the sloughs themselves." (*Lectures, &c. p. 310.*)

There can be no doubt, that, after an abscess has received a membranous lining, or cyst, the secretion of pus is continued from the surface of the latter part entirely, as well as whatever degree of absorption of the same fluid happens to be going on. In fact, the cysts must be both secreting and absorbing surfaces. The circumstances which leave no doubt of this point, are the frequent, sudden, or gradual removal of very large manifest

collections of matter; the continual changes occurring in the quantity and consistence of the pus, and the speedy filling of the cavity with purulent matter again, after the first contents of the abscess have been discharged.

The facts and opinions adduced by Dr. Carswell, in relation to the long disputed question, whether suppuration ever happens unpreceded by inflammation, I have already noticed. Professor John Thomson believes, that the affirmative on this point was first suggested by De Haen, of Vienna; but he thinks that much of the difference of sentiment in this matter has proceeded from the vague "notions entertained with regard to the symptoms which necessarily characterise the state of inflammation, and also with regard to the properties, by which pus is to be distinguished from other animal fluids. Accordingly, in almost all the examples which De Haen has adduced to prove the formation of pus, without the previous existence of inflammation, he has himself occasion to remark the exudation of coagulating lymph, and the existence of preternatural adhesions; phenomena which we now know are produced by that state which Mr. Hunter has denominated adhesive inflammation." But De Haen uses the term inflammation to express that state which we denominate ulceration, or ulcerative absorption; for, in speaking of the cases of suppuration which he has adduced, he observes, that "in many of them no previous loss or consumption of substance could be perceived." An observation, similar to this, was made about the same time, or perhaps a little earlier, by Dr. W. Hunter, and an account given of it in the second vol. of the *London Medical Observations and Inquiries*.

"Mr. Hunter, though he endeavours to establish it as an invariable fact, that no suppuration takes place, which is not preceded by inflammation, is of opinion, that collections of what he terms extraneous matter, something like pus, may form in various parts of the body, without the previous existence of inflammation in the parts in which it is formed; and accordingly you will find, at page 300 of his *Treatise on Inflammation*, a chapter entitled 'Of Collections of Matter without Inflammation.'"

Professor Thomson doubts, however, "whether these collections of matter, said to be formed without inflammation, would not have been more properly denominated scrofulous abscesses, or chronic suppurations. I am disposed to believe (says he) that, in whatever texture, or organ of the body, scrofula manifests itself, there inflammation will be found to exist. The phenomena, it is true, of inflammation, both local and constitutional, are modified by the existence of the scrofulous diathesis; but they are, I believe, always present in such a degree as to justify us in giving to them the name of inflammation, and in classing most, if not all local scrofulous affections, among inflammatory diseases. When the indolent swellings, of which Mr. Hunter speaks, occur near to the surface of the body, that part feels warmer than usual, as may be felt in white-swellings of the joints. The swelling also is either preceded or accompanied with some degree of pain, though, when the affection is internal, the patient may not always be very accurate with regard to the precise state of this pain. When cut into, the parts affected with scrofulous swellings are always found



more vascular than usual; in short, all the symptoms occur, by which the state of inflammation is characterised." (*On Inflammation*, pp. 313, 314.) In another place Dr. Thomson admits, that the matter, which is formed in chronic suppurations, does not always accurately resemble that which is formed in acute abscesses; yet he contends, that it is so analogous both in its physical and chemical characters, as well as in the circumstances in which it is produced, that he can see no reason why it should not be called pus, or a puriform fluid. (P. 315.) Sir A. Cooper also inculcates the common doctrine, that the formation of matter is preceded by inflammation, which, he says, in healthy persons is active, while, in the debilitated and scrofulous, it is often very slight, and the pus produced generally less perfect. Sometimes there is even such a change of action, that the products entirely differ, being in scrofulous abscesses serous and curdlike, or even chalky. (*Lectures, &c.* vol. i. p. 120.) The doctrine of Dupuytren likewise was, that abscesses never constitute primary diseases, but are constantly the effect, or termination, of previous inflammation of greater or less intensity, depth, and extent in the living textures. (See *Dict. de Méd. et de Chir.* t. i. p. 3.)

[Genesis of Pus. Since the publication of the preceding edition of this Dictionary in 1838, has arisen that school of pathology which is founded on microscopic investigation, and which has been enabled by this instrument to penetrate further into the secrets of nature than was thought possible by the illustrious men whose opinions have been quoted above. The cell theory, with its applications and modifications by the Goodsirs, Hughes Bennett, Lebert, Virchow, and Beale, has come into existence; and the arteries, instead of being considered the very seat of all living operations, as in Hunter's time, are now ranked merely as purveyors and distributors of blood; whilst the *real tissues*, the intervascular or extravascular, as they would have been called, are seen to be the real seats of suppuration, as of other pathological changes.

The problem is, to account for the production of this fluid called pus, apparently a stranger and alien to the healthy body, and to explain the origin of the liquid, and of the globules which the most unfit and imperfect microscopes detected in it.

We have seen Gendrin's explanation, based on a conversion of red blood into pus globules, which he believed he witnessed in the web of the frog's foot. It may suffice here to say, that observations on the conversion of red blood globules into pus have been revived. Professor Schaffhausen, of Bonn, at the meeting of German naturalists and physicians in 1867, declared that he had distinctly traced the formation of pus out of blood globules. He had seen the transition from the red blood into the pus corpuscle in carbuncles, in pustules of the skin, and in fresh hemorrhage from the kidneys. The change was one of fatty degeneration. Professor Schaffhausen's observations require to be repeated and confirmed (*Med. Times and Gaz.* 1867, vol. ii. p. 551), for it is not now believed that red globules are capable of such conversion. They are found in instances innumerable under conditions in which their conversion into pus by mere fatty degeneration would have been easy if it were possible. The process of pus formation, on the contrary, is believed to be one, not of de-

generation or decay, but of active growth; and pus to be one of a set of products whose vitality is far too great. The modern doctrine of pyogenesis makes it a point of tissue development, and every advance of histogenetic doctrine includes a deeper and deeper view of the formation and analogies of pus.

In accordance with the views promulgated by Schwann and Schleiden, all living organised tissues are composed originally of cells, living independent units, and the contributions and modifications which they undergo. A cell is said to originate in a *structureless* medium, as *blastema*, in the form of a nucleus, or small solid particle, which grows by accretion, forms around it a cell membrane, and acquires *contents* in the interval between the membrane and nucleus. Of cells, some in the animal body continue isolated; some coalesce (as epithelium); some are modified into tubes and fibres. Amongst those which continue isolated, are reckoned lymph cells, blood corpuscles, mucus and pus corpuscles. "Pus corpuscles are thus," says Schwann, "peculiar cells which are formed in the serum of pus—i. e. in cyto-blastema, exuded during inflammation, in increased quantity, and of anomalous composition:—precisely in the same manner that mucus corpuscles originate in mucus, and, indeed, as all cells form in this cyto-blastema, in accordance with the fundamental law laid down." (*Microscopical Researches into the Structure of Animals and Plants. Trans. from the German of D. T. Schwann, Lond. Sydenham Soc., 1847.*)

The doctrine of the origin of pus (as of other morbid cells) in a cyto-blastema, has been developed with singular ability by Dr. John Hughes Bennett, of Edinburgh, in his various works on microscopical pathology, beginning with his *Essay On Inflammation as a Process of Abnormal Nutrition*, 1844, and going on to his *Lectures On Molecular Pathology* (*Lancet, passim*, 1863). Inflammation, says Dr. Bennett, is a process of abnormal nutrition (see article INFLAMMATION) in which a liquor sanguinis of abnormal quantity and quality is exuded into the inflamed tissues. The exudation, whether it continue liquid, or, as more frequently happens, solidifies after the manner of coagulable lymph, constitutes a blastema. According to this author's "matured molecular theory of organisation," "the ultimate parts of the organisation are not cells nor nuclei, but minute molecules, from which these are formed. They possess independent physical and vital qualities, which enable them to unite and arrange themselves so as to produce higher forms. Amongst these products of the union of molecules are nuclei, cells, fibres, and membranes," &c. &c. (*Lancet*, 1863, vol. i. p. 56.) In accordance with this doctrine, Dr. Bennett shows a picture of red hepatization, in which the vessels of an inflamed lung are filled with *molecular* exudation—coagulable lymph, inflammation, exudation, &c. A second figure shows the molecules coalescing to form *cells*; a third, shows the whole exudation converted into pus cells.

Nothing can be stronger, however, than the opposition which Rudolph Virchow (*Cellular Pathology by Chance, Lond., 1860*, p. 27) gives to the molecular theory, or to anything which conceives that living elements can be produced out of parts destitute of shape, as formative fluids, blastema, cyto-blastema, and the like. He condemns this

doctrine, along with that of equivocal or spontaneous generation, of which he declares it to be an offshoot. A pus cell can no more arise from a conglomeration of molecules in a catarrhal fluid than a worm can. Where a cell arises, there a cell must have previously flourished—*omnis cellula e cellula*. Pus, says Virchow, is a "young tissue in which, amidst the rapid development of cells, all solid intercellular substance is gradually dissolved." The pus cells are the offspring of existing cells; they are created by luxuriant subdivision or proliferation of existing cells. There are two kinds of cells whose proliferation produces pus, and there are two categories of suppuration in correspondence—that of epithelial surfaces, and that of the connective tissue.

Suppuration of epithelial surfaces, says Virchow, is the more easy in proportion as the epithelium is stratified, as in the skin, urethra, &c. Those cell-elements, which under natural conditions should slowly generate successive layers of epithelium, are under inflammation converted into pus corpuscles. The cellular elements divide, nuclei become more abundant, and single cells have their places taken by several, which in their turn again provide themselves with dividing nuclei. It is not the case that an exudation is poured out which produces pus in itself; neither are pus cells independent new formations, formed by germs arising spontaneously in exuded fluids. Hence there may be every transitional stage between pus and epithelial cells: not that a pus cell is a mucous or epithelial cell in an *imperfect* state of development; it has taken a wrong development, and can never become a healthy epithelial cell. Suppuration in the connective tissue begins with an enlargement of the cells (or connective tissue corpuscles) with excessive multiplication and division of nuclei. Thus the part is swelled, and with swelling are the other phenomena of inflammation according to its kind. As the cell multiplication proceeds, so the affected tissue is infiltrated, broken down, or *abscessed* (see *ABSCCESS*), and a collection of pus is the result. The coverings, if they participate in the diseased process, gradually thin away under it, and so the abscess bursts; unless its progress to the surface is impeded by some structure as thick cuticle which is dead, or thick fascia which is incapable of ulceration. So far Virchow.

There can be nothing final in physiology and pathology until we know all. In the meantime every observer who has better instruments than his predecessors, and a greater gift at interpreting the phenomena which he witnesses, must bring forth new theories, which if they do not destroy preceding ones, at least absorb them, and show that what were formerly considered fundamental facts are but partial instances, capable of being comprehended under more general laws. Thus, Professor Beale has abolished the "cell theory" as a general doctrine, and has shown that the cell is not an essential but an accidental state of living matter in some of its simplest conditions. The cell, he says, is an occasional modification of living substance, but living substance in its most elementary state need not be a cell, nor form a cell. Space permits us here to state only, that Professor Beale believes that the active properties of life belong, not to the whole mass of the animal or vegetable, but to a certain portion of it, which lives, grows, and forms the rest; this he distinguishes as *germinal* matter.

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The rest of the substance of the tissues is laid down under the influence of this germinal matter, or grows out of it, and is called *formed material*. Thus, for example, in bone or tooth, the transparent soft substance contained in the lacunæ and canaliculi, and tubes, is living, germinal, formative; the earthy matter outside them is the product of their life, but is itself not living—it is formed, not formative. This germinal matter exists throughout the body, and its changes are of the most profound importance in natural growth, and in disease, which is unnatural growth. Small masses of germinal matter constitute what are called *nuclei*, which grow, absorb nourishment, and form around them an envelope as in epithelium and other cells. Pus, according to Dr. Beale, is not produced by the precipitation of particles from a clear exudation, as Dr. Bennett supposes. Neither is it formed, as Virchow supposes, from connective tissue corpuscles and epithelium only. The white blood corpuscle, the minute masses of germinal matter existing in the blood, lymph corpuscles, chyle corpuscles, the masses of germinal matter in the spleen and other ductless glands, those found in the walls of capillaries, germinal matter of nerve, muscle, and other tissues of the body, may give rise to pus, if placed under conditions in which they are too fully supplied with pabulum. (*Beale, The Microscope in Medicine, Lond. 1868, p. 200.*)

Pus, then, according to Dr. Beale's doctrine, consists of minute masses of germinal matter from one of the sources just enumerated, which, under the influence of some cause of disease, and of an increased supply of pabulum (such as is given by hyperæmia and exudation), grow abnormally, absorb nourishment, and convert it into the formed material which forms the so-called cell-membrane and contents, whilst themselves form the nuclei.

This is the fitting place for noticing Cohnheim's views on the mechanism of inflammatory exudation and pus formation, which have been so ably brought before us by Dr. Charlton Bastian. The advance of microscopic observation shows two things with regard to exudation; viz. that it is rendered easy by slits, which are produced in the capillaries when distended, and possibly by minute stomata, or apertures left in the original structure of these tubes; and secondly by the structure and behaviour of the blood corpuscles, red and white. As to their structure, they are capable of assuming any form that will fit any aperture; and as to their behaviour, the amœba-like movements of the white corpuscles would almost seem to indicate something of a force which impels them to linger, to adhere, and to find their own way through the coats of the capillaries. Dr. Beale cannot agree to this latter theory of the voluntary movement of the corpuscles. But when it is assumed that the pus formed in any abscess, or discharged from a suppurating surface, consists of white corpuscles, which have escaped from the capillaries in this manner, other considerations come in. For it cannot be admitted that white blood corpuscles are pus corpuscles, although they may, like other germinal matter, become the parent of them. (This whole matter, including Dr. Bastian's demonstrations before the Pathological Society, and Dr. Beale's criticisms, will be found in *Med. Times and Gazette*, 1868, vol. i.)

It would be giving a very imperfect account of the modern views of the genesis of pus, were we not to lay emphasis on the fact that pus, by its

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nature, is living material, and capable of increase and multiplication as such. "Pus corpuscles," says Dr. Beale, "should be obtained from a mucous or other surface at the time that they are growing and multiplying. Pus which is usually examined consists of *dead*, not of *living* corpuscles. These are spherical as represented in books, and many have a sharp, well-defined outline, owing to coagulation having taken place upon their surface. Thus the so-called cell-membrane or cell wall of the pus corpuscle has resulted." Pus (or rather its germinal matter) shows its living properties in three ways: by movement, by multiplication, and by those powers of propagation which it exhibits when acting as *contagium*. The most convenient form of pus for exhibiting its movements and multiplication, is said by Dr. Beale to be that from the mucous membrane of the bladder when chronically inflamed. "So far from the corpuscles being spherical, as usually figured and described, in many specimens not a single corpuscle of this form is to be detected. Every corpuscle exhibits little 'buds,' 'offsets,' or protrusions at every part of its circumference; and attentive observation, even under moderate magnifying powers, will convince the observer that the corpuscles are slowly undergoing alterations in form." The similarity of the behaviour of the germinal matter of pus to that of the *ameba* is pointed out. "One of the smallest particles detached from a pus corpuscle is capable of absorbing nutrient material, and growing into a corpuscle, having all the properties and powers of that from which it was derived." (*Ibid.* p. 64.)

Under inflammation the living germinal matter of an epithelial cell may absorb the surrounding substance, and may increase in size at the expense of the formed material it has already produced. Thus the germinal matter in one epithelial cell may row and separate into many pus cells.

We must return to this point when treating of the qualities of pus; meanwhile, we may complete this section with a short account of suppuration within blood-vessels, in clots, &c. This may be of three kinds: 1, an accumulation of white corpuscles of the blood; or, 2, a fluid formed by the softening down of previously existing clots; or 3, genuine pus. The white corpuscles of the blood exist in uncertain quantity, and of unknown use. They were early recognised by observers of the modern microscopic school, and thought to be pus, and many interesting but false conclusions were founded on these observations. For instance, Herbert Mayo, in 1839, pricked the skin in the vicinity of an ulcer of the leg, and having found white globules, which were conceived to be pus, announced the discovery of pus in the blood of the skin adjoining ulcers. In like manner the discovery by Galliou of similar bodies in the blood of patients who had died of puerperal fever and pyæmia, was thought to give a ready explanation of the pathology of those disorders. (See *R. Ferguson on Puerperal Fever. Lond. 1839.*) But it became known at length that they are a fluctuating constituent in all blood, and that an excess is connected with disorder of those ductless glands so called, the spleen, thymus, thyroid, and lymphatic glands, whose function is supposed to be the elaboration of the blood. Nevertheless, when the existence of that remarkable disease *Leucocythæmia* was discovered by Drs. Craigie and Hughes Bennett, of Edinburgh, in 1841-45, they mistook it

for pyæmia, and described it as such: it was Virchow who, in 1845, observed the disease independently, and gave it its true interpretation. We cannot enter into details here, except to state that *Leucocythæmia* is a kind of cachexia, attended with enlargement of the above-mentioned blood-making glands; that the blood drawn from a prick shows a large proportion of white globules; that if blood be taken in quantity and whipped to free it from fibrine, the red corpuscles sink, whilst the white float in the serum, which they render milky—a milkiness not removed by ether, as it would be if it were fat globules—and that the clot of blood, whether taken during life or found in the veins after death, contains large loose soft yellow coagula, consisting almost entirely of colourless corpuscles. (See *Gulliver, Lectures on Blood, Chyle, Lymph, &c., Medical Times and Gazette, 1863, vol. ii.; Hughes Bennett, Lectures on Molecular Pathology, Lancet, 1863; Virchow, Cellular Pathology, by Chance, &c.*; and a very useful and fair résumé in *Aitken's Science and Practice of Medicine, 4th ed. vol. ii. p. 67.*)

A fluid formed by the physical and chemical disintegration of clots may have most of the outward properties of pus, without the presence of the characteristic globules. Such a fluid may be produced by allowing fibrine to putrefy, and may be got from ulcerating, softening and decaying tissues, and from blood clots in veins in cases of pyæmic and blood infection. It presents under the microscope, oil globules, granules, amorphous particles, or in some cases imperfect cells something like those of pus, but without nuclei. (See *Henry Lee, Pathological and Surgical Observations, Lond. 1854, p. 91 et seq.*)

True pus is, however, often found in veins, sometimes in the open orifice of veins in a wound, or on the inner surface of the womb, sometimes in other parts of the venous and portal systems, which may have been implicated, by *contiguity* with an ulcer, abscess, or other suppurative disease. Thus, in a case of chronic ulcer of stomach, reported by Dr. Bristowe (*Pathological Transactions, vol. ix. p. 275*), suppurative inflammation of the entire thickness of the walls of the viscus was accompanied by fibrinous clots containing distinct pus, in many of the branches of the portal vein. This pus presented the ordinary reaction on the addition of acetic acid. "In the present state of our knowledge," says Dr. Dickinson (*Pathol. Trans. vol. xvii. p. 78*), we must confess to some uncertainty whether pus may be produced by the breaking down of fibrinous coagulum." But all evidence is tending to the fact, that though not every coagulum can soften into pus, yet that true pus may be produced by growth within some coagula.

It has already been stated, in accordance with the doctrines ably laid down by Mr. Henry Lee, that healthy blood, by coagulating in pus and other foreign substances, has the power of preserving itself from admixture, and the whole system from the peril of contamination. But the coagula, the safeguards of the venous system, may be displaced by mechanical means, and floated into the general venous current, and then many evils are likely to follow: for instance, the symptoms of cardiac and pulmonary embolism—with sudden death if the displaced clots be sufficient to fill the heart's right cavities or pulmonary vein; or slow death, if they block these passages incompletely and serve as nidus for the deposit of layers of fibrine;

or pulmonary inflammation and abscess, if they become entangled in the smaller branches in the lungs. But in other cases, septic fluids poison the whole mass of blood; or diseased germinal matter, whether in the shape of pus globules or not—more probably in far minuter forms—finds admission. Such diseased germinal matter may grow in and obstruct capillaries, producing local congestions; or may escape from them, producing exudations, rashes, boils, carbuncle, pustules, vesicles, and all the local phenomena that attend the exanthemata and other blood diseases. (See *Beale, Microscope in Medicine*, 3rd ed., p. 174.) Similar admixtures produce the deposit within the veins of separated fibrine, and the exudation into the joints and other parts, common in pyæmia, of morbid fluids quickly converted into pus. Yet it is not probable that pus is separated from the blood and deposited as such, but only its materials in the shape of fibrine and of germinal matter.

To our account of the genesis of pus we may add a few words on its dissolution. When it is not discharged from an abscess, its watery parts may be absorbed, its solid constituents form a creamy or putty-like mass; the individual globules undergo fatty degeneration and break up, and at last all are taken up by the blood-vessels. (See *Paget, Lectures on Surgical Pathology*, by Turner, 2nd ed. p. 295.) Much dead and inspissated pus is (like a dozen other things of similar appearance) called yellow tubercle by the makers of post-mortem examinations.]

#### QUALITIES OF PUS.

True pus has certain properties, which, when taken singly, may belong to other secretions, but which, conjointly, form the peculiar character of this fluid; viz. globules swimming in a fluid, which is coagulable by a solution of the muriate of ammonia. This fluid, like serum, is coagulable by heat. "Pus also contains abundance of fibrin: if water be poured upon pus, until the solid part, which remains at the bottom of the vessel, be entirely deprived of its serum and globules, numerous portions of fibrin are found remaining, and although not exactly of the same size, yet they have a great uniformity of appearance. Thus pus is composed of serum, fibrin, and globules; and (says Sir A. Cooper), if I were to hazard a theory upon this subject, I should say that pus was composed of the constituent parts of the blood, slightly changed in their character by inflammation." (*Lectures*, vol. i. p. 121.)

The colour and the consistence of pus are the two qualities which first attract the notice of every, the most superficial, observer. The colour arises from the largest portion of this fluid being composed of very small round bodies, much resembling the globules of cream. The fluid, in which the globules of pus swim, might at first be supposed to be the serum of the blood, for it coagulates with heat, like the latter fluid. Pus is also probably mixed with a small quantity of coagulating lymph; as it partly coagulates, after it is secreted. However, the fluid part of pus is found to have properties which serum has not. There being a similarity between pus and milk, experiments have been made to ascertain whether the fluid of pus could be coagulated with the gastric juice of animals; but no coagulation could be effected in this manner. A solution of muriate

of ammonia made the fluid part of pus coagulate; but not any other secretion, or natural fluid; and hence it was concluded, that whenever globules were found swimming in a fluid, coagulable by muriate of ammonia, the matter was to be considered as pus.

It was announced by M. Dumas, in 1828, that, amongst the component parts of pus, there is one exactly similar to caseum, which must therefore not be regarded as a product peculiar to the mammary secretion. (See *Andral, Précis d'Anat. pathol. t. i. p. 351.*)

"Formed by a process similar to that of secretion, the chemical composition of pus must vary, not only with the nature of the tissue from which it is derived, but likewise under the influence of various morbid conditions, which are known to modify the products of secretion in general. It is on this principle, that we explain the difference which exists, particularly at the commencement and termination of suppuration, between the pus furnished by serous and mucous membranes; the quantity of albuminous matter being much greater in the former than in the latter case, and, as has been observed by Gendrin, the pus furnished by the granulations in caries contains a greater quantity of the phosphate and muriate of lime; the puriform discharge of scrofulous ulcers a larger proportion of soda and the muriate of soda; and that which is found in the tissues surrounding the joints in gout, an excess of the carbonates, phosphates, and perhaps the urate, of lime." (See *Carswell's Illustrations of the Elementary Forms of Disease*, fasc. 8.)

The proportion which the white or yellowish opaque globules bear to the other parts of pus depends on the health of the parts producing the discharge. When the globules are very abundant, the matter is thicker and whiter, and is called *healthy pus*; the meaning of which, according to Hunter, is, that the solids which produced it are in good health; for these appearances in the matter are no more than the result of certain salutary processes going on in the solids, the effect of which processes is to produce the disposition on which both suppuration and granulation depend.

Besides the above properties, pus has a sweetish, mawkish taste, very different from that of most other secretions; and this, whether it be pus from a sore, or from an inflamed surface. It has likewise a smell in some degree peculiar to itself; but different in different cases. Some diseases, it is said, may be known by the smell of the discharge, as, for instance, gonorrhœa and ulcerated cancer.

Pus sinks in water, but mucus generally floats; not always, however, for the mucus secreted by the lining of the bladder, as is well known, always sinks to the bottom of the vessel in which the urine is received. The elastic viscous quality of mucus, a quality which never belongs to pus, seemed to Dupuytren a much better criterion. (See *Dict. de Méd. et de Chir. t. xi. p. 6.*)

Pus communicates to water a uniformly troubled white colour; mucus gives the appearance of stringy portions floating in it. Mucus is said to be more readily dissolved by sulphuric acid than pus is. It has also been asserted, that, if water be added to such solutions, the pus is precipitated to the bottom of the vessel; while the mucus, instead of being completely precipitated, forms swim-



ming flakes. These and other distinctions between pus and mucus are not however deemed of much importance at the present day, when pus is no longer regarded as a sure proof of the existence of ulceration.

Pus does not irritate the particular surface which secretes it, though it may be very irritating to any other. Hence no suppurating surface of any specific kind can be kept up by its own matter: if this had not been the case, no sore of a specific quality, or producing matter of an irritating kind, could ever have been healed. This is similar to every other secretion of stimulating fluids, as the bile, tears, &c., which fluids do not stimulate their own glands, or ducts, but are capable of stimulating any other part of the body. (*Hunter.*)

Whenever disease attacks either the suppurating surface or the constitution, the production of true pus ceases, and the fluid becomes changed. In general, it becomes fetid, thinner, and more transparent, and partakes more of the nature of the blood, as is the case with most other secretions under similar circumstances.—*Sanies* is the term usually applied by surgeons to pus in this degenerated state. This unhealthy sort of matter has more of the serum, and frequently more of the coagulating lymph in it, and less of the combination, which renders it coagulable by a solution of muriate of ammonia. It has also a greater proportion of the extraneous parts of the blood, which are soluble in water, such as salts; and it has a greater tendency than true pus to become putrid.

The secretion of pus is often suspended in fevers: while the constitution is thus disturbed, a sore will frequently appear almost dried up; but, on the subsidence of the fever, its surface will again secrete pus in abundance. This is a fact which every young dresser must have noticed. A similar check to the secretion of pus is also produced when a sore, or the parts immediately around it, are attacked by fresh inflammation. At the same time the pus is changed in its qualities, for it becomes a thin ichor, or a red fluid, composed of serum and red particles. (See *A. Cooper's Lectures*, vol. i. p. 123.) The qualities of pus, in fact, vary with every change in the state of the health and constitution, and, like other secretions, this fluid is altered by everything which excites, depresses, or deranges the system. The properties of pus in specific and infectious diseases are not indicated by any particularity in its appearance, nor has chemical analysis thrown any light upon this part of the subject. The pus of small-pox and of a venereal ulcer differs in no respect in its physical and chemical properties from that of a phlegmonous abscess. The nature of such pus can only be known by its action on the living body.

When the vessels lose the power of producing good pus, they also lose more or less the power of forming granulations. This may depend on some deviation from the due structure and action, which such vessels should possess, in order to be qualified for the performance of these two operations.

Pus has been suspected to have a great tendency to putrefaction; but this is not the case with pure pus, which, when first discharged from an abscess, is perfectly sweet. But, if the abscess has any communication with the air, while the matter is confined in it; or if the collection has

been so near the colon, or rectum, as to have been infected by the feces, then the matter will quickly become putrid. When blood is blended with pus; when sloughs are mixed with it; when the parts forming the seat of the abscess are in a gangrenous state from an erysipelatous affection, the matter has a greater tendency to putrefy than the pure pus discharged from sound abscesses or healing sores. Pure matter, though easily rendered susceptible of change, by extraneous additions, is in its own nature tolerably uniform and immutable. It appears so unchangeable, that we find it retained in an abscess for weeks, without having undergone any alteration. These qualities, however, only belong to perfect pus. If a healthy sore inflames, the matter now produced from it, though unmixed with extravasated blood, or dead solids, becomes much sooner putrid, and more irritating, than the discharge formed before this alteration of the ulcer. (*Hunter.*)

In the preceding paragraph it is stated that matter frequently remains unchanged in abscesses for weeks. This expression is not strictly correct; for, inasmuch as the cysts of abscesses are absorbing, as well as secreting surfaces, there must be a continual mutation going on in the contained matter.

In the words of one of the most eminent surgeons of modern times: "the functions of the proper membrane of an abscess are not restricted to containing the pus and forming a boundary for it in the midst of the adjacent textures. By means of the very active absorption and exhalation, which take place upon its surface, its contents are incessantly undergoing renewal, and its qualities modified, according to the different degrees of stimulation which it receives. An abscess is not altogether removed from the influence of life; on the contrary, it participates in it, though feebly and obscurely, like all other fluids collected in organic receptacles. It is through the medium of the living cyst that, in consequence of excitement of all kinds, the fluid of abscesses is seen to augment, or diminish in quantity, to become thicker or thinner, and often to be reached by substances introduced by the regular action of the absorbents, or by direct injection into the sanguiferous system. It is because the cysts of abscesses are connected by close sympathies with the principal centres of our organisation, that they rapidly feel the effects of the least stimulation of the viscera, and that medicines, internally exhibited, are sometimes so efficacious in bringing about the absorption of pus. The cyst of an abscess is its most important part: it is a special organ, of new formation, which takes rank, as it were, in the living economy, and is to be classed with those parts of it whose relations are the most conspicuous and the most active." (See *Dupuytren*, in *Dict. de Méd. et de Chir.* t. i. p. 7.)

When dead bone, or other extraneous bodies, are present, and keep up irritation, or when blood becomes mixed with the purulent matter, the discharge is always fetid and offensive. This state of it is one mark of the presence of carious or dead bone.

The discharge of an unhealthy sore blackens silver probes and preparations of lead. This effect is imputed by Dr. Crawford to the sulphuretted hydrogen gas, generated in such matter. (*Phil. Trans.* vol. lxxx. year 1790, p. 385.) Further

observations on pus may be found in an *Essay on the Differences between Pus and Mucus*, by Dr. Darwin, junior; and also in Dr. G. Pearson's Paper in *Philos. Trans.* 1811.

#### USE OF PUS.

Suppuration is sometimes regarded as a constitutional disease, changed into a local one, the former being supposed to be discharged, or thrown out of the body, either in the form of pus, or together with this fluid. Critical abscesses have been thought to be an example of this use of suppuration. It has also been imagined to carry off local complaints from other parts of the body, on the old principle of derivation, or revulsion. For this reason, sores or issues are sometimes made, before an attempt to heal up an ulcer of long continuance. Suppuration is sometimes excited with the view of making parts, such as indurated swellings, dissolve into pus; but it is by no means certain that it ever operates on this principle.

The secretion of pus has been looked upon as a general prevention of many, or of all the causes of disease. Hence, issues have been made to keep off universal, as well as local, disease. However, the use of pus is perhaps unknown; for it is formed most perfectly from healthy sores, and in healthy constitutions; and large discharges from parts not very essential to life, produce very little change in the constitution, and as little upon being healed up, whatever some may suppose to the contrary. (*Hunter*.) This is certainly the case with many old ulcers, the suppuration from which seems to have little, or no effect, in impairing the health.

When the surface of a sore is left uncovered, the thin part of the matter evaporates, and the thick part dries and forms a scab. Nature, therefore, seems to have designed, that one use of pus should be to make a cover, or protection, for ulcerated surfaces. But I cannot agree with what has been asserted (*Hunter*), that the natural healing of a sore under a scab usually takes place more quickly, than when surgical dressings are employed.

On ulcers, as would appear from certain microscopical observations, "the coagulated pus is rendered tubular by the extrication of its carbonic acid gas, and these tubes, or canals, are immediately filled with red blood, and thus connected with the circulation." If this point were established, Sir Everard Home conceives that there would then be little difficulty in making out the succeeding changes, by means of which the coagulated pus afterwards becomes organised. (*On the Conversion of Pus into Granulations or new Flesh*, in *Phil. Trans.* vol. cix. p. 109, Lond. 1819.) These statements may be curious; but I do not imagine that nature will let us trace much further the secrets here referred to.

Among the secondary uses of suppuration may be mentioned that of opening a communication between a disease and the external surface of the body; and that of leading to the formation of a passage for the exit of extraneous bodies, &c.

Though an abscess is sometimes dispersed by its contents being absorbed, this is not the usual course of the case; and the tumor, instead of diminishing, generally continues to increase, instead of subsiding, or remaining stationary. Under such circumstances the pus commonly advances either to the

skin or a mucous surface, in which an outlet for it is produced by an ulcerative process. Here we find that pus is subject to the general law of the animal economy, which tends to expel from the body all extraneous substances, capable of irritating and disturbing its textures. It is scarcely necessary to observe, that when pus makes its way into a cavity, passage, or organ lined by a mucous membrane, it finds almost as ready an outlet from the body as if the abscess had taken its still more frequent course to the cutaneous surface. If an abscess be near a mucous texture, then nature will often make the pus take this direction to discharge itself, instead of conducting it to the skin, which may be more remote. But we do not remark a similar tendency of abscesses to make their way into cavities invested by a serous membrane, because as this always constitutes a close sac, the advantage of an outlet for the purulent matter would not thereby be obtained. Illustrations of this disposition are afforded in abscesses in the vicinity of bones, or in the parietes of the abdomen or chest, or situated near fibrous or synovial membranes, where, instead of weakening the textures, abscesses frequently have the contrary effect, by thickening the periosteum, the pleura, the peritoneum, and the fibrous and synovial structures.

Notwithstanding the fact, that abscesses generally tend to the surface, and not to the great cavities and internal organs, which seem even to be frequently protected by a thickening of the textures interposed between them and the collection of matter, exceptions are sometimes noticed. If an abscess, situated in the parenchyma of the lungs, may occasion an adhesion of the pulmonary to the costal pleura, followed by ulceration of the intercostal muscles, and the formation of an outlet for the matter through the parietes of the chest, it is not less certain that purulent collections situated on the outside of the chest, in contact with the ribs, may insinuate themselves between these bones, press back the pleura, and be effused within that cavity. The son of J. L. Petit is said to have died from such a cause. Analogous occurrences have been observed in abscesses situated on the outside of the peritoneum, and especially in those which so commonly form in the inguinal region in women who have been recently delivered. The extension of an abscess into an adjoining cavity is also possible, where the matter is originally formed near a joint.

#### OF THE TIME WHEN ABSCESSSES SHOULD BE OPENED.

The following are generally regarded as cases in which an opening should be made, as soon as the slightest degree of fluctuation is perceptible, or sometimes even sooner.

1. Abscesses arising from extravasation or effusion of irritating fluids or matters in the cellular tissue. To this class especially belong urinary and fecal abscesses. Here the incision is necessary, not only for the discharge of pus, but of the effused matter, or fluid, which is the cause of irritation and suppuration. I may add, that, under such circumstances, a very free incision is required to fulfil these two important indications.

2. Abscesses preceded by intense inflammation, and situated in parts abounding in adipous cellular tissue; as, for instance, the verge of the anus, the neighbourhood of the rectum, the sides



of the neck, and the axillary, inguinal, and popliteal regions. In such cases, if an early opening be not made, the purulent matter spreads to a great extent in the cellular tissue, and an enormous denudation of parts, or separation of them from one another, is apt to ensue.

3. Daily experience teaches the surgeon that abscesses are seriously retarded in their progress to the surface of the body by the intervention of a fascia, or an aponeurosis. These are cases, therefore, requiring an early opening to be made, in order to prevent the matter from spreading widely in the interstices of the muscles, from detaching the vessels and nerves from their connections, and from forming numerous and extensive sinuses in various directions. Abscesses, under the fasciæ of the thigh, arm, forearm, and leg, come under the rule here specified, as well as collections of matter under the palmar and plantar fasciæ, and in the sheaths of tendons. Here, as Dupuytren observes, the practice of an incision is warranted as soon as the practitioner perceives œdema of the parts, a broad and undefined swelling of them, the phenomena attending the progress of internal abscesses, and a deep obscure fluctuation, following the ordinary symptoms of inflammation.

4. Abscesses in the parietes of the chest, or abdomen, in the vicinity of a serous membrane, should be opened without delay, in order to prevent with certainty the effusion of pus inwardly, an occurrence which, though rare, has sometimes happened. Certain abscesses of the neck, formed under the sterno-cleido mastoid muscle, call for an early opening; because they not only cause a considerable and very painful swelling, but the matter may easily descend towards the clavicle and chest, in the course of the vessels and nerves.

5. Abscesses in parts abundantly supplied with nerves and capillary blood-vessels, and which when inflamed, are accompanied by excessive pain or close confinement or strangulation of the textures, as whitlows, large painful boils, carbuncles, &c.

6. All abscesses producing serious disturbance, or interruption of the functions of very important organs, and thereby endangering life; as abscesses of the throat, or near the larynx, or pharynx; abscesses compressing the jugular veins, and threatening the patient with apoplexy or suffocation, &c. In such cases, if the practitioner were to defer making an opening until the swelling had softened, and the abscess had been perfectly formed, the patient would be in great danger of perishing ere such changes had taken place.

7. The generality of chronic abscesses should be opened early, more especially if the means usually resorted to for promoting the absorption of the matter present no prospect of success. By omitting to make an outlet for the matter, we allow the accumulation of it to increase, and sometimes the abscess then becomes dangerous from its mere size, the inner surface of it, or the cyst, acquiring vast magnitude. With respect to chronic abscesses, connected with diseased bone or diseased joints, and collections of purulent fluid in the synovial membranes, some directions will be found in other parts of this work. (See JOINTS; LUMBAR ABSCESS; VERTEBRÆ.)

"Those abscesses ought to be opened early (says Professor Thomson) that are situated in parts through which the matter is liable to become widely diffused. This is particularly the

case with abscesses that are situated on the fore-part of the neck, or in the cavity of the axilla, or by the side of the rectum. When matter is formed in the cavity of the axilla, if it does not speedily obtain an external outlet, it is very liable to pass up towards the clavicle in the course of the axillary plexus of nerves and vessels, or forwards under the pectoral muscle. I have repeatedly seen axillary abscess take both of these directions at the same time, forming one of the most painful and difficult cases to treat which occurs in the management of abscesses." Dr. Thomson also considers an early opening proper and necessary, when the matter is lodged, as in some cases of whitlow, in the sheaths of the tendons; when matter is formed under the periosteum; when it collects under fasciæ, or in the vicinity of large arteries, joints, or the greater cavities of the body; and also when the abscess is deep-seated. (See *On Inflammation*, pp. 336-338.)

With respect to making an early opening into abscesses situated near large arteries, I am not aware that any danger of the artery ulcerating, in consequence of the nearness of the pus, really exists. Therefore, some doubts may reasonably be entertained of the soundness of Professor Thomson's advice in this particular case, as the general rule of opening abscesses near large blood-vessels, in an early stage of the disease, would be objectionable on the ground of the practice exposing the vessels themselves to injury. Indeed, this well-informed writer distinctly mentions, in considering the subject in question, that the arteries are not very susceptible of ulcerative absorption. (P. 337.)

The making of an opening in certain abscesses should be deferred longer than in common instances. Such are collections of purulent matter, situated in internal organs, as the liver, spleen, kidney, and lungs, and producing an outward swelling. Dupuytren deems it most prudent not to open such tumor until the skin is inflamed, the only circumstance which can be depended upon as denoting the formation of those adhesions, by which alone the insinuation of the pus into the great serous cavities will be prevented.

#### OF THE PLACE WHERE THE OPENING SHOULD BE MADE.

If a free opening be not required, or making such free opening be not practicable, it is at least proper to make whatever outlet for the matter can be made in a depending situation. By this means, the pus will more readily escape, and all pressure arising from its confinement or lodgment will be prevented.

When circumstances forbid an opening to be made at the most depending part of an abscess, the surgeon should make a freer opening than would otherwise be required, press out the matter as often as necessary, and keep the sides of the abscess together with a compress and bandage. In some instances, the opening may be converted into one sufficiently depending, by keeping the patient in a desirable posture.

But abscesses are not always to be opened at the most depending part. The distance between the matter and the skin at this part is the common reason against the method. If an abscess is rather deeply situated, and points in a place which is higher than that where the main collection lies,

it is proper to make the opening where the conical eminence, or (as it is termed) the *pointing*, appears. Thus, if an abscess should form in the centre of the breast, and point at the uppermost part, which is often the case, it would be improper to cut through the lower half of the mamma, in order to make a passage for the matter in that direction. If an abscess should form on the upper part of the foot, it would be wrong to make an opening through the sole of the foot to get at the most depending part of the abscess; for, besides cutting such a depth of sound parts, a great many useful ones would be destroyed.

When the abscess did not point in a depending situation, Mr. Hunter preferred leaving the collection of matter first to burst of itself, and then dilating the opening as freely as necessary. By allowing abscesses to burst spontaneously, the opening is not so apt to heal as if made by art, and therefore, Mr. Hunter conceived, better, in such situations.

In most cases, however, it is decidedly better even to cut through a certain thickness of parts, for the sake of obtaining a depending opening, than to make the opening where the pointing appears; that is, where the parts are thinnest, and the matter is nearest the surface. This advice is worthy of remembrance, when there is no doubt of the existence of matter at the depending place, and when the parts to be divided are not important. Collections of matter beneath the fasciæ of the forearm and thigh particularly demand attention to this direction, as they commonly point where those fibrous expansions are thinnest, not where the matter can most readily escape. Abscesses in the sheath of the rectus abdominis should also be opened in a low situation.

#### DIFFERENT METHODS OF OPENING ABSCESSES.

All abscesses will sooner or later naturally burst of themselves, unless the matter be absorbed; and sometimes they ought to be allowed to take this course. There are, however, as I have already explained, particular circumstances which urgently require an early opening; but, when the skin over the abscess is very thin, it is not of much consequence, whether the case be permitted to burst of itself, or it be opened by the surgeon.

When abscesses are large, it is generally necessary to open them by art, whether they have burst of themselves or not; for the natural opening will seldom be sufficient for the completion of a cure; and, although it may be sufficient for the free discharge of the matter, yet these abscesses will heal much more readily when a free opening is made; for the thin skin over the cavity granulates but indifferently, and therefore unites but slowly with the parts underneath. (Hunter.)

Abscesses may be opened either with a lancet or knife, or occasionally by making an eschar with caustic. Against the latter plan, however, strong objections generally lie: the use of caustic is not usually attended with any advantage which may not be obtained by a simple puncture or incision: upon a tender inflamed part it gives much more pain; it is more slow in its effects; and the surgeon can never direct its action so nicely as to destroy exactly the parts which he wishes, and no more. If the eschar be not made deep enough, the lancet must, after all, be used. Caustic also leaves

a disagreeable scar, a consideration of much importance in the female neck or face. To these numerous objections I may add, that the eschar is frequently ten or twelve days in becoming detached. It is seldom, except when there is a redundancy of skin, or when there is a good deal of it thinned and undermined, that caustic should be preferred. It may sometimes be advantageously resorted to when there is a good deal of indolent hardness around a small abscess.

For this purpose, the *potassa cum calce*, or the *potassa* alone, is the best caustic. The part is first to be covered with a piece of adhesive plaster, which has a portion cut out exactly of the same figure and size as the opening intended to be made in the abscess. The end of the caustic is then to be dipped in water, and to be rubbed on the part till the skin becomes brown. The surface is now to be immediately washed with some wet tow, the plaster is to be removed, and an emollient poultice applied.

In almost all cases it is better to use the lancet, double-edged bistoury, or sharp-pointed narrow knife. Either of these instruments opens the abscess at once, and with less pain than results from caustic; it occasions no loss of substance, consequently a smaller cicatrix; and, by using it, the opening may be made in the most advantageous direction, and of the exact size required.

#### QUALITIES OF PUS.

[It is most difficult to condense into moderate compass the history of the progress made in the knowledge of the properties of pus during the last thirty years. We will attempt it under the following heads:—

(a) *Physical Qualities.*—Of its naked-eye characters we need say little more. It is a homogeneous creamy liquid, of yellowish-white colour, easily miscible with water, but forming a sediment at the bottom of the vessel if allowed to rest. Its specific gravity is from 1030 to 1033. Examined under the microscope, it shows globules floating in a clear liquid. Taking the words of one of the earliest and ablest microscopic observers, these are perfectly globular in form, and vary in size from  $\frac{1}{100}$ th to  $\frac{7}{15}$ th of a millimeter (or from about  $\frac{2}{3000}$ th to  $\frac{8}{3000}$ th of an inch) in diameter. Their surface is finely granular. They have a regular, well-defined edge, and roll freely in the liquor puris upon each other. On the addition of water they become much increased in size, their finely granular surface disappears, and they become more transparent. Weak acetic acid partially, and the strong acid completely, dissolves the cell-wall and brings into view the nucleus, which generally assumes the appearance of two or three granules close together, each with a central shaded spot. They are generally about  $\frac{1}{400}$ th of a millimeter in diameter. Occasionally the nucleus may be thus seen to be composed of four or even five granules. (Hughes Bennett on Cancerous Growths, &c., Edin. 1849, p. 156.)

On this reaction the general diagnosis of pus is founded; a creamy liquid containing abundant globules, which on the addition of acetic acid become transparent, and show a two- to five-partite nucleus.

When urine or other liquid mixed with pus is exposed to heat, after the visible parts have subsided it becomes opaque from the coagulation of the serum.



Pus, when thin, lets fall an opaque deposit of corpuscles, leaving a thinner supernatant layer of serum. In some cases it is so dense that not a drop of clear liquor can be separated. It is not known to coagulate spontaneously. In the rabbit, after wounds and experiments, collections of pus form under the skin, constituting firm cheesy crumbling masses, covering the whole animal like a coat of mail. (*Kühne, Lehrbuch der physiologischen Chemie, Leipzig, 1858.*)

(b) *Chemical Composition and Qualities.*—Pus yields in chemical analysis, according to Gorup Besanez, as *constant ingredients*—Water, albumen, fats (oleates and palmitates of glycerine), soaps (oleates and palmitates of alkalies), cholestearin, cerebrie acid, and phosphorised fat, extractive with leucin; salts, especially chloride of sodium, alkaline phosphates and carbonates, sulphate of lime, earthy phosphates and iron.

*Occasional ingredients*—Mucus, pyin, casein (?)

chondrin, gluten, chlorodinic acid, pyocyanin, bile acids and pigments, sugar and urea.

The solids of pus vary very much in quantity in different cases. Thus, Scherer found 12·8 per cent. in the pus of a psoas abscess just opened, and only 4 per cent. in the thin alkaline discharge some days afterwards. Usually, they are from 10 to 16 per cent., and when burned leave 5 or 6 of inorganic ash, of which chloride of sodium is the most abundant ingredient. According to Nasse, 1000 parts of pus serum contain 12·6 of chloride of sodium; 100 parts of ash of pus contain 72·33 of the same. It specially belongs to the serum. (*Kühne.*)

The following table, extracted from Gorup Besanez (*Textbook of Physiological Chemistry, Brunswick, 1862*), gives an interesting view of the relative composition of liquor sanguinis, serum, and pus:—

In 1000 Parts	BLOOD PLASMA	BLOOD SERUM	Pus					
	C. Schmidt	Scherer	Bödeker	Lassaigne	Von Bibra			
					I	II	III	
Water . . . . .	901·51	960·60	887·6	902·0	907·0	862·0	769·0	
Fixed material . . .	98·49	93·40	112·4	98·0	93·0	138·0	231·0	
Fibrin . . . . .	8·06	—	—	—	—	—	—	
Albumen . . . . .	—	77·62	43·8	60·0	63·0	91·0	180·0	
Extractive . . . . .	81·92	5·15	—	—	20·0	29·0	19·0	
Mucus, pus corpuscles	—	—	46·5	—	—	—	—	
Cholestearin and fat .	—	—	10·9	25·0	9·0	12·0	24·0	
Chloride of sodium . .	—	—	5·9	—	—	—	—	
Other salts of alkalies.	8·51	9·45	3·2	13·0	6·0	9·0	9·0	
Earthy phosphates and iron . . . . .	—	—	2·1	—	—	—	—	

Dr. W. H. Dickinson (*Med.-Chir. Trans.* vol. 1. p. 48) calls attention to the fact that the analyses of pus in Simon's *Chemistry* by Güerboch and Valentin show the soluble or alkaline salts of its ash to be to the insoluble in the proportion of 5 to 0·7, and in another case of 4·7 to 0·62. According to Nasse, in 1000 parts of blood serum the alkaline salts amounted to 7·1; in 1000 parts of pus serum to 15·32. Lehmann affirms that the ash of pus contains 6·9 per cent. of potass, whilst the ash of blood contains only 4·8 per cent. This chemist infers that "the ash of pus always contains a larger quantity of phosphates and potass than the intercellular fluid of the corresponding blood." Dr. Dickinson shows that in the case of a child with dilated bronchi, who coughed up daily about  $3\frac{1}{2}$  ounces of pus, this contained ·922 grammes of mineral matter, of which ·867 gramme (about 13 grains) was alkaline, and ·055 earthy. The alkalies consisted of soda ·275, potass ·113. In pus from a psoas abscess, 100 parts contained, of potass ·504, soda ·476, earthy salts ·2. The significance of these analyses will be adverted to presently.

The cells of freshly-formed pus, says Kühne, exactly resemble white blood corpuscles, and exhibit lively contractile movements. Fine glancing particles are more abundant in pus corpuscles than in white blood-cells, and nuclei are rather more numerous. Indented nuclei appear to be always produced when pus loses its vitality, especially on the addition of water or diluted acid. The fine particles are supposed to be fatty. Changes in pus

are speedily induced by standing, especially in a warm place.

By the addition of salts, pus can with some difficulty be filtered and its corpuscles separated. When the thickish mass left behind has been washed with water, and then with a ten per cent. solution of common salt, a thick slimy mass is formed, which is precipitated with water. This precipitate gives the reactions of myosin. (*Hoppe-Seyler.*) Pus serum closely resembles blood serum; it is fibrino-plastic, it contains para-globulin, and after being treated with carbonic acid it throws down a precipitate with dilute acetic acid (albuminate of potass), and it coagulates like blood serum at a temperature of about 167° F. (75° C.) from the serum-albumen it contains. According to Hoppe also it contains myosin. The pus of abscesses may be either strongly acid, or strongly alkaline from ammonia produced by decomposition, and besides the above components may contain protagon, cholestearin, soap, free, fixed, and volatile fatty acids, gluten, chondrin, leucin, tyrosin, xanthin, chlorodinic acid, pyocyanin, bilirubin, urea, and sugar. As to the existence of casein in pus, the albuminate of potass already alluded to is identical with this substance. (*Kühne.*) Of the bodies nearly allied to these albuminoid substances, mucin, chondrin, and gluten might be looked for in pus. Mucin has not, however, been discovered, although carefully sought for by H. Fischer; but Bödeker has found the two others in abscesses following congestion several times in association, but gluten alone, he only

found once. It is not certain whether these pre-exist in the serum or in the cell-walls of the corpuscles. Chondrin probably comes from cartilage when the pus is connected with joints, the glutin from the gelatinous connective tissue. So glutin is found in leucocythæmic blood from the multitude of white corpuscles therein contained. (*Seherer.*)

By rubbing pus corpuscles with quartzose sand and exhausting with ether, protagon may be obtained. The quantity of phosphorus sometimes found in pus is explained by the presence of this body. The fixed fatty acids, palmitic and stearic, sometimes separate from acid pus after standing; they appear in a crystalline form and in considerable abundance. In fresh weakly alkaline pus (the normal condition) these exist as soaps. Pus serum, after the addition of acetic acid, forms on its surface a collection of oil drops (oleic acid). The cholestearin contained in pus separates in pretty rhombic plates. The volatile fatty acids only appear after considerable change in the pus, either in the body or out of it. They give rise to the strong acid reaction already alluded to. H. Fischer, by distilling normal pus of a weak alkaline reaction with tartaric acid, failed to obtain any of them; but when the pus was either very acid or very alkaline, he thus obtained formic acid, butyric acid, &c. The name of chlorodinic acid was given by Bideker to a substance existing in the pus of phosphorus necrosis, and of congestive abscesses, as well as in cancer juice. It is separated with some difficulty, and gives even when very dilute with chlorine water a rose-red colour; when more concentrated, a darker red. The reaction is not uncommon with other decaying animal substances. Sometimes pus itself will be reddened with chlorine water. Bilirubin and the bile acids are found in the pus of jaundiced persons, sugar in that of diabetics. The dark orange or brown colour occasionally assumed by pus is not due to bilirubin, but to some other uninvestigated colouring matter. (*Kühne.*)

The frequently observed blue colour of pus depends, according to Lücke, on the presence of a kind of vibrio which grows on suppurating surfaces. This explains the fact that healthy wounds can be made to produce blue pus by placing on them a small quantity of blue material removed from another sore. The blue substance (pyocyanin) is soluble in chloroform, whence it may be made to separate by dilution in blue needle-shaped crystals. This blue is reddened by acids and restored by alkalies, like that of litmus. It is destroyed by chlorine, fuming nitric acid, and ozonized oil of turpentine. In chloroform it after a time becomes green, and then yellow, changing, according to Fordos, into pyoxanthose, a substance reddened by acids and turned violet by alkalies.

(c) *Vital Properties.*—Besides physical and chemical qualities, pus is, at first, a living thing, and, as such, possesses properties other than those that belong to the dead fluid as it is submitted to the microscope and test tube. Whatever may be our ideas on the nature of life, and whether we say, with Hughes Bennett, that the formation of pus is due to molecular aggregation—or, with Virchow, to growth from pre-existing corpuscles—or, with Beale, to the overgrowth of germinal matter—pus must be considered as a living thing at first, although it soon loses its life if exposed to cold or chemical agents. It ranks with the white blood corpuscles, the younger mucous, epithelial and cuticu-

lar cells, and with other embryonic particles. True it is an abortive form, but, as was pointed out by Sir E. Home (*On Ulcers, Lond. 1801, pp. 35 et seq.*), it has in itself in an early stage the potentiality of development. Pus is one form assumed by those minute living masses which are called granulation cells; and these are indistinguishable from white blood corpuscles. (*Paget, Surgical Pathology, by Turner, 2nd ed., Lond. 1863, p. 173 et seq.*) As Virchow says, the difference between pus and white blood corpuscles is one of origin, place, and function, rather than of visible structure (*Cellular Pathology, by Chance, Lecture 7*); the illustrious pathologist H. Lebert also declares that, as to visible properties, "leur spécificité n'est pas absolue," and that reason and good sense must be called in to give their stamp to inferences from microscopical observation. (*Traité d'Anatomie pathologique, Paris, 1857, fol. tome i. p. 45.*)

a. Of the properties of living matter which recent pus possesses, we may first particularise movement. "Pus," says Beale, "which is usually examined, consists of dead, not of living corpuscles." Their spherical, sharp, well-defined outline is owing to coagulation having occurred upon the surface. Thus the so-called membrane or cell-wall of the pus corpuscle has resulted. In real living pus, in many specimens not a single corpuscle of this form is to be detected. Every corpuscle exhibits little buds, offsets, or protrusions, and these are in constant motion, like that of the amœba. The same, says Beale, is the case with the living particles of vaccine lymph; with the mucous corpuscle, young epithelial cells, and the germinal matter of ova.

This movement, says Beale, is not ciliary or contractile, but primary and vital. It is manifested by these corpuscles, which are "free masses of living germinal matter, destitute of any firm cell-wall, embedded in a fluid medium, and free to move in every direction." It can be witnessed by placing a very small quantity of recently secreted pus on a warmed slide, covering it very carefully with thin glass, and interposing a few hairs to prevent pressure.

β. Besides movement, pus possesses power of growth and multiplication. "The smallest particle detached from a pus corpuscle is capable," says Beale, "of absorbing nutrient material and growing into a corpuscle, having all the properties of that whence it was derived." (*The Microscope in Practical Medicine, by Lionel S. Beale, M.B., F.R.S., 3rd ed., Lond. 1867, p. 64.*)

γ. If pus lives, grows, and multiplies, it must have the power of absorption and assimilation, and it may be taken for granted that its normal pabulum is the liquor sanguinis. But there is little doubt that pus in the normal or development stage is capable of absorbing the material of, and of disintegrating any living tissue, within the interstices of which it is developed. This happens in the ordinary process of an abscess to the surface.

δ. These vital properties of pus often continue to exist, though in a latent state, when particles of pus (which, of course, may be much smaller than the ordinary globules) are transferred from one part of the body to another, or to another individual, or lifted into vapour into the air. These living particles may be infectious and contagious. Implanted in a fresh mucous membrane, they may there grow and multiply, and may do two things besides—communicate to the existing epithelium



the tendency to rapid growth, and force the blood-vessels to bring adequate pabulum for their maintenance. Hence an inflammation of mucous membrane or catarrh.

ε. Contagious pus (and the same of contagious liquids that are not pus, e.g. lymph or the fluid of a chancre) has, amongst other vital qualities, a force of *atavism*, whereby it reproduces in its new habitat the characters of the diseased surface whence it originated. The nature of this force is quite incomprehensible; but whatever it be, it is at the bottom of the difference between the results of the implantation of pus from a languid, and from an actively inflamed mucous surface.

ζ. It follows, that our predecessors were hardly correct in asserting that pus does not irritate. It is true there are some abscesses whose contents are so little irritating, that the serum first, and the corpuscles after, having undergone fatty degeneration, are absorbed. But far more frequently pus irritates like a foreign body, and must be got rid of; all sinuses, passages, and hollows that harbour pus must be laid open, or they will not heal. Copious suppuration is a sign that pus is pent up: nothing so checks copious suppuration as getting rid of the pus; the best applications to suppurating surfaces are such as kill pus. The pus of diseased lungs irritates the throat, and causes the peculiarly debilitating sore-throat of the consumptive. Any tissue bathed in pus may ulcerate, even the carotid or femoral artery. (See *Busk, Med.-Chir. Trans.*, vol. xxix.)

(d) *Consequences of suppuration.*—α. The beneficial effects of suppuration, spontaneous or artificial, have been dwelt on in the text. There is no doubt but that spontaneous inflammation and suppuration may sometimes “carry off” some material elements which cause impaired health. Of the benefits of suppuration artificially produced, the opinion of the profession is less favourable than it was thirty years ago.

β. That the process may be intensely injurious needs no demonstration. Whatever the nature of *vital force*, it is clear that there must be a great expenditure of it in the evolution of this embryonic tissue, and a great expenditure likewise of material. Hence the wan, ill-conditioned looks of persons subjected to this drain, and the necessity of good diet and tonics.

But besides the general ill consequences of suppuration, Dr. Dickinson has attempted to show that it is the parent and precursor of a special form of mischief—to wit, that pale, waxy, or fibrous infiltration and degeneration of liver, kidneys, and other organs, which has, under the influence of a particular theory, been called the *amyloid*. Dr. Dickinson's theory is this: the “so-called ‘amyloid’ or ‘waxy’ deposit consists of dealkalised fibrine.” That it is deficient in alkali is shown by the facts that it loses its characteristic reactions when allowed to absorb potass or soda, and that waxy degenerate organs yield on analysis a smaller proportion of alkali than do the same organs in health. Ordinary fibrine and albumen can be made to exhibit the same reactions as “amyloid” tissue, if deprived of alkali by artificial means. The morbid deposit is of the nature of a residuum, and occurs in cases in which the system has been drained of alkalies, and contains an excess of fibrine, with deficiency of potass and soda. In five cases out of six, the cause of the loss of alkali

is the drain of suppuration. Other conditions, Dr. Dickinson allows, may produce the same result. Dr. Dickinson gives several series of cases of amyloid disease in which extensive suppuration—as from disease of bone, ulcers, phthisis, or pyelitis—was the forerunner and accompaniment, and, as he thinks, the cause. This view has been much challenged by other pathologists, and, no doubt, must be well sifted before it is accepted. Of course it may be possible to find series of cases in which suppuration has not been a marked feature; nevertheless, suppuration may be the most frequent cause, whether absolutely or concurrently. Anyhow, Dr. Dickinson has added to our precise knowledge of the exhausting conditions of the loss of pus.

(e) *Death and Decay of Pus.*—That pus may die, and undergo septic changes, is manifest from the phenomena of *hectic*, and from the observed fact that abscesses, chronic and quiescent for a time, may suddenly give rise to a train of symptoms arising from absorption, which imply a change in the matter absorbed. Pus, when absorbed totally, usually breaks up into an emulsion of minute fatty particles; if it become of the consistency of curd or putty, it is much more difficult of absorption, and after remaining an indefinite time may create ulceration and abscess.]

R. Druitt.

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**SURGERY**, or **CHIRURGERY** (from *χελρ*, the hand, and *ἐργον*, work), has been sometimes represented to be that branch of medicine which principally effects the cure of diseases by the application of the hand alone, the employment of instruments, or the use of topical remedies. Such definition, however, conveys but a very imperfect idea of the nature of this most useful profession, and, as applied to the present state of practice, cannot be said to be correct. It might, indeed, be applicable to that short unfavoured period of surgery, some centuries ago, when its practice, was denounced by the Council of Tours, as unfit for the hands of priests and men of literature, and when the surgeon became little better than a sort of professional servant to the physician; the latter alone not only having the sole privilege of prescribing internal medicines, but even that of judging and directing when surgical operations should be performed. Then the subordinate surgeon was only called upon to execute, with his knife or his hand, duties which the more exalted physician did not choose to undertake; and, in fact, he visited the patient, did what was required to be done, and took leave of the case, altogether under the orders of his master. In modern times, however, the good sense of mankind has discovered that surgery is deserving of an eminent rank amongst those arts and sciences which ought to be cultivated for the benefit of society at large; that the man who is not himself accustomed to the performance of operations cannot be the best judge of their safety and necessity; and that, in every point of view, the surgical practitioner merits as much favour and independence, in the exercise of his profession, as he whose avocation is confined to physic. Hence, the surgeon is

now exclusively consulted about many of the most important diseases to which the human body is liable. Being no longer under the yoke of the physician, he follows the dictates of his own judgment and knowledge; he prescribes whatever medicines the case may demand, internal as well as external; and under the encouragement of an enlightened age, he sees his profession daily becoming more scientific, more respected, and more extensively useful.

Surgery, as Mr. Lawrence has stated, is a branch of that science and that art which have diseases for their object. This science, considered generally, embraces the physical history of man. It investigates the construction of the human body, and its living actions; it inquires into the purposes executed by each part, and into the general results of their combined exertions; it observes the human organisation under all the various modifications impressed on it by surrounding influences of all kinds; and it draws from these sources the rules for preserving health and removing disease. The practical application of these rules constitutes the *art of healing*, or rather of *treating disease* (for, in many cases, we are unable to *heal*, and do not even attempt it), while the assemblage of facts and reasonings, on which these practical proceedings are grounded, make up the *science of medicine*.

By some writers, physic is said to have for its object the treatment of internal, surgery that of external, diseases. This definition, however plausible it may at first appear, can only be received with numerous exceptions in regard to modern practice: for instance, necroses of the shafts of bones, psoas abscess, stone in the bladder, polypi and scirrhus of the uterus, strictures of the œsophagus, urethra, and rectum, an extravasation of blood within the skull, in consequence of accidental violence, are universally allowed to be strictly surgical cases; yet no man in his senses would call these disorders external.

As Mr. Lawrence has pertinently observed, "Nature has connected the outside and inside so closely, that we can hardly say where one ends and the other begins. She has decreed that both shall obey the same pathological laws; and has subjected them to such powerful mutual influences, that we cannot stir a step in investigating the diseases of either, without reference to the other. How deep would the domain of surgery extend, according to this view? Half an inch, or an inch? The entrance of the various mucous membranes presents a series of puzzling cases; and the distribution of diseases in these situations, between the two branches of the profession, is quite capricious. How far is the surgeon to be trusted? He is allowed to take care of the mouth. Where is he to stop? At the entrance of the fauces—in the pharynx—or in the œsophagus? Inflammation and ulceration of the throat from syphilis belong to the surgeon; catarrhal affection of the same membrane to the physician. Polypus and ulceration of the nasal membrane are surgical; coryza is medical. The affections of the bones and joints have been given to the surgeon; yet they can hardly be called external parts. In hernia and aneurism, there is external tumour; but it is produced by displacement or disease of organs that are quite internal.

"When we look to the nature and causes of



disease, the absurdity of the distinctions now under consideration is still more apparent, and the inseparable connection between the interior and exterior of our frame more obvious. Internal causes produce external disease, as we see in erysipelas, carbuncle, nettle-rash, gout, cedema; while external agencies affect inward parts, as in catarrhal rheumatic affections, in various inflammations of the chest and abdomen."

Others have defined surgery to be the mechanical part of physic, "*quod in therapeia mechanicum*;" but, although this has obtained the assent of so eminent a surgeon as M. Richerand (*D'ct. des Sciences Méd.* t. v. p. 85), I believe few on this side of the water will be of his opinion. The late Mr. J. Pearson observed: "Many people have imagined that, when a man has learnt the art of dressing sores, of applying bandages, and performing operations with a little dexterity, he must necessarily be an accomplished surgeon. If a conclusion so gross and fallacious had been confined to the vulgar and illiterate, the progress of scientific surgery would have suffered little interruption; but if young minds are directed to these objects, as the only important matters upon which their faculties are to be exercised, if the gross informations of sense constitute the sum of their knowledge, little more can be expected from such a mode of study than servile imitation or daring empiricism. Indeed, some people have affected to oppose surgery as an *art*, to medicine as a *science*; and if their pretensions were justly founded, the former would certainly be degraded to a mere mechanical occupation. But it is not very easy to comprehend the grounds of such a distinction. The internal and external parts of the body are governed by the same general laws during a state of health; and if an internal part be attacked with inflammation, the appearances and effects will bear a great similarity to the same disease situated externally; nor are the indications of cure, in general, materially different. If by science, therefore, be meant 'a knowledge of the laws of nature,' he who knows what is known of the order and method of nature, in the production, progress, and termination of surgical diseases, merits as justly the title of a scientific practitioner as the well-educated physician. The practical parts of physic and surgery are very frequently disunited; but their theory and principles are indivisible, since they truly constitute one and the same science." (*Principles of Surgery*, Preface.)

As a learned Professor notices, the limits between physic and surgery are not very precisely marked, and the respective functions of the physician and surgeon, long as those names have existed, are still but very inaccurately defined. "The most superficial acquaintance with the symptoms, progress, and termination of the various morbid affections, to which the human body is liable, must be sufficient to convince every unprejudiced inquirer that there is but a slight foundation, if indeed there be any, for this distinction in the nature of the diseases which these practitioners are required to treat, or in the modes of treatment by which the diseases themselves may be cured or relieved. Experience has long shown, that the use of internal remedies is not only required in a large proportion of the diseases, which are regarded as strictly chirurgical, but also, that

there are few diseases which come under the care of the physician in which morbid affections requiring the manual aid, or practical skill of the surgeon, do not frequently occur.

"The treatment of febrile and internal inflammatory diseases, it will be allowed, belongs exclusively to the province of the physician wherever the distinction between physician and surgeon has been introduced and is rigidly observed; yet, in some species of fevers, and in all internal inflammatory diseases, blood-letting is often the principal, if not the only, remedy that is required. But this is an operation, however urgent the necessity for it be, which from engagement the physician cannot, and, from the fear of degrading his province of the profession, will not perform. Retention of urine not unfrequently takes place in symptomatic febrile diseases, and this is an affection which does not always yield to the use of internal remedies; but it is an affection also, from the painful uneasiness which it immediately excites, as well as from the danger which it threatens, that will not admit of delay. When internal remedies, therefore, fail in relieving the patient, the urine must be speedily drawn off by means of a chirurgical operation; otherwise inflammation, mortification, and rupture of the bladder, must necessarily ensue. Febrile and internal inflammatory affections terminate not unfrequently in the formation of fluids, which it is necessary to let out by a chirurgical operation; and abscesses, fistulous openings, and ulcers are formed, which require the aid of the surgeon. In patients, also, affected with severe febrile diseases, from being long fixed down to their beds in one position, some of the parts of the body, upon which they rest, occasionally acquire a disposition to mortify; larger or smaller portions of the skin and subjacent cellular membrane becoming dead, separate from the living parts, and sores are formed, which are but too often the subject of unavailing chirurgical practice. To employ, in the different stages of this species of mortification, from its first commencement to the complete separation of the dead parts, and the formation of a new skin, the appropriate external and internal remedies, requires a greater share of chirurgical skill than can reasonably be expected in those who make a profession solely of physic. Unhappy, therefore, must be the lot of that patient who, in circumstances similar to those which I have described, has the misfortune to have for his sole medical attendant a physician ignorant of surgery.

"But (continues Professor Thomson), if a knowledge of surgery be necessary to the student who intends to practise physic, the knowledge of physic, on the other hand, is no less necessary to him who intends to devote his attention exclusively to the profession of surgery; for, indeed, there are few chirurgical diseases which are not, in some period or another of their existence, accompanied by morbid affections of the same nature with those which fall properly, and most frequently, under the care of the physician. It will only be necessary to mention, as examples of these affections, the symptomatic fever, which attends inflammation, whether this affection has been induced by external injury, or has occurred spontaneously in the body from internal disease; the hectic fever supervening to long-continued processes of suppuration; the febrile state, and other morbid affections,

which are sometimes brought on by the too sudden and injudicious use of mercury; bilious fevers, and the various derangements of the digestive organs, which are sometimes the cause, and at other times the consequence, of local diseases; the nervous affections, such as apoplexy, convulsions, paralysis, and mania, which arise not unfrequently from injuries of the head; and locked jaw, or tetanus, which, in warm climates particularly, is so very liable to be induced by punctured wounds. These are morbid affections, the proper study and treatment of which, when they occur without local injury, are supposed to belong to the physician rather than the surgeon; but occurring very frequently as they do in surgical diseases, and always modifying or aggravating the effects of these diseases, ignorance of their nature, relations, and modes of cure, is not only inexcusable, but highly criminal, in the practitioner who ventures to undertake their treatment." (*Thomson's Lectures on Inflammation*, Introduction. Also *J. R. C. Bollman, Tentamen ostendens Chirurgiam a Medicina laud impune separari*, 12mo. Rintel. 1803.)

From what has been stated, I think it very certain that there never can be a complete and scientific division of the healing art into physic and surgery; and that all attempts to distinguish the numerous diseases and injuries of the human body into medical and surgical cases must, in a great measure, be decided by custom, and the mutual agreement of practitioners, rather than by any rules, or principles, which are at all consistent.

Mr. Lawrence joins in the opinion, that the line of demarcation between surgery and physic cannot be easily traced, and he considers the distinction between them to be a mere matter of arbitrary usage. He employs the word *surgery* in its common acceptation; understanding it to include, 1st, Injuries of all kinds; 2ndly, The greater part of external and local complaints; 3rdly, Such internal affections as produce changes recognisable externally—for example, alterations of figure, colour, or consistence; 4thly, All cases requiring external topical treatment, operations, or manual proceedings of any kind. This view coincides very much with the catalogue of diseases treated of in the present work; yet such is the difficulty of separating surgery from physic by any general definitions, that every man of experience will immediately recollect various exceptions to some of the foregoing principles of classification. Thus, ascites or dropsy, which is an internal disease productive of change of figure, and often requiring an operation, is usually regarded as a medical case. I should say, that it is an instance in which the skill both of the physician and surgeon is plainly necessary.

In the earliest periods, the same men cultivated the whole field of medicine. The writings of Hippocrates, Galen, Celsus, Paulus Ægineta, Albucasis, &c., prove that the Greeks, Romans, and Arabians never had an idea of the human body being susceptible of only two classes of diseases, one of which formed the province of physic, while the other constituted a separate and distinct science, called surgery. They had no conception of two systems of pathology, one applicable to the exterior, the other to the interior parts of the body. They knew as well as the best informed practitioners of the present day,

that, though each organ has its particular function to perform, its office is not independent of, but closely connected with, the use and perfect state of other organs. Hence, as Mr. Lawrence has noticed, the expression of Hippocrates is perfectly correct, "*Labor unus; consentientia omnia.*"

The numerous individual organs, which make up the human body, although various in structure and office, are all intimately connected and mutually dependent. They are merely subordinate parts of one great machine; and they all concur, each in its own way, in producing one general result, the life of the individual. All the leading arrangements are calculated to give a character of unity to the organisation and living actions of our frame. There is a common source of nutrition for the whole body; a single centre of circulation; a common place of union for all sensations and volitions, for nervous energy of whatever kind. The various organs are not only intimately connected by the share which they severally take in executing associated and mutually dependent functions, they act and react on each other, often very powerfully, by those mysterious, or, at least, hitherto unknown influences, which we call sympathies. As the animal machine, although complicated in structure, is single, and as its living motions, although numerous and intricate, form one indivisible series, so a similar connection runs through those changes of structure and functions which constitute disease. Hence, there is *one anatomy* and *physiology*, and there can be only *one pathology*. (Richerand, Lawrence, J. Cloquet, &c.)

Hippocrates, Galen, Celsus, and other writers of high antiquity, treat successively of fevers, fractures, wounds, and nervous diseases; and none of them appear to have supposed, that there could be any disorders which really deserved to be called *external*, and others *internal*. Nor was it until the middle of the 12th century, when the clergy were restrained by the Council of Tours from undertaking any bloody operation, that surgery was rejected from the universities, under the empty pretext, "*Ecclesia abhorret a sanguine,*" often expressed in its decrees, as Professor Thomson well observes, but never acted upon, except in this instance, by the Church of Rome. It is to this epoch that we must refer the artificial separation of physic from surgery; the latter being abandoned to the laity, who, in those ages of barbarism, were totally illiterate.

It is an observation made by the celebrated Bichat, that two things are essentially necessary to form a great surgeon—viz., genius and experience. One traces for him the way; the other rectifies it: both reciprocally assist in forming him. Without experience, genius would be unprofitably fertile; without genius, experience would only be a barren advantage to him. (*Œuvres chir. de Desault, par Bichat*, tom. i. *Discours préliminaire.*) Out of the large number of hospital surgeons who are to be met with in every country of Europe, and who enjoy ample opportunities of profiting by the lessons of experience, how few distinguish themselves, or ever contribute a mite to the improvement of their profession! Opportunity, without talents and an aptness to take advantage of it, is not of more use than light to a blind man. On the other



hand, splendid abilities, without experience, can never make a consummate surgeon, any more than a man with the greatest genius for painting can excel in his particular art, without having examined and studied the real objects which he wishes to delineate. In short, as a sensible writer has remarked, "*Les grands chirurgiens sont aussi rares que le génie, le savoir et les talents.*" (*Mém. de l'Acad. de Chir.* t. i. Préf. p. 41, edit. 12mo.)

The description of the qualities which a surgeon ought to possess, as given by Celsus, is excellent so far as it goes. A surgeon, says he, should be young, or, at any rate, not very old; his hand should be firm and steady, and never shake; he should be able to use his left hand with as much dexterity as his right; his sight should be acute and clear; his mind intrepid and pitiless, so that when he is engaged in doing anything to a patient, he may not hurry, nor cut less than he ought, but finish the operation, just as if the cries of the patient made no impression upon him. (*A. C. Celsi Med. Præf. ad lib. vii.*) By the word "*immisericors*," as Richerand has observed (*Nosogr. chir.* tom. i. p. 42, edit. 2), Celsus did not mean that a surgeon ought to be quite insensible to pity; but that, during the performance of an operation, this passion should not influence him, as all emotion would then be mere weakness. This undisturbed coolness, which is still more rare than skill, is a most valuable quality in the practice of surgery. Dexterity may be acquired by exercise; but firmness of mind is a gift of nature. Haller, to whom nature was so bountiful in other respects, was denied this quality, as he candidly confesses. "Although (says he) I have taught surgery seventeen years, and exhibited the most difficult operations upon the dead body, I have never ventured to apply a cutting instrument to a living subject, through a fear of giving too much pain." (*Bibl. chir.* 1775, vol. ii.)

Surgery may boast of having had an origin that well deserves to be called noble; for the earliest practice of it arose from the most generous sentiment which nature has implanted in the heart of man—viz., from that sympathetic benevolence which leads us to pity the misfortunes and sufferings of others, and inspires us with an anxious desire to alleviate them. He who first saw his fellow-creatures suffer, could not fail to participate in their pain, and endeavour to find out the means of affording relief. Opportunities of exercising this useful inclination were never wanting. In the first ages of the world, man in his destitute state was under the necessity of earning, by force or stratagem, a subsistence which was always uncertain; and in the combats to which this sort of life exposed him, he frequently met with wounds and other injuries. Wherever the chase was followed as a means of livelihood, or amusement; wherever broils and contests occasionally arose; wherever man was the same animal which he now is, liable to various diseases and accidental hurts, there must have existed a necessity for surgery.

Among the ancients, the profession of medicine and surgery constituted a sacred kind of occupation, and the practice of it belonged only to privileged persons. *Æsculapius* was the son of *Apollo*. In the armies, the highest princes gloried

in dressing the wounds of those who had fought the battles of their country. Amongst the Grecians, *Podalirius*, *Chiron*, and *Machaon* were not only distinguished for their valour, but also for their skill in surgery, as we learn from the poem of the immortal *Homer*. The value which was placed upon the services of *Machaon* by the Grecian army may well be conceived from the anxiety which it evinced to have him properly taken care of when he was wounded in the shoulder with a dart. "O *Nestor*, pride of Greece (cries *Idomeneus*)! mount, mount upon thy chariot! and let *Machaon* mount with thee! Hasten with him to our ships; for a warrior, who knows, as he does, how to relieve pain, and cure wounds, is himself worth a thousand other heroes." (See *Iliad*, lib. xi.) *Hippocrates* was one of the first citizens of Greece; he nobly refused all the rich offers of several kings, enemies of his country, to entice him into their service; and, in particular, he disdained to accept those of *Xerxes*, whom he regarded as a barbarian.

It is in the immortal poems of the *Iliad* and *Odyssey* that we find the only certain traditions respecting the state of the art, before the establishment of the republics of Greece, and even until the time of the Peloponnesian war. There it appears that surgery was almost entirely confined to the treatment of wounds, and that the imaginary power of enchantment was joined with the use of topical applications. In the infancy of the art, in every nation, the intervention of a supernatural power is always believed to be combined with what is within the scope of human possibility. The priests of India, the physicians of China and Japan, and the jugglers of the savage or half-civilised tribes of the old and new continents, constantly associate with drugs and manual operations certain mysterious practices, upon which they especially rely for the cure of their patients. Such was also, no doubt, the character of the medicine and surgery of the Egyptians, in the remote times previous to the invention of the alphabet, and upon which so little light is now thrown.

From some observations made by the men of science who accompanied the French expedition to Egypt, in 1798, it appears that, amongst the ruins of ancient Thebes, there are documents, fully proving that surgery, in the early time of the Egyptians, had made a degree of progress, of which few of the moderns have any conception. It is noticed by *Larrey*, that, when the celebrated French General *Desaix* had driven the Mamelukes beyond the Cataracts of the Nile, the Commission of Arts had an opportunity of visiting the monuments of the famous Thebes, and the renowned temples of *Tentyra*, *Karnac*, *Medinet-Abu*, and *Luxor*, the remains of which still display their ancient magnificence. It is upon the ceilings and walls of these temples that basso-relievos are seen, representing limbs that had been cut off with instruments very analogous to those which are employed at the present day for amputations. The same instruments are again observed in the hieroglyphics, and vestiges of other surgical operations may be traced, proving that, in these remote periods, surgery had made more progress than is often supposed. (*Larrey, Mém. de Chir. militaire*, t. i. p. 233; t. ii. p. 223.)

The mention of Egypt will not permit me to pass on, without offering a tribute of praise to one of the

most enterprising surgeons, whose services were ever exerted for the benefit of mankind: need I say, that it is here my wish to express admiration of the public services of Clot-Bey, that extraordinary individual, by whose meritorious exertions in Egypt medical science is returning to a land, once her cradle, but from which she had been an exile more than a thousand years? (See *Compte rendu des Travaux de l'École de Médecine d'Abou-Zabel (Égypte)*, etc., par Clot-Bey, 8vo. Paris, 1833.)

We next come to the epoch when, by the union and arrangement of scattered facts, the science truly arose. Hippocrates, born in the island of Cos, four hundred and sixty years before the common era, collected the observations of his predecessors, added the results of his own experience, and composed his first treatises. In the hands of this great genius, medicine and surgery did not make equal progress. The former reached a high degree of glory. Hippocrates drew up the history of acute diseases in so masterly a style, that twenty past centuries have added scarcely anything to the performance. But surgery was far from making the same approach to perfection. The religious veneration for the asylums of the dead, and the impossibility of dissecting the human body, formed an insurmountable obstacle to the study of anatomy. An imperfect acquaintance with the structure of animals, reputed to bear the greatest resemblance to man, could only furnish venturesome conjectures, or false inferences. These circumscribed notions sufficed for the study of acute diseases. In these cases, the attentive observation of strongly-marked symptoms, and the idea of the operation of a salutary principle, derived from remarking the regular succession of such symptoms, and their frequently beneficial termination, enlightened the physician in the employment of curative means; while surgery, deprived of the assistance of anatomy, was too long kept back in an infant state. Whatever praises may have been bestowed on those parts of the works of Hippocrates particularly relating to surgery, and which amount to six in number (*de officina medici*; *de fracturis*; *de capitis vulneribus*; *de articulis vel luxatis*; *de ulceribus*; *de fistulis*), when compared with his other acknowledged legitimate writings, they appear only as rough sketches by a great master.

Excepting the fragments collected or cited by Galen, we possess no work written by any of the successors of Hippocrates until the period of Celsus; which leaves a barren interval of almost four centuries. In this space lived Erasistratus, as well as Herophilus, celebrated for the sects which they established, and particularly for having been the first who studied anatomy upon the human body.

Celsus lived at Rome in the reigns of Augustus, Tiberius, and Caligula. He appears never to have practised the healing art, on which, however, he has written with much precision, elegance, and perspicuity. His work is the more precious, inasmuch as it is the only one which gives us information, with regard to the progress of surgery in the long interval between Hippocrates and himself. The four last books, and especially the seventh and eighth, are exclusively allotted to surgical matter. The style of Celsus is so elegant, that he is regarded quite as the Cicero of medical writers. Notwithstanding he

wrote at Rome, his surgery was entirely that of the Greeks; for, in that capital of the world, physic was then professed only by persons who had either come from Greece, or had received instruction in the celebrated schools of this native soil of all the arts and sciences.

Passing over the interval between Celsus and Galen, I shall not dwell long on the latter, who was born at Pergamus, in Asia Minor, and came to Rome in the reign of the Emperor Marcus Aurelius, where he practised surgery and physic about the year 165 of the Christian era. (*Galen Opera omnia*; 1521, ed. Aldi, 5 vols. in fol.) These two sciences were at that time still united, or rather the possibility of completely dividing them had never been conceived; and, though some writers of much earlier date speak of the division of physic into dietetical, chirurgical, and pharmaceutical, no such distinction had been followed in practice. As Galen had been a surgeon, or more probably a general practitioner, at Pergamus, he continued the same profession at Rome; but, being soon attracted, by the predominating taste of the age in which he lived, to studies which more easily accommodated themselves to the systems and dazzling speculations of philosophical sects, he afterwards neglected surgery, which strictly rejects them. His writings prove, however, that he did not abandon it entirely. His commentaries on the treatise of Hippocrates, *De Officina Medici*, and his essay on bandages, and the manner of applying them, show that he was well versed even in the minor details of the art. Besides, it is known that he paid great attention to pharmacy; and in his work upon antidotes (chap. 13) he tells us himself that he had a drug-shop in the Via Sacra, which fell a sacrifice to the flames which destroyed the Temple of Peace, and several other public edifices, in the reign of Commodus.

To Galen succeeded the compiler Oribasius, Ætius of Amida (who lived towards the close of the fifth century), Alexander of Tralles, and Paulus Ægineta—so called from the place of his birth, though he practised at Rome and Alexandria. Paulus collected into one work, still justly esteemed, all the improvements which had been made in surgery down to his own time. He concludes the series of Greek and Roman physicians, and may be looked upon as the last of the ancients, unless it be wished to let the Arabians have a share in the honours of antiquity. "He appears," says Portal, "to be one of those unfortunate writers to whom posterity has not done justice. It seems as if he had been decried without having been read; for if pains had been taken to examine his works, he would neither have been regarded as a mere copyist, nor been called the 'ape of Galen,' with whom he does not always coincide. Nay, in some places, he ventures to oppose the doctrines of Hippocrates. He was perfectly acquainted with the practice of the ancients; and when he agrees with or differs from them, it is not from a spirit of contradiction, but because the reasons which led him to take one side or the other appear to him well founded." (*Portal, Hist. de l'Anat. etc. t. i. p. 123.*) All now agree, that surgery is much indebted to him. (See *R. A. Vogel, De Pauli Æginetæ Meritis in Medicinam, imprimisque Chirurgiam*, 4to. Gött. 1768.)

Afterwards the downfall of surgery followed that



of all the other sciences, and from the capture of Alexandria by the Saracens under Amrou, Viceroy of Egypt, in 641, until the end of the tenth century, nothing prevailed but the dark clouds of ignorance and barbarism. The Arabians, who became masters of a great part of the Roman Empire, dug up the Greek manuscripts, which lay buried under the ruins of the libraries; translated them; appropriated to themselves the doctrines which they contained; impoverished them by additions; and transmitted to posterity only enormous compilations. In a word, such are the treatises of Rhazes, Hali-Abbas, Avicenna, Averrhoes, and Albucasis, the most celebrated of the Arabian authors. Inventors of a prodigious number of instruments and machines, they appear to have calculated the efficacy of surgery by the richness of its arsenals, and to have been more anxious to inspire terror than confidence. As an instance of the cruelty of their methods, I shall merely notice, that, in order to stop the bleeding after amputation, they plunged the stump in boiling pitch.

The fate of medicine was not more fortunate. In vain the school of Salerno, founded about the middle of the seventh century, made some attempts to revive its splendour. As a modern writer observes, medical science, seated on the same benches where the doctrine of Aristotle, accommodated to religious opinions, was the subject of endless controversies, imbibed, as it were by contagion, the argumentative and sophistical mania, and became enveloped in the dark hypotheses of scholastic absurdity. (*Richerand, Nosogr. t. i. ed. 2.*)

The universal ignorance (continues this author); the pretended horror of blood—the dogma of a religion, which shed it in torrents for useless quarrels; an exclusive relish for the subtleties of the schools, and speculative theories, are circumstances further explaining the profound darkness which followed these empty labours. About the middle of the twelfth century (1163), the Council of Tours prohibited the clergy, who then shared with the Jews the practice of medicine and surgery in Christian Europe, from undertaking any bloody operation. It is to this epoch that the true separation of medicine from surgery must be referred. The latter was abandoned to the laity, the generality of whom, in those ages of barbarism, were entirely destitute of education. The priests, however, still retained that portion of the art which abstained from the effusion of blood. Roger Rolandus, Bruno, Gulielmus de Salicetus, Lanfranc, Gordon, and Guy de Chauliac, confined themselves to commentaries on the Arabians; and, if the latter author be excepted, they all disgraced surgery by reducing it nearly to the mere business of applying ointments and plasters. Guy de Chauliac, however, the last of the Arabians, is to be honourably excluded from such animadversion. His work, written at Avignon in 1363, in the pontificate of Urban the Fifth, to whom he was physician, continued to be, for a long while, the only classical book in the schools. It may be observed, that as he imitated in every respect the other Arabian physicians, and, like them, thought that it did not become a priest to deviate from the austerity of his profession, he has passed over in silence the diseases of women.

At length, Antonio Beneveni, a physician of Florence, began to insist upon a truth of the highest

importance to the extension of surgical knowledge, viz., that the compilations of the ancients and Arabians ought to be relinquished for the observation of nature. (*De abditis Rerum Causis. Florent. 1507. 4to.*) A new era now began. The moderns were convinced, that by treading servilely in the footsteps of their predecessors, they should never even equal, much less surpass them. The labours of Vesalius also gave birth to anatomy, illuminated by which science surgery put on quite a different appearance in the hands of Ambroise Paré, the first and most eminent of the ancient French surgeons. For the credit of Italy, however, it should be recorded, that the sensible writings, published in that country prior to the time of Paré, had the greatest influence in creating a due sense of the value and importance of surgery, and in disposing men of talents and education to cultivate it as a liberal profession.

Obedying the dictates of his genius, Paré either compelled authority to yield to observation, or endeavoured to reconcile them. However, his superior merit soon excited the ignorant, the jealous, and the malignant against him; and he became the object of a bitter persecution, his discoveries being represented as a crime. Although he was the restorer, if not the inventor, of the art of tying the blood-vessels, the power of his persecutors compelled him to make imperfect extracts from Galen, and alter his text, in order to rob himself, in favour of the ancients, of the glory which this distinguished improvement deserved.

Surgeon to King Henry the Second, Francis the Second, Charles the Ninth, and Henry the Third, of France, Paré practised his profession in various places, followed the French armies into Italy, and acquired such esteem, that his mere presence in a besieged town was enough to reanimate the troops employed for its defence. In the execrable night of Saint Bartholomew, his reputation saved his life. As he was of the Reformed religion, he would not have escaped the massacre, had not Charles the Ninth himself undertaken to protect him. The historians of those days (see *Mém. de Sully*) have preserved the remembrance of this exception, so honourable to him who was the object of it, but which should not diminish the just horror which the memory of the most weak and cruel tyrant must ever inspire. “Il n'en voulut jamais sauver aucun (says Brantôme) sinon maistre Ambroise Paré, son premier chirurgien et le premier de la chrétieneté, et l'envoya quérir et venir le soir dans sa chambre et garderobe, lui commandant de n'en bouger, et disait qu'il n'était raisonnable qu'un qui pouvait servir à tout un petit monde fût ainsi massacré.”

Ambroise Paré was not content, like his predecessors, with exercising his art with reputation: he did not follow the example of the Quatre-Maîtres of Pitard, so justly celebrated for having composed the first statutes of the College of Surgeons at Paris, in the reign of St. Lewis, whom he had attended in his excursions to the Holy Land; and of several other surgeons, the fruits of whose experience were lost to their successors: he transmitted the result of his own experience to posterity, in a work that is immortal. (See *Œuvres d'Ambroise Paré, Conseiller et premier Chirurgien du Roi, divisées en 28 livres, in folio, ed. 4to. Paris, 1535.*)

His writings, so remarkable for the variety and number of facts in them, are eminently distin-

guished from all those of his time, inasmuch as the ancients are not looked up to in them with superstitious blindness. Freed from the yoke of authority, he submitted everything to the test of observation, and acknowledged experience alone as his guide. The French writers are with reason proud of their countryman Paré to this day: they allege that he must ever hold amongst surgeons the same place that Hippocrates occupies amongst physicians. Nay, they add that perhaps none of the ancients or moderns are worthy of being compared with him. (*Richerand, Nosogr. Chirurg. t. i.*)

After the death of this great man, surgery, which owed its advancement to him, continued stationary, or even took a retrograde course. This circumstance is altogether ascribable to the contemptible state into which those who professed the art fell, after being united to the barbers by the most disgraceful association.

Pigrai, the successor of Ambroise Paré, was far from being an adequate substitute for him. A spiritless copier of his master, he abridged his surgery in a Latin work, where the unaffected graces of the original, the sincerity, and the ineffable charm, inseparable from all productions of genius, entirely disappeared. He received, however, equal praise from his contemporaries; doubtless because he filled a high situation: but, as Richerand remarks, his name, which is to-day almost forgotten, proves sufficiently, that dignities do not constitute glory.

Rousset and Guillemeau distinguished themselves, however, in the art of midwifery; while Covillard, Cabrol, and Habicot, enriched surgery with a great number of new observations. (See *Obs. Chir. pleines de Remarques curieuses*, Lyon, 1639, in 8vo. *Alphabet Anatomique*, Genève, 1602, in 4to. *Semaine Anatomique; Question Chir. sur la Bronchotomie*, Paris, 1620, in 8vo.)

In the next or seventeenth century, a fresh impulse produced additional improvements. Then appeared in Italy Cæsar Magatus, who simplified the treatment of wounds (*De Rarâ Vulnere Medicatione libri 2*, Venet. 1616, in folio); Fabricius ab Aquapendente, even less praiseworthy as a surgeon than as a physiologist (*Opera Chir.*, Paris, 1613, in folio), and Marcus Aurelius Severinus, that restorer of active surgery. (*De Efficaci Medicina libri 3*, Francofurti, 1613, in folio. *De recondita Abscessuum Natura libri 7*, Neapoli, 1632, in 4to.; and *Trimembris Chirurgia, &c.*, Francofurti, 1653, in 4to.) Amongst the English surgeons flourished Wiseman, who was the Paré of England (see *Several Chirurgical Treatises*, Lond. 1676, in fol.); and William Harvey, whose discovery of the circulation of the blood had such an influence over the advancement of medical science in general. (See *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*, Francofurti, 1653, in 4to.) In Germany, Fabricius Hildanus (*Obs. et Curationum Centuriæ 6*, 2 vols. in 4to. 1641), who was far superior, as a surgeon, to the Italian Fabricius; Scultetus, so well known for his work, entitled *Armenarium Chirurgicum* (Ulmae, 1653, in folio); and Purnann and Solingen, who had the fault of being too partial to the use of numerous complicated instruments. (See *Curse, Obs. Chir.*, Lipsiæ, 1710, in 4to. *Manuale Obs. Chirurgiæ*, Amsterdam, 1684, in 4to.)

Holland, restored to liberty by the generous exertions of its inhabitants, did not long remain

a stranger to the improvement of surgery. This nation, so singular in many respects, presents us with one particularity, which claims the notice of a medical historian. Ruysch, who was an eminent anatomist, and merits equal celebrity for his *Obs. Anatomico-Chirurgicarum Centuriæ* (Amstelodami, 1691, in 4to.), carried with him to the grave the secret of his admirable injections. (See also his *Thesaur. Anat.* x., in 4to. *Adversariorum anatomicorum medico-chirurgicorum, Decad. 3*, in 4to. Amstelodami.) Roonhuysen also made a secret of his lever, which, before the invention of the forceps, was the only resource in difficult labours. Raw, who successfully cut fifteen hundred patients for the stone, took such pains to conceal his manner of operating, that Heister and Albinus, his two most distinguished pupils, have each given a different explanation of it. Such a disposition, which is extremely hurtful to the advancement of medical and surgical knowledge, would materially have retarded the progress of surgery in Holland, had not Camper, in the following century, effaced the imputation by the great number of his discoveries, and his zealous desire to render them public.

While great improvements were going on in Italy, England, and Holland, surgery languished in a humiliated state in France. The accoucheur Mauriceau (*Traité des Maladies des Femmes grosses*, Paris, 1668, in 4to.), Dionis (*Cours d'Opérations de Chirurgie*, Paris, 1707, 8vo.), Saviard (*Nouveau Recueil d'Obs. Chir.*, Paris, 1702, in 12mo.), and Belloste (*Chirurgien d'Hôpital*, Paris, 1696, in 8vo.), were the only French surgeons of note, who could be contrasted with so many distinguished men of other nations. Richerand observes, that the splendid days of Louis the Fourteenth were an iron age for discouraged surgery. And yet this monarch seems to have been personally interested in the melioration of this important art; for he was very nearly falling a victim to a surgical disease, a fistula in ano, and not cured till after a great number of blundering operations, and useless experiments.

In the last century, amongst the distinguished surgeons of France, there are two of extraordinary genius, round whom, as it were, all the others might be grouped and arranged, and whose names deserve to be affixed to the two most brilliant epochs of French surgery. These are J. L. Petit, whose glory was shared by the Academy of Surgery; and the celebrated Desault.

The eulogy on J. L. Petit, delivered in the midst of the Royal Academy of Surgery, of which he was one of the first and most distinguished members, represents him as blending the study of anatomy with his amusements when a boy; and ardently seeking every opportunity to increase his knowledge by observation. He had had experience enough to publish at an early period of his life his *Traité sur les Maladies des Os*, (Paris, 1705, in 12mo.), a work which, for a century, was esteemed the best upon the subject. His success was most virulently opposed by envious critics; and it was not till after more than thirty years of academical labours and extensive practice, that he was unanimously chosen the head of his associates. This acknowledged superiority, however, was the more flattering, as the honour was obtained at a period when surgery was in a flourishing state in France, and when Petit held no office from which he could derive any influence uncon-



nected with his personal merit. While Mareschal, La Peyronie, and La Martinière, assured him of the royal favour, Quesnay, Morand, and Louis, who corrected his writings, made him speak a language which does honour to that famous collection to which he contributed his observations (see *Mémoires et Prix de l'Académie Royale de Chirurgie*, 10 vols. in 4to.), and in which, if some theoretical explanations be put out of consideration, nothing has lost its value by age. J. L. Petit was also the author of *Traité des Maladies Chirurgicales et des Opérations qui leur conviennent*. (ouvrage posthume), a production that will always stand high in the estimation of the judicious surgeon.

The history of this epoch, so glorious for the profession of surgery, is completely detailed in the *Memoirs and Prizes of the Royal Academy of Surgery*; a work which is absolutely indispensable, and the various parts of which cannot be too often considered. In it are preserved the labours of Mareschal, Quesnay, La Peyronie, Morand, Petit, De la Martinière, Le Dran, Garengot, De la Faye, Louis, Verdier, Foubert, Hevin, Pibrac, Fabre, Le Cat, Bordenave, Sabatier, Puzos, Levet, and several other practitioners; who, though less famous, contributed by their exertions and knowledge to form this useful body of surgical facts. Many of the preceding surgeons also distinguished themselves by other productions; which, however, I shall not here enumerate, as they are quoted in many other parts of this work.

To the foregoing list of eminent French surgeons must be added the names of La Motte, Maître-Jean, Goulard, Daviel, Ravaton, Mejean, Pouteau, David, and Frère Cosme.

While surgery was thus advancing in France, other nations were not neglectful of it. At this period flourished in Great Britain, C. White, Cheselden, the two Monros, Sharp, Cowper, Warner, Alanson, Bromfield, Pott, Kirkland, Hawkins, Smellie, and the two Hunters.

But, of all these eminent men, none contributed more powerfully than Percival Pott to the improvement of the practice of surgery in England. His life, indeed, forms a sort of epoch in the history of the profession. Before his inculcations and example had produced a desirable change, the maxim of "*dolor medicinu doloris*," as we learn from Sir James Earle, remained unrefuted. The severe treatment of the old school, in the operative part and in the applications, continued in force. The first principles of surgery, the natural process and powers of healing, were either not understood, or not attended to; painful and escharotic dressings were continually employed; and the actual cautery was in such frequent use, that at the times when the surgeons visited the hospitals, it was regularly heated, and prepared as a part of the necessary apparatus. Where shall we find more sensible, or more truly practical observations on the treatment of abscesses, than in Pott's excellent treatise on the fistula in ano? Where shall we meet with better remarks on the local treatment of gangrenous parts, than in his valuable tract on the mortification of the toes and feet? What author abounds with so many just observations on the injuries of the head, blended, it is true, with rather too great a partiality to the trepan, the so frequent necessity for which is now less generally acknowledged? His description of inflammation

and suppuration of the dura mater, and of the treatment, is matchless. The account which he has left us of the disease of the vertebræ, attended with paralysis of the limbs, is perhaps his most original production. His celebrated essay on fractures was also very original, and has had in this country considerable influence over the treatment of these injuries; but there can now be no doubt, that the effects of position were exaggerated in this part of his writings, and that surgeons ought still to make every possible exertion to render their apparatus for broken bones more effectual. (See FRACTURES.) A more really valuable production of this eminent surgeon is his remarks on amputation. The necessity for that operation in certain cases is there convincingly detailed; and the most advantageous period for its performance clearly indicated. The urgency for its prompt execution, after particular injuries, he has indeed so perfectly explained, that the late inculcations on the subject by Larrey, and several other modern surgeons, appear to be in a great measure anticipated; the only difference being that Pott's remarks applied principally to compound fractures, while Larrey's refer to gunshot wounds. All these, however, are cases of accidental violence; and, of course, should be treated upon the same general principles.

A longer comment on the writings and improvements of Percival Pott would here be requisite to do him every degree of justice; but his name, advice, and opinions are so conspicuous throughout this volume, that I shall be excused for not saying anything more in the present place, than that he was in his time the best practical surgeon, the best lecturer, the best writer on surgery, the best operator, of which this large metropolis could boast.

Another character of still greater genius and originality, though of inferior education, was the ever-memorable John Hunter, surgeon to St. George's Hospital, who was at once eminent as a surgeon, an anatomist, a physiologist, a naturalist, and a philosopher. Indeed, he was the greatest man that ever adorned the profession, either in ancient or modern times, without making any exception of Hippocrates, the reputed father of physic; Paré, the pride of the French; or Harvey, the still greater glory of England, the immortal discoverer of the circulation of the blood. If Pott materially improved many parts of the practice of surgery in England, and evinced himself to be the most skilful operator of his time, John Hunter was also not less importantly employed in extending the boundaries of physiological knowledge, and in the investigation of human, and particularly comparative, anatomy. The knowledge which he derived from his favourite studies he constantly applied to the improvement of the art of surgery, and he omitted no opportunity of examining morbid bodies, whereby he collected facts which are invaluable, as they tend to explain the real causes of the symptoms of numerous diseases.

In the practice of surgery, whenever operations proved inadequate to their intention, Mr. Hunter always investigated with uncommon zeal the causes of ill success, and in this way he detected many fallacies, as well as made some important discoveries in the healing art. He ascertained the cause of failure, common to all the operations in use for the radical cure of the hydrocele, and was enabled

to propose a mode of operating attended with invariable success. He ascertained, by experiments and observations, that exposure to atmospherical air, simply, can neither produce nor increase inflammation. He discovered in the blood so many phenomena, connected with life, and not to be referred to any other cause, that he considered it alive in its fluid state. He improved the operation for the fistula lachrymalis, by removing a circular piece of the os unguis, instead of breaking it down with the point of a trocar. He explained, better than any of his predecessors, all the highly interesting modern doctrines relative to inflammation, union by the first intention, suppuration, ulceration, and mortification. His writings also throw considerable light on the growth, structure, and diseases of the teeth. As instances of his operative skill, it deserves to be mentioned, that he removed a tumor from the side of the head and neck of a patient at St. George's Hospital, as large as the head to which it was attached; and by bringing the cut edges of the skin together, the whole wound was nearly healed by the first intention. He likewise dissected out of the neck a tumor, which one of the best operators in this country had declared, rather too strongly, that no one but a fool or a madman would meddle with; and the patient got perfectly well. But perhaps the greatest improvement which he made in the practice of surgery, was his invention of a new mode of performing the operation for the popliteal aneurism, by taking up the femoral artery on the anterior part of the thigh, without opening the tumor in the ham. (See *Trans. of a Society for the Improvement of Med. and Chir. Knowledge.*) The safety and efficacy of this method of operating have now been fully established, and the plan has been extended to all operations for the cure of this formidable disease. (See ANEURISM.)

According to Sir Everard Home, Mr. Hunter was also one of the first who taught, that the excision of the bitten part was the only sure mode of preventing hydrophobia; and he extended the time, during which this proceeding might be reasonably adopted, beyond the period generally specified.

His researches into the nature of the venereal disease, and his observations on the treatment, will for ever be a lasting monument of his wonderful powers of reasoning and investigation. If he left many points of the subject confused and unsettled, he admirably succeeded in the elucidation of others; and his work on this interesting disorder, with all its defects, will long continue to be a source of valuable information.

Even the language and mode of expression of this great man were his own; for so original were his sentiments, that they could hardly be delineated by any ordinary arrangement of words. His phrases are still adopted in all the medical schools of this country, and continue to modify the style of almost every professional book. Great as Mr. Hunter's merit as a surgeon was, it was still greater as a comparative anatomist and physiologist. In these characters, the museum of the Royal College of Surgeons in London, and his papers in the *Phil. Trans.*, will for ever attest his greatness.

While in Great Britain the preceding distinguished men were raising the character of their profession — Lancisi, Morgagni, Molinelli, Bertrandi, Guattani, Mascagni, Matani, Troja, and

Moscatti, were pursuing a corresponding honourable career in Italy. Bertrandi's *Treatise on the Operations of Surgery*, and Troja's work, *On the Regeneration of Bones*, are, even at this day, in high repute. Of late years, the credit of the Italian surgeons has been well maintained by Monteggia, Scarpa, Paletta, Quadri, Assalini, Morigi, Regnoli, and others. In Holland flourished Albinus, Sandifort, and Camper; and in Germany and the north of Europe, the immortal Haller, Heister, well known for his *Institutiones Chirurgiæ*, Platner, Bilguer, Acrell, Callisen (*Systema Chirurgiæ Hodiernæ*, 2 vols. 8vo.); Brambilla, Theden (*Progrès Ultérieurs de la Chirurgie*); Schmucker (*Vermischte chirurgische Schriften*, b. 3, and *Chir. Wahrnehmungen*), Richter (*Traité des Hernies*, 2 vols. 8vo. *Bibl. für die Chirurgie; Anfangsgr. der Wundarzn.* 7 h. and *Obs. Chirurgicarum Fasc.*); Arnemann, Weidmann, Soemmering, Creutzenfeldt, Hesselbach, Hufeland, Graefe, Klein, Rust, Himly, Langenbeck, Walther, J. A. Schmidt, G. J. Beer, Chelius, Ammon, Dieffenbach, &c. Be it also recorded, as a part of the great merit of the Germans, that they rank amongst the best and most minute anatomists; that they are zealous cultivators of comparative anatomy; that their industry allows no improvement in medical science, wherever made, to escape their notice; and that surgery is greatly indebted to them for the best descriptions of the diseases of the eye.

On the continent, the Royal Academy of Surgery at Paris was long considered quite as the solar light of this branch of science. Nothing, indeed, contributed so materially to the improvement of surgical knowledge as this establishment; a noble institution, which, for a long while, gave our neighbours infinite advantage over us, in the cultivation of this most useful profession. The French Revolution, however, did not spare even this beneficial establishment, in which emulation and talents had been so long united for the benefit of mankind. The various dissertations, published by its illustrious members, will serve as a perpetual memorial of the spirit, ability, and success with which its objects were pursued; and centuries hence, practitioners will reap from the pages of its memoirs the most valuable information. Although the Academy was deprived of the talents of Louis, who died a short time before its suppression, it still had at this period several members, worthy of continuing its labours, and supporting its reputation; Sabatier, Desault, who may be regarded as the Pott of France, Chopart, Lassus, Peyrilhe, Dubois, Percy, Baudelocque, Pelletan, Sue, &c.

The Academy of Surgery in France was succeeded by the School of Medicine (*École de Médecine*). Desault, who had been almost a stranger in the former, became the leading character in the latter. Several things strongly recommend him to the remembrance and admiration of posterity; as for instance, the exactness and method which he introduced into the study of anatomy; the ingenious kinds of apparatus which he invented for the treatment of fractures; a noble ardour in his profession, which he knew how to impart to all his pupils; his clinical lectures upon surgery, which were the first ever delivered; and the boldness and simplicity of his operations. From the *École de Médecine* issued Dupuytren, Boyer, Richerand, Dubois, Lhéritier, Manoury, Lallemand, Petit de Lyon, Bichat, Bécлар, Cloquet, &c. Bichat, as a phy-



siologist, and man of very original genius, may be considered as the John Hunter of France; but his qualities were of a different cast, and hardly admit of comparison with those of Hunter, whose investigations were not limited to man, but extended to the whole chain of animated beings. The example of Bichat, says Richerand, proves most convincingly what Boerhaave always inculcated, and every man of experience knows, how indispensable the study and even the practice of surgery are to him, who would wish to be a distinguished and successful physician. (*Nosogr. Chir.* t. i. p. 25.)

The brilliant career of Baron Dupuytren during the space of five-and-twenty years, at the Hôtel-Dieu, justly raised him to a degree of eminence, as a surgeon and pathologist, which few, either in his own or any other country, ever attained. His recent death seems to me, indeed, to have left in France a blank in the surgical community, not likely to be immediately filled up; for a surgeon of his genius and ability cannot be expected to be born, even in that favourite clime of the arts and sciences, more frequently than once in a century. The light, which his observations have thrown on many difficult parts of surgery; the rigorous exactness with which he always enforced the connection between scientific surgery and anatomy, physiology and pathology; the important reforms which he introduced into many of the operations; his readiness and prompt resources on every emergency in practice; and the combination which he exhibited of boldness, skill, and judgment, will always be subjects of admiration, and I feel no hesitation in pronouncing him to be the pride of modern surgery in France. Great originality will be found in his remarks on every topic which he undertook to investigate. Proofs of this will be noticed in his observations on permanent contractions of the fingers; on diseases of the testis; on prolapsus ani; on fractures of the fibula; on dislocation of the vertebræ; on strangulated hernia; on burns; on fractures of the neck of the thigh-bone; on artificial anus; on phlegmonous erysipelas; on lithotomy; on gun-shot wounds; on the growth of the toe-nails into the flesh; on dislocations of the humerus; on clubfoot; on laceration of the perinæum; on congenital dislocations of the femur; on fistula lachrymalis; on ranula; on fracture of the lower end of the humerus; on exostosis of the great toe; on fibro-cellular tumors of the uterus; on trachæotomy; on erectile tumors; on fungus hæmatodes; on hare-lip; on anthrax; on the formation of callus; on fractures of the lower end of the radius; on amputation; on hydrocele; on bronchocele; on preparations of arsenic for cancerous and phagedenic ulcerations; on chronic gangrene; on the ligature of arteries; and on amputation of the lower jaw-bone. These, with some other subjects, constitute the contents of the four volumes, published under the title of *Leçons orales de Clinique chirurgicale, par M. le Baron Dupuytren*, 8vo. Paris, 1834; an invaluable contribution to the sources of instruction on a vast number of most interesting surgical topics.

Amongst the public institutions in Europe for the improvement of medical and surgical knowledge, the Royal Medical and Chirurgial Society of London certainly stands pre-eminent, whether the reputation and number of its members, the importance of many of the papers which it has

published, or the extent and value of its library, be taken as the criterion of the character which is here assigned to it. Many of the facts which it has collected and published are of considerable practical importance, especially those relating to the subjects of aneurism, hæmorrhage, diseases of the joints, calculi in the bladder, and that least intelligible of all diseases, syphilis. Its library, which, next to that of the Royal College of Surgeons in London, is the most select, valuable, and complete collection of medical literature in Great Britain, more especially with reference to modern works, is continually receiving additions, both by large purchases at home and abroad, and by the numerous donations of its members and others. When, however, I contemplate the arrangement made by the foregoing College for the advantage of its members; when I recollect its magnificent museum; its rich and continually increasing library, both open almost daily for the accommodation of its scientific members and others; the lectures annually delivered in its theatre; and the improved character of its regulations for professional education; I rejoice, that this metropolis at length seems to possess a great and influential public institution, which is contributing most essentially to maintain the usefulness and the rank of the surgical profession.

In the course of the last thirty years, great and essential improvements have been made in almost every branch of surgery.

Before the time of Mr. Hunter, our ideas of the venereal disease were surrounded with absurdities; and it is to this luminary, and the plain facts laid before the profession by the late Mr. Rose, that we are, in an eminent degree, indebted for the increased discrimination and reason, which now prevail, both in the doctrines and treatment of the complaint. It must be confessed, however, that much yet remains to be made out, respecting the nature and treatment of syphilitic disorders. Need I mention a greater proof of the truth of this remark, than the remarkable change of practice in some of the principal hospitals of the kingdom, mercury being now exhibited in not more than one out of every eight or ten cases, for which this medicine a few years ago was always deemed indispensable? Numerous cases, having all the characters of primary venereal sores, seem also now to be curable by simple dressings and cleanliness; and the necessity for violent salivation, in any cases, is beginning to be generally disbelieved. In short, so different is everything from what it used to be, that many surgeons are tempted to suppose the nature of the disease totally altered. See VENEREAL DISEASE.

Strictures in the urethra, an equally common and distressing disease, were not well treated of until Mr. Hunter devoted his attention to the subject. He first improved the method of applying caustic within the urethra; a practice which was afterwards perfected, first by Sir Everard Home, and again by M. Ducamp.

In modern times, hernial diseases, those common afflictions in every country, have received highly interesting elucidations from the labours of Pott, Camper, Richter, Sir Astley Cooper, Hey, Gimbernat, Hesselbach, Scarpa, Lawrence, Langenbeck, Jules Cloquet, &c.

The treatment of injuries of the head has been materially improved by Quesnay, Le Dran, Pott,

Hill, Desault, Dease, Hey, Abernethy, Brodie, and Velpeau.

The disease of the vertebræ, which occasions paralysis of the limbs, formerly always baffled the practitioner; but the method proposed by Pott is now frequently productive of considerable relief, and sometimes of a perfect cure. The diseases of the joints in general may also be said to be at present viewed with much more discrimination than they were a very few years ago; and this great step to better and more successful practice reflects great honour on Sir Benjamin Brodie, while it keeps up a well-founded hope that morbid anatomy (the study of which has of late banished so much confusion from this part of surgery) will yet be the means of bringing to light other useful facts and observations relative to the pathology of the joints.

In the time of Pott, few patients afflicted with lumbar abscesses ever recovered; for, soon after a free opening had been made, according to the method then in vogue, the constitution was usually seized with violent irritative fever, which hardly admitted of any control. Mr. Abernethy ascertained that, in some instances, much of this risk might be avoided by making only a small opening, healing it by the first intention, after the matter had been let out, and then repeating the same plan, from time to time, so as to prevent the cavity of the abscess from ever being distended, and give it the opportunity of diminishing by a natural process. Of course, success cannot be expected to attend even this treatment, when the vertebræ are carious, or any other serious organic disease prevails. It is right also to state, that Abernethy's plan has not received universal approbation.

The rarely failing plan of curing hydroceles by means of an injection, as described by Sir James Parle, may be enumerated as one of the most decided improvements in modern surgery: at least, no doubt is entertained on this point by any surgeon of eminence in France, the British dominions, or the United States of America. Whether acupuncture will ever prove efficacious enough to become a common practice, and to supersede the foregoing mode of cure, is a question which I apprehend will be finally answered in the negative.

The increasing aversion to the employment of the gorget in lithotomy, the many distinguished advocates for the use of better instruments, and, above all things, the clearer exposition of the right principles of the operation, now made, both by lecturers and authors, I regard as an agreeable indication of the augmented degree of success with which lithotomy is now likely to be practised, in every fair case for the operation. The necessity for the same frequent performance of lithotomy which prevailed formerly, must not, however, be now recognised by any humane or judicious surgeon; more especially since the art of crushing calculi in the bladder, so that the fragments may be voided through the urethra, has already attained great perfection. The circumstances, however, which ought to determine the preference of lithotomy or of lithotritry, are noticed under these respective terms. The urethral forceps, recommended by Sir A. Cooper, for removing calculi through the urethra, and all the ingenious inventions of Dr. Civiale, M. Le Roy, and Baron Heurteloup, designed to break or to reduce the stone to powder, so that it may be voided with the urine

through the urethra (each plan thus superseding, when it answers in fit cases, all occasion for lithotomy), are great and signal improvements, which entitle their inventors to a distinguished rank amongst those men of genius, from whose labours the present and future generations will receive inestimable benefit.

The diseases of the eyes, cases to which English surgeons once seemed to pay much less attention than was bestowed by foreign practitioners, now obtain due attention in this country. Although we always had what are called oculists, it was not till the period of the establishment of eye infirmaries in London, about forty years ago, that regular surgeons began to study the subject, scientifically, and with much success. Until this epoch they had remained wonderfully ignorant of this part of their profession; and, uninformed on the subject, they had given up to professed oculists and quacks one of the most lucrative and agreeable branches of practice. However, the able writings of Daviel, Wenzel, and Ware, are now familiarly known to practitioners; and the observations of Scarpa, Richter, Beer, Schmidt, Himly, Lawrence, Frick, Wardrop, Travers, Saunders, Guthrie, Mackenzie, and Middlemore, have had immense effect in diffusing in the profession a due knowledge of the numerous diseases to which the organs of vision are liable.

In the treatment of aneurismal diseases, English surgeons have much to be proud of. Many of the boldest operations in this branch of surgery have been devised by the genius, and executed by the spirit and skill of British surgeons. Even M. Roux himself is here obliged to confess our superiority. (*Parallèle de la Chirurgie anglaise*, &c. p. 249.) The carotid artery, the external and internal iliac, and the subclavian have all been successfully tied by surgeons of this country. The first operation, in which the external iliac was tied, I was a spectator of: it was performed by Abernethy in Bartholomew's Hospital; and has subsequently been repeated in many examples, both in this country and others, with considerable success. I had also the honour of seeing the same gentleman tie the carotid—the first instance of it, I believe, in England. This measure was resorted to by him for the stoppage of hæmorrhage, from a wound of the neck. Sir A. Cooper's claim to the distinguished merit of having first applied a ligature to the carotid, for the cure of aneurism, still continues unaffected by it.

In the article ANEURISM, I have cited many examples, in which the carotid artery has been successfully tied; and the safety and propriety of the operation are now generally known and acknowledged. Indeed, so little are surgeons now afraid of the ill effects upon the brain, that the carotid artery has been tied merely for the purpose of enabling the operator to take away a large tumor, including the whole of the parotid gland, from the side of the neck, without risk of hæmorrhage; a proceeding, however, which ought not to be encouraged into a common practice. (See *Med. Chir. Trans.* vol. vii. p. 112.) The example of skill, judgment, and boldness, set by the surgeons of this country, has not been lost upon foreign practitioners. In France, in Germany, in Italy, and particularly in the United States of America, operations for aneurism are familiarly practised. Indeed, in the two latter countries, the arteria innominata had



been tied, previously to the publication of the 6th edition of this work; a proceeding which, though it was originally suggested here, was not ventured upon in Great Britain until very recently, when it was executed by Mr. Lizars. The result, however, like that of the two earlier cases, was the loss of the patient. Whether the ligature of the innominate is a justifiable proceeding, appears to me a questionable point; for experience has not yet adduced anything in its favour. All the patients on whom it has been performed, have died of secondary hæmorrhages, and Brasdor's plan, as adopted by Wardrop and Mott, which brings with it the recommendation of occasional success, may be a safer expedient. (See ANEURISM.) Weiss's aneurismal needle, and some others, intended for the conveyance of the ligature under very deep arteries, where there is but little room, are also inventions likely to prove of material service in this branch of surgery, where sometimes the most skillful surgeons have either been baffled in their endeavour to pass the ligature under the vessel, or have detained their patient so long in the operating-room, exposed to the greatest agony, ere the business was accomplished, that the chance of a happy issue was seriously lessened. Before I quit this subject, my feelings call upon me to express the high opinion which I entertain of my friend Mr. Hodgson's *Treatise on the Diseases of Arteries and Veins*, first published in 1815; a work which reflects great credit on English surgery, and contains practical precepts far superior to those of Scarpa.

In the modern practice of surgery, a variety of old prejudices are gradually vanishing. Peruvian bark, not many years ago, was regarded as a sovereign remedy and specific for nearly all cases of gangrene; and in these, and many other instances, it was prescribed without any discrimination, and in doses beyond all moderation. But the false idea, that this medicine, or any preparation of it, has any specific effect in checking mortification, no longer blinds the senses of the most superficial practitioner. He neither believes this doctrine, nor the still more absurd opinion, that strength can be mysteriously extracted from this vegetable substance, and communicated to the human constitution, in proportion to the quantity which can be made to remain in the stomach.

At the present day, the subject of mortification opens to us a point for investigation of first-rate consequence. Every surgeon is aware, that when a limb is deeply affected with mortification, amputation is commonly necessary. This is generally acknowledged; but the performance of the operation has, since the time of Pott, only been sanctioned when the mortification has manifestly ceased to spread, and a line of separation been formed between the dead and living parts. All other patients, in whom the disorder was in a spreading state, were left to their fate. It is true, some of the old surgeons occasionally ventured to deviate from this precept; but, as they did so without any discrimination, or knowledge of the particular examples which ought to form an exception to the general rule, their ill success cannot constitute a just argument against the plan of amputating earlier in a certain description of cases.

Now, if it be proved by modern experience, that many lives may be saved by a timely performance of amputation, under circumstances in which it has until lately been generally condemned, it must

be allowed that the established innovation will be one of the greatest improvements in the practice of the present time.

For reviving the consideration of this question, and venturing to deviate from the beaten path, the world is much indebted to that eminent military surgeon, Baron Larrey. How different his doctrines and practice are from those usually taught in the schools, the article MORTIFICATION will sufficiently prove.

Connected with this topic is *Hospital Gangrene*, a case which deserves here to be pointed out, as having received considerable attention of late years, and being much better treated, since the efficacy of the solution of arsenic, and of the strong nitrous acid, has been so completely proved by the observations of Blackadder and Welbank.

In the treatment of ununited fractures, the simple and ingenious practice, suggested by Dr. Physick of Philadelphia, merits particular notice: various successful trials have been made of it in this country and France, as well as in America, and, though liable to failure, it is yet entitled to be regarded as a valuable addition to the plans hitherto devised for these cases, which too often render the patient a helpless cripple during life. The considerations, however, which should guide us in the choice of a plan for bringing about the union of fractures, which have not admitted of bony union under ordinary treatment, have not been neglected in their proper place. See FRACTURE.

The inestimable treatise of Dr. Jones, *On Hæmorrhage*, may be said to have produced quite a revolution in all the principles by which the surgeon is guided in the employment of the ligature for the stoppage of bleeding, and the cure of aneurisms. Instead of thick clumsy cords, small firm silks, or threads, are now generally used; and so far is the practitioner from being fearful of tying arteries too tightly, lest the ligature cut through them, that it is now a particular object with him to apply the silk, or thread, with a certain degree of force, in order that the middle and inner coats of the vessel may be divided. If this be not done, the effusion of fibrine within the artery, an important part of the process of obliteration, cannot be expected as a matter of certainty, and secondary hæmorrhage is more likely to occur. But, in order to convey an adequate idea of the beneficial changes which Dr. Jones's observations are tending to produce in practice, I have been careful, in the article HÆMORRHAGE, to give a tolerably full account of the results of all his interesting experiments.

Dr. Veitch, an eminent naval surgeon, deserves here to be mentioned with particular honour, since he is probably the earliest writer that laid due stress on the advantage of tying the arteries with very small ligatures; one of the greatest improvements in the treatment of wounds and in operative surgery. "My experience and reasoning (says he) led me to recommend a small ligature; and its nature and form were not left to conjecture, but clearly laid down; and the introduction of this practice to surgery is, I think, unquestionably due to me. Dr. Jones did not apply his round ligature to operations on the human body; and the practice of using the small single ligature was not adopted at the Edinburgh Infirmary, in which city his experiments were made, until the appear-

ance of the following Essay on the Ligatures of Arteries, which was sent to the editor of the *Edin. Med. and Surgical Journal*, in 1805, but was not published until the 1st of April, 1806." (See *Obs. on the Ligature*, &c. Lond. 1824.) In justice to Dr. Jones, I should mention, that his book was published in 1805.

Besides using very small, firm, round threads, instead of large, flat tapes, or cords, as was the custom a few years ago, some modern surgeons have suspected, that much benefit might arise from cutting off both portions of the ligature close to the knot, after amputation, the removal of the breast, &c. No one has insisted so much as Lawrence upon the propriety of examining further the merits of this innovation. If no bad effects were to result from leaving so small a particle of extraneous substance in the flesh, as the little bit of silk composing the knot and noose on the artery, the practice would form a considerable improvement. The wound would then admit of being brought together at every point; the quantity of extraneous matter in the part would be lessened to almost nothing; the danger of convulsive affections would be reduced in proportion as a serious cause of pain and irritation is diminished; and the chance of accomplishing perfect union by the first intention would be materially increased. Lawrence tried the plan, and did not find any ill consequences follow, while many advantages seemed to him to be the result of it. Mr. Crosse, of Norwich, however, detailed some observations, which were adverse to the practice; and candour obliges me to state, that, with the exception of cases where the parts must suppurate, and no prospect of union by the first intention can be entertained, the plan has now few advocates. (See AMPUTATION, ANEURISM, HÆMORRHAGE, and LIGATURE.)

Amongst the signal improvements in modern practice, I must not forget the present more rational method of dressing the wounds, after capital operations, with light cooling applications, instead of laying on the part a farrago of irritating pledgets and plasters, and a cumbersome mass of lint, tow, flannel, and other bandages, woollen caps, &c. The fewer the adhesive strips are, the better, if they only hold the lips of the wound together. This is all they are intended to do. Whereas, if more than are necessary for this purpose be employed, they do harm by heating the part, and covering the wound so entirely as to prevent the issue of the discharge. The isinglass plaster, introduced into use by Mr. Liston, and so commonly employed in University College Hospital, I regard also as sometimes possessing advantages over the common adhesive plaster, and likely therefore not to be discontinued. Instead of employing numerous ointments of various compositions, the generality of practitioners find more simplicity equally, if not more, effectual, and in dressing wounds and ulcers, they rarely have occasion to resort to any other applications than adhesive or isinglass plaster, lint, the water dressing, the nitrate of silver, or gently stimulating lotions of sulphate of zinc or sulphate of copper.

Wars, which are unfavourable to most other sciences, are rather conducive to advances in surgery. The many new and interesting observations, which Baron Larrey made in the course of his long and extensive military experience, are a

proof of the foregoing remark. Pitard, almost the founder of surgery in France, was a military surgeon. Ambrose Paré and Wiseman collected their most valuable knowledge principally in the service of the army. Mr. Hunter himself gained much of his practical information in the same line of life. To Baron Larrey surgeons are indebted for many highly important observations, relating to amputation in cases of gun-shot wounds. In particular, he has adduced a larger and more convincing body of evidence than was ever before collected, to prove, that, in gun-shot injuries, the operation of amputation should always be performed without the least delay, in every instance in which such operation is judged to be unavoidable, and the ultimate preservation of the limb either impossible, or beyond the scope of all rational probability. He has established the truth of this most important precept in military surgery by innumerable facts, drawn chiefly from his own ample experience, but partly from the practice of many able colleagues. The great operations of the shoulder-joint and hip-joint amputations, he has executed with success. The necessity for the former, however, he proves many sometimes be superseded, and the limb be saved, by making a suitable incision for the extraction of the splintered portions of the upper part of the humerus. This method, which was in many instances done with success in the Peninsular War, and has been also repeatedly performed with the same result by Baron Percy, was, I believe, originally proposed and practised by Boucher. (See *Mém. de l'Acad. de Chir.* t. ii. 4to.) However, it was first more particularly described, and even practised, by Mr. C. White of Manchester. (See his *Cases in Surgery*.) Mr. Morell also performed it successfully in York Hospital. (See *Med. Chir. Trans.* vol. vii.) See AMPUTATION.

Amputation at the hip-joint, performed only in the most dreadful cases, because itself the most dreadful operation in surgery, Baron Larrey performed five times, and twice (I believe) with success. It has also been performed by Brownrigg, Guthrie, Mott, Sir Astley Cooper, Graefe, Walther, Delpech, and others; and several of the cases terminated in the recovery of the patients. As must necessarily be the case, however, on account of the desperate circumstances under which the operation is performed, and the severity of the operation itself, the examples of recovery bear only a small proportion to the large number of deaths known to have followed amputation at the hip in the many cases in which it has now been undertaken. Yet this unfortunate truth should not be exaggerated into a reason for an unqualified condemnation of the practice, which is adopted as the only means affording a chance of saving life. But, as there may be difficulty in deciding whether the patient will have the best chance with, or without the operation, it is to be hoped, that no surgeons will perform it, except under the authority of the united opinion of a board, or consultation of the best-informed practitioners, whom circumstances will allow to assemble. It is to be hoped, likewise, that there is no man in the profession, so destitute of honour and principle, as to aim at notoriety through the medium of this terrible operation, and court the opportunity of doing it merely with this view, instead of being compelled to undertake it by the really desperate



circumstances of the case. If there be such an individual in existence, his scheme of wading through blood to reputation, now that the novelty of the operation has vanished, would have but little chance of success. Be it also recollected that, while the operation itself requires only ordinary talents, the business of avoiding it, and of discriminating the exact cases in which it should be attempted, implies an extensive acquaintance with the principles of surgery, ample experience, and more than common abilities and judgment. See AMPUTATION.

Another improvement in surgery, of an humbler but not less useful description than some things to which I have already adverted, is the elastic gum seton, which, for cleanliness and convenience, is far superior to what has generally been employed. The needle for it, and the slips of elastic gum, may be procured of Messrs. Weiss. The invention, I believe, is one of the results of French ingenuity.

The simple operation of dividing the tendo-Achillis, in order to rectify one species of the deformity termed club-foot, a proceeding which I have known adopted with success, has not been practised so frequently as its efficacy would justify till a very recent period. It may be enumerated as a decidedly valuable addition to the operative department of surgery.

The treatment of phlegmonous erysipelas by free incisions under certain circumstances, and on the principles explained in the article ERYSIPELAS, I regard as a practice of infinite merit. Ample opportunities of trying it, both in hospital and private practice, have filled me with this conviction, which I am glad now to acknowledge, as I formerly expressed disapprobation of the plan. Mr. A. Copland Hutchison, to whom we are indebted for suggesting the practice, and bringing it under the consideration of the profession, seems to me thereby to have rendered a great service to the public.

The excision of more or less considerable portions of the lower jaw, in cases of irremediable disease of it, is a new proceeding exemplifying the still-continued progress of the boldest parts of operative surgery. The practice also merits notice on another account; it is an extension of the most effectual part of surgery to a class of miserable and hopeless cases, first executed by our transatlantic brethren in the United States, Dr. Mott having been the means of conferring this honour upon them.

The removal of the superior maxillary bone may also be specified as another operation, the propriety of which, under certain circumstances, is now fully established. In promoting the introduction of this bold measure into practice, perhaps M. Gensoul, of Lyons, must be regarded as the leader; although I believe that Mr. Lizars was very early in the field; and it is but justice to add, that my colleague Mr. Liston may claim the merit of having brought the requisite operative proceedings to the greatest perfection.

I regret, that, in the last edition, due justice was not done to the meritorious surgeons of the United States of America. This happened, however, not from any want of desire on my part to pay the tribute of honour, where it was deserved; but from my not being then in possession of the valuable information, respecting the progress of surgery in the United States, which I have since obtained

from Dr. Reese's American edition of this *Dictionary*, and other sources. I most cordially join, then, in the observation that, in a history of this kind, mention ought to be made of "the names of Drs. White, Dudley, Davidge, Dorsey, Shippen, Bard, Post, Mott, Gibson, Parrish, Baufon, McClellan, Stevens, Warren, Smith, Jamieson, and a host of others, who have contributed by the pen and the knife to elevate this department of the profession: this will be admitted, unless the successful ligature of the subclavian, the common iliac, the internal iliac, and that of the innominata, the amputation of the hip-joint, and upper and lower jaw, the extirpation of the parotid gland, the exsection of the clavicle, and the cure of aneurism, by tying on the distal side of the tumor, be unworthy of record. Some of these operations (continues Dr. Reese) had never been attempted in Europe, till our surgeons had led the way; and by these, and other splendid achievements in operative surgery, had demonstrated their practicability and success." In adverting to such merit in the surgeons of the United States, I feel all that heartfelt pleasure, which arises from the remembrance of their close connection with my native country by the ties of blood and language, and they may rest assured of my sincere esteem; and of my earnest wish to render full justice to them on every subject.

#### PROGRESS OF SURGERY.

[I am unwilling to attempt the complete re-modelling of each paragraph, which would be necessary if, to each reference to the surgical opinions and practice of his time by Cooper, I should make the modifications and additions necessary to bring this article into accord with the prevalent opinions now, and to register the progress of the last thirty years. It would destroy the *cachet* of the author's style and habit of thought. I shall add only, therefore, a very brief résumé of some of the leading elements of progress in surgery since Cooper wrote.

They have been accomplished chiefly in SURGICAL PATHOLOGY; in the METHODS OF EXPLORATION; in OPERATIVE SURGERY; and in the TREATMENT OF WOUNDS. SURGICAL ANATOMY, of which the object is to teach the surgeon to direct with certainty his knife amidst the deepest parts, and to interpret pathological peculiarities by the relation of the parts, has been greatly advanced in this country by the labours of Morton, Quain, MacLise, Hilton, and Prescott Hewett; and in France by Blandin, Bourgey, Paulet, and Sarrazin. To the aid of the surgeon *experimental physiology*, which was cultivated with so much genius and enthusiasm by Hunter, brings daily tribute. Syme, Paget, Simon, Wharton Jones, Lister, Larrey, Richardson, Henry Lee, especially in this country; Flourens, Bernard, Sédillot, Brücke, Brown-Séquard, Langenbeck, and others on the continent, and Hammond in America, have added to our knowledge of subjects, such as the laws of growth; the part played by the periosteum in the renewal of bone; the nature of the inflammatory change; the pathological physiology of the blood and the arteries; the course and origin of purulent infection; the relation of cataract to diabetes. The microscope, in creating the science of *histology*, has given a new impulse to surgery. Its revelations cannot shake our convictions, derived from the

complete clinical study of pathological growths such as tumors; but, although it does not (now) pretend to direct our clinical conclusions, it constantly furnishes the most valuable information, and enables us to define and classify the various forms of growth and to record with precision the anatomical character side by side with the clinical symptoms. Paget, in his great work on surgical pathology, laid the foundation of the science in this country; Virchow, Rokitsansky, and Lébert are his prominent rivals abroad. The foundation of the Pathological Society of London has done much to keep alive a spirit of scientific investigation in surgical pathology; its transactions are among the most precious storehouses of knowledge, and the contributions to its pages by English surgeons entitle them to take rank as among the foremost pathologists.

*New methods of exploration* have done much to advance the progress of surgery. The ophthalmoscope, first imagined by Cumming, and described by him in the *Medico-Chirurgical Transactions*, became in the hands of Helmholtz a perfect and marvellous instrument of exploration, by which we are enabled, with the utmost ease, quickness, and precision, to explore the condition of the nervous and vascular tissues and of the transparent humours of the eye. It has revolutionised ophthalmic medicine and surgery. Von Graefe, Donders, Liebreich, and Schweiger abroad; Bowman, Dixon, Critchett, Hulke, J. Z. Laurence, and Carter here, have studied its applications with great success, and have added to our knowledge in this, as have many others in other departments of ophthalmic surgery and in various degrees. *Laryngoscopy*, practised with success by Garcia, has been popularised by Czerniak, and studied in this country by Gibb, Morell Mackenzie, Arthur Durham, Sieveking, Walker of Peterborough, G. Johnson, and others, who have achieved striking successes in the removal and treatment by local applications of tumors, &c. of the larynx. The *ENDOSCOPE*, first used by Avery of Charing Cross Hospital, has been revived as an instrument of practical surgery by Desormeaux, who has made valuable improvements; by Cruise in Ireland, Warwick of Richmond, and Jeevan and Christopher Heath of London. *Electrolysis*—the dissolution of tumors by the action of electricity—has been attempted with some success by Crussell of St. Petersburg; and by Ciniselli of Cremona. Nélaton in France, and Althaus in England, have employed it with good result, and Althaus has modified the instrument employed, and believes it to be capable of numerous and useful applications. M. Middeldorpf in Germany, M. Nélaton in France, and Mr. Marshall in England have employed, in numerous instances, the heated galvanic wire (*Galvanicæusis*) for the amputation of tumors, the division of sinuses, and the destruction of erectile growths. M. Chassaignac in France has urged with great vigour the employment of a linear saw or ligature for division of the tissues in lieu of the knife. Advocated by its author as a method capable of very extensive application indeed, this method is at present confined in this country to the limited class of operations where highly vascular tissues require division—as in ablation or abscission of the tongue, of some forms of uterine polypi, &c. For these purposes—and for no other—it seems particularly adapted. The method of crushing, and of removal of growths by caustic

wedges, has been much used and greatly abused by Maisonneuve in France.

Among the great general additions to the resources of surgery, and the great steps in its progress, must be included *artificial anæsthesia*. In 1799 Humphrey Davy, working in the laboratory of Beddoes, who was investigating the effects of the inhalation of gases, intimated that pure protoxide of nitrogen enjoyed, amongst other properties, that of annihilating pain, and added that, in surgical operations accompanied by pain, it might probably be employed with advantage. Its exciting and troublesome effects, as then used, soon brought it into disfavour, but in 1842 Dr. W. C. Long, of Athens, U.S., found that ether possessed satisfactory effects in allaying the pain of surgical operations; in the same year Dr. Jackson of Harvard, U.S., and, after him, Morton of Boston, fully made out and proclaimed the invaluable qualities of this substance. Subsequently Simpson of Edinburgh engaged in the study of narcotic vapours fit for inhalation, and, on the suggestion of Waldie of Liverpool, employed chloroform, which had already been in use by Laurence and others, diluted with spirit, as chloric ether, and had been experimented with by Flourens on animals in the pure form. The superior rapidity of action and portability of chloroform have, among other qualities, enabled it to be used on the battle-field and in ordinary practice with almost universal consent, and have thus extended the blessings of anæsthesia. According to Holmes and to Trélat, it has not only facilitated all the proceedings of the surgeon, but has diminished the mortality of operations, probably by lessening shock. For taxis of hernia; for reduction of old dislocations; for diagnosis in many forms of surgery, of hysterical diseases and malingering, it is in constant use, no less than for cutting operations. The protoxide of nitrogen has again been restored to favour in America by Colton, for dental and other short operations. Administered without admixture of air or re-breathing of the products of respiration, it produces rapid, complete, and transient anæsthesia. At present it can only be produced by inconvenient processes, and is excessively bulky; but I see no reason why it should not be manufactured and liquefied by proper processes, which would allow of the condensation of a great volume of gas into a comparatively small compass. It seems applicable for most of the purposes of diagnosis, for many of the more rapid operations on the eye, &c. Richardson has done much to perfect *local anæsthesia* by the use of *ether in spray*, and the anæsthetic effects of the cold produced by its rapid volatilisation. Arnott, by the use of ice or snow and salt in combination, had previously produced similar congelation, more slowly, and by means not so uniformly at command, or so universally applicable, but still often at hand and highly serviceable.

Passing now to certain GROUPS OF DISEASES, I must only refer to the labours of Ricord, who distinguished clearly between *gonorrhœa* as a local disease, and *syphilis* as constitutional; and who declared that the soft chancre might become hard, and in this stage infect the system. This is the theory now known as the “unicity” of syphilis. On the other hand, the dualists now hold that the hard chancre is alone infecting, and that the soft is a purely local lesion. In this country opinions are not quite settled on this subject, and the diver-



gence is illustrated in the Report of the Venereal Commission of 1866, of which Mr. Skey was chairman, and Mr. H. Spencer Smith secretary. The contagion of the secondary suppurative accidents, proved by Wallace in 1835, is now generally admitted, although long disputed by Ricord and his school. This has had an important bearing on the health of the military and naval forces, by the influence on them of rules laid down under the "Contagious Diseases Act." In treatment we have learnt to rely on the mild use of mercurials, which, following Diday of Lyons, many English surgeons use now only when the evidence of constitutional infection is indubitable; and for secondary and tertiary symptoms, on the iodide of potassium, of which Wallace again first proved the usefulness. The salts of gold, silver, and platinum, the bichromate of potash, and other remedies, have had a brief and unmerited popularity. To Jonathan Hutchinson and to Wilks amongst Englishmen, and to Virchow and Lancereaux abroad, we are especially indebted for great additions to our knowledge of the symptoms, history, and treatment of visceral, nervous, and hereditary syphilis.

Syphilisation, discovered by Auzias Turenne in 1844, and thoroughly investigated by Sperino in Italy (1853), by Boeck in Christiania (1862), by James Lane and Mr. Gascoven in this country (1869), must be here noticed as having a most important bearing on all future investigations in this branch of surgery.

THE DISEASES OF BONES have been studied with great success by Brodie, Stanley, Fergusson, and Syme, and the museums of the past are loaded with specimens of limbs removed for necrosis, &c., which would now be treated by local means and saved. Brodie's investigations of abscess of bone, and of the diseases of the cartilages of joints, are held to be masterpieces of philosophic and successful research. We shall have again to refer to this subject further on.

In speaking of the SURGICAL AFFECTIONS OF NERVES we must mention especially the remarkable work of Smith of Dublin on neuromata (1849), and of Lockhart Clarke on the pathological changes in the spinal cord in *tetanus*, both of which form starting-points for fresh paths to knowledge on obscure affections.

The great work of Porter (1845), and the experiments of M. Notta, of Lisieux (1850), have only confirmed the researches of Jones on the influence of the clot in the arrest of hæmorrhage from the cut ends of ARTERIES. The surgeons of Great Britain have continued to take an ample share in the study of *aneurisms* since the time of Hunter. The school of Dublin surgeons demonstrated the practicability of curing aneurisms by *pressure* on the artery at a distance above the aneurism, as advocated by Freeth. Using graduated pressure by appropriate apparatus they overcame the difficulties of sloughing of the skin, extreme pain, &c., and elevated the compression treatment into a practical and highly successful method. Bellingham's work on this subject is classical. It was soon found that the pressure of the finger was a more successful and quicker mode of cure, inasmuch as it was better borne, and the pressure could be made more complete without causing pain. Isolated cases occurred in Ireland and America without attracting much attention, till Vanzetti, of Padua, established this as a mode of treatment, and in his hands, as well as

those of other surgeons, digital pressure now counts a splendid list of successes. The writer of this note invented and introduced into European practice a successful method of treating popliteal and other aneurisms by *flexion* of the limb at the joint opposite to the aneurism, which has often the effect of arresting the flow of blood and consolidating the contents of the sac. Ligature by the Hunterian method has still many warm partisans (including Mr. Syme, of Edinburgh) as the best mode of treatment; he has had thirty-six successes of ligature of the femoral artery without any failure. It is, in all ordinary cases, the *alternative* method. For cases of exceptional character the old operation of Antyllus has been revived with brilliant success by Syme. Sir W. Fergusson lately used Brasdor's operation for an otherwise inaccessible iliac aneurism. The modern surgeon has besides at his command the injection of coagulating fluids, especially perchloride of iron, and of galvano-puncture; the latter resource is especially useful for arterio-venous tumors and carotid aneurisms. The last and most brilliant advance in the treatment of aneurisms has been the cure of aortic aneurisms by Dr. Murray of Newcastle, and by Dr. Mapother of Dublin, within a few hours, by the powerful compression of the aorta under chloroform with Suter's aortic tourniquet.

For the arrest of hæmorrhage after division of arteries, torsion has been highly recommended as a substitute for LIGATURES, especially in the case of small arteries, for which it has, perhaps, been too little used. Sir James Simpson of Edinburgh has in an elaborate treatise urged the substitution of pressure on the cut ends of arteries by needles, which could be removed when the hæmostatic clot was sufficiently firm. Thus "the strangulation" of the extremity of the artery would be avoided, and primary union favoured by the "absence of small sloughs," while the metallic needles are less irritating than the threads. Keith and Pirrie of Aberdeen especially, amongst British surgeons, have obtained excellent results with *acupressure*, and others have reported favourably; but many who have tried it consider it less simple than the ligature, more liable to be followed by secondary hæmorrhage, and not more often followed by early or complete union of the wound. In France it is at present entirely condemned. It is being employed in Vienna by Billroth, and in Canada by Hingston, who report favourably. It is being largely tried, there is a great body of evidence in its favour, but it is still *sub judice*, and cannot yet be pronounced to have established its place in surgery as a permanent and general method. The whole question of "temporary ligatures" is being worked out afresh in England by Nunneley, Taylor, Tait, Humphry, and others. (*British Medical Journal*, Jan. to March, 1868.)

Passing from ligatures to SUTURES, it should be mentioned that Marion Sims, of America, by the introduction of silver or iron wire sutures, which remain long *in situ* without causing irritation or cutting their way through the tissues, has rendered great service, and, in operations such as for vesico-vaginal fistula, has won great victories over diseases previously very intractable. They have aided largely the progress of reparative surgery. By the perfection of the details of AUTOPLASTY much greater success is now attained than heretofore. Fergusson, Teale, and several of the Dublin surgeons; Nélaton,

Denonvilliers, Dieffenbach, and Langenbeck, have done much to perfect the details of rhinoplasty, blepharoplasty, staphyloraphy, cheiloplasty, and hare-lip operations. Fergusson in this country, and Mason Warren in America, may be said almost to have created pleuranoplasty. Roux and Graefe disputed the honour of introducing staphyloraphy in 1816, but the success of Roux has found few imitators in France; and while Fergusson and Pollock have rendered it one of the most common and successful of operations here, it has almost died out in France, from the frequency of failure amongst French surgeons. A reparative operation equally new and important is perinaeorrhaphy, of which the honour belongs to Fricke of Hamburg, Roux in Paris, and Baker Brown in London. James Lane has introduced some valuable modifications, and this operation is, in his hands, one of the most brilliant and successful in surgery. For vesico-vaginal fistula, utero-vesical fistula, &c., we owe success mainly to the genius of Marion Sims, whose speculum, metallic sutures, and general surgical inventions have removed these distressing and formerly irremediable affections into the class of those which are perfectly and rapidly curable.

From restorative we may pass to CONSERVATIVE surgery. And here the greatest advances have been made, and mainly by British surgeons. The practice of resecting joints was due to White of Manchester, and Park of Liverpool. It remained an exceptional operation until the striking successes of Jones of Jersey, the brilliant and persevering labours of Fergusson, Syme, Butcher, Hancock, and other British surgeons established resections of the great joints as among the most valuable operations in surgery, to the great saving of life and limb. In the most severe forms of hip and knee-joint diseases these conservative procedures are eminently successful. In traumatic injuries, especially in gunshot wounds, the results are equally satisfactory. Esmarch, Stromeyer, Langenbeck, Longmore, Macleod, Muir, Blenkins, Williamson, and others have rendered great services to this department of surgery. The success of our British surgeons in the Crimea was by far greater than that of the French, as is recorded in the great work of Chenu, and by Legouest, Baudens, and others. For the treatment of tumors of the jaws partial resections have been introduced with equal success by Fergusson (following Lizars and Gensoul), who has greatly simplified and improved the incisions and the mode of excising the bones.

The principle of preservation has led to the abandonment of "places of election" for amputation, and to the adaptation of methods of operation by various flaps to all parts of the limbs. Among the great and permanent improvements in surgery is to be reckoned Syme's operation on the ankle-joint, which gives a result unequalled by any other proceeding. This the experience of the American war has amply confirmed. Teale of Leeds, and Carden of Worcester, have successfully modified our flap-operations.

Passing to special operations, we must speak only briefly of strabotomy, due to Dieffenbach, studied with great care by Bonnet (who explained the relation of the muscles with the capsule of Tenon), and still further by Critchett and by Von Graefe. It is now admirably successful; and the use of appropriate glasses, such as Donders has shown to be desirable to correct the optical defect

which frequently causes the deviation of the eye, tends to make the vision binocular, and the cure permanent. Bowman has greatly facilitated the cure of lachrymal inflammations, strictures and fistulae, by his method of dividing the canaliculi, to which Weber has added, with advantage in some cases, the subcutaneous division of the tendo oculi, which facilitates the catheterisation and topical medication of the naso-lachrymal duct. Graefe, by his operation of *iridectomy*, has enabled us to transfer acute glaucoma to the list of remediable diseases. The extraction of cataract is being actively studied with a view to the improvement of the methods of extraction. Linear extraction with iridectomy, has advantages for certain difficult cases, but in ordinary cases extraction under chloroform by the flap operation is so brilliantly successful as to leave little to desire. Reclination is abandoned (almost, and ought to be entirely). Discission is valuable for soft cataracts. The surgery of the ear has been reconstituted by Toynbee, Politzer, and Von Trotsch. The catheterisation of the Eustachian tube, the pathology, diagnosis, and treatment of these diseases, has been studied anew; and not without good results, although they still remain among the least tractable. In the surgery of the *air-passages*, tracheotomy has become an ordinary operation, and its application to the treatment of certain diseases and accidents determined. Here we are much indebted to Bretonneau and Trousseau. In *strangulated hernia* the chief progress has been made by Luke and Gay, who have shown that femoral hernia is sometimes strangulated by the fascia cribriformis, and that it is commonly not necessary to open the sac in order to restore its contents. The operations for *artificial anus* have been studied with good effect by Callisen, Amussat, and Curling (for adults) in the lumbar region, and by Littré, and Holmes (for infants) in the groin.

The surgery of the genito-urinary organs owes its greatest progress to Civiale and Heurteloup, who may be said to have created lithotripsy (1820-32), and to have since brought it to great perfection. Except for the perfection of instruments by Weiss and by Henry Thompson, little has been done elsewhere to improve this operation; although it has been studied with great skill and success, and valuable rules laid down for its performance by British surgeons, especially by Brodie, Coulson, Fergusson, and Henry Thompson. It has, indeed, been more completely studied and more successfully practised in England than in any part of the world. *Strictures* of the urethra are now treated by gradual dilatation, sudden or forcible dilatation, or by section. Syme, in 1844, introduced external urethrotomy with a conductor; but, except in very severe cases, it is now rarely practised. It is partly superseded by internal urethrotomy, if not by dilatation. Internal urethrotomy by Civiale's (or Maisonneuve's) instrument, is a valuable resource: its effect is limited to the strictured part. Forcible dilatation by Holt's dilator, produces excellent results in very severe cases; but so also does slow dilatation. In neither case does the patient escape the tendency to subsequent contraction. The use of M. Segalas's "bougies à boule" has greatly facilitated the exploration and diagnosis of strictures; and the soft polished French bougies are great improvements on the ordinary gum bougies still in use in England.

Amongst the most notable conquests of surgery



has been the successful introduction of operations for the removal of *ovarian tumors*. Clay of Manchester, Walne, Samuel Lane of London, Baker Brown, and Spencer Wells are the names which must be chiefly connected with the history of this operation. By the two latter especially it has been studied with great care, modified with great ingenuity, and performed with marvellous success. Frederick Bird, Keith of Edinburgh, Tyler Smith, Kœberlé of Strasburg, Boinet, Atlee of Philadelphia, and his countryman Peaslee, are names which ought to be honourably mentioned in connection with the introduction of this operation. It is, however, essentially English; and it needed the visit of no less eminent a surgeon than M. Nélaton to give it currency on the Continent.

In nothing have we made more promising progress than in the after treatment of *persons wounded* and operated on. The principles laid down by Jackson and Hanen and other of our military surgeons are now firmly established throughout the world as canons. The effective ventilation (and, for this purpose, sufficient cubic space of wards), their convenient installation, and the importance of absolute purity of air, water, and dressings, have done much to banish hospital gangrene. But more remains to be done. The carbolic acid dressings of Mr. Lister, of Glasgow, promise to render great service in preventing the suppurative and putrefactive changes in injured parts, and have already produced results justly characterised as "astounding." The nutritious *alimentation* which we afford to our patients is very generally, though gradually, being followed abroad. The statistics of British operations are by far more favourable than those of the continent, especially of the French surgeons. In the treatment of fractures important improvement has been effected by the use of immovable bandages—starched, gummed, or stiffened with plaster of Paris, as advised by Baron Senten. Gutta-percha has provided us with a substance easily moulded to limbs and joints, and affording great support. The American surgeons have greatly simplified the apparatus of retention and extension, by the employment of weights for extension, and the substitution of cane splints and straps of plaster for the more cumbersome splints and bandages commonly employed. Brodhurst has shown in selected cases with what facility under chloroform movement can be restored to *ankylosed joints*, by breaking down the adhesions.

Finally, we must dismiss in a few words the great advances made in rectifying *deformities* generally, or what is called orthopædic surgery. Of this department of surgery, Stromeyer is the father. His disciple in this country was Dr. Little; and Tamplin, Adams, and Brodhurst, following him, have done much to erect it into a science. There is perhaps a tendency to over-much instrument-making here; and the Swedish system of exercises introduced by Ling is too little employed for vertebral deviations. But the most serious deformities of the limbs are now cured by division of the tendons and subsequent rectification of malpositions which were formerly beyond the reach of art, and the treatment of spinal curvature is both successful and free from cruelties. The comparative impunity with which the "subcutaneous" division of tendons is effected, has led to the generalisation of the method, and in the removal of loose cartilages from a joint in the operation of strabismus and torticollis, as in other opera-

tions of surgery, the "subcutaneous" method is found to have many advantages.

I will conclude by asking indulgence for this rapid summary, which the necessity for extreme condensation (amongst other reasons) has in my hands rendered even more imperfect than it might otherwise have been.]

*White's Cases in Surgery, 1770. Cheselden's Treatise on the High Operation for the Stone. Lond. 1723, in 8vo.; and his Treatise on the Anatomy of the Human Body; Sharp's Treatise of the Operations, and his Critical Inquiry into the Present State of Surgery. Monro's Works, by his son; Warner's Cases in Surgery, 1754; and his Description of the Eye and its Diseases, 1775. Alanson's Treatise on Amputation. Pott's Chirurgical Works. Kirkland's Obs. on Fractures, 1770; his Thoughts on Amputation, 1780; and his Medical Surgery, 1783. Smellie's Midwifery; and John Hunter, On the Blood, Inflammation, &c.; his Treatise on the Venereal Disease, Animal Economy, the Teeth, and all the papers written by himself and his brother, in the Phil. Trans., Med. Obs. and Inquiries, and Trans. of a Society for the Improvement of Med. and Chir. Knowledge, are productions which reflect the highest credit on the state of surgery in England.*

*Ernest Hart.*

**SUSPENSORY.** A bandage for supporting the scrotum; a bag truss. In cases of inflamed testis, varicocele, some particular herniæ, and several affections of the testicle and spermatic cord, a suspensory bandage is of great service.

**SUTURES** (from *suo*, to sew). A mode of uniting the edges of a wound, by keeping them in contact with stitches.

Mr. Sharp remarks, that "when a wound is recent, and the parts of it are divided by a sharp instrument, without any further violence, and in such manner that they may be made to approach each other, by being returned with the hands, they will, if held in close contact for some time, reunite by inosculation, and cement, like one branch of a tree ingrafted on another. To maintain them in this situation, several sorts of sutures have been invented, and formerly practised, but the number of them has, of late, been very much reduced. These now chiefly described are the *interrupted*, the *glover's*, the *quilled*, the *twisted*, and the *dry*, sutures; but the interrupted and twisted are almost the only useful ones, for the quilled suture is never preferable to the interrupted; the dry suture is ridiculous in terms, since it is only a piece of plaster, applied in many different ways, to reunite the lips of the wound; and the glover's, or uninterrupted stitch—which is recommended in superficial wounds, to prevent the deformity of a scar—does rather, by the frequency of the stitches, occasion it, and is therefore to be rejected, in favour of a compress and sticking plaster." (*Oper. of Surgery*.) The twisted suture is described with *hare-lip*; and **GASTRORAPHE** forms a distinct article in this Dictionary.

**Interrupted Suture.**—The wound being cleansed from all clots of blood, and its lips being brought evenly into contact, the needle, armed with a ligature, is to be carefully carried from without inwards to the bottom, and so on from within outwards. Care must be taken to make the puncture far enough from the edge of the wound, lest the ligature should tear quite through the skin and flesh. The distance, according to Mr. Sharp, may be three or four tenths of an inch. The other stitches required are only repetitions of the

same process. The threads having been all passed, "you are in general to begin tying them in the middle of the wound; though, if the lips be held carefully together, it will not be of great consequence which stitch is tied first." (*Operations*, chap. 1.)

Surgical writers, in general, state, that the number of stitches must, in a great measure, depend upon the extent of the wound. The common rule is, that one suture is sufficient for every inch of the wound; but that, in some instances, a stitch must be more frequently made, particularly when a wound gapes very much, in consequence of a transverse division of muscles. As we have already explained, it is necessary to pierce the skin, at a sufficient distance from the sides of the wound, lest the thread should cut through the flesh in a short time: but, though Mr. Sharp lays down the necessary distance, in general, as three or four tenths of an inch, and others advise the needle to be always carried through the deepest part of the wound, we must receive these directions, particularly the last, as subject to numerous exceptions. When a wound is very deep, it would be absurd, and even, in many instances, dangerous to drive the needle through a vast thickness of parts. Other wounds, of considerable length, might not be, in some places, four-tenths of an inch deep; though, it is true, sutures could never be requisite at such points.

The needles for the interrupted suture will pass with the greatest facility, when their shape corresponds exactly with the segment of a circle, and they should always form a track of a sufficient size to allow the ligatures, which they draw after them, to pass through the flesh with the utmost ease.

The interrupted suture obviously receives its name from the interspaces between the stitches; and it is the one most frequently employed. Its action is frequently assisted, and supported, either with the uniting bandage (see *BANDAGE*), or with strips of adhesive plaster, compresses, &c.

*Quilled Suture.*—As Mr. John Bell has observed: "When the wound was deep among the muscular flesh, the old surgeons imagined, that so large a wound could not be commanded by the common interrupted suture, however deep the stitches might be driven among the flesh; they were, besides, fearful of using the continued glover's suture in deep gashes, lest the wound should be made to adhere superficially, while it was still open within, forming perhaps a suppuration, or deep collection of matter. They believed that a deep muscular wound could not be safely healed without a degree of suppuration: while they wished to bring it together at the bottom, they were afraid to close it very exactly at the mouth, lest the matter should be collected in the deeper parts of the wound: it was for this purpose (says Mr. John Bell) that they used, what they called the *compound* or *quilled suture*. It is merely the interrupted suture, with this difference, that the ligatures are not tied over the face of the wound, but over two quills, or rolls of plaster, or bougies, which are laid along the sides of the wound. In performing this suture, we make first two, three, or four stitches, of the interrupted suture, very deep; and then, all the ligatures being put in, we lay two bougies along the sides of the wound; then slip one bougie into the loop of the ligatures on one side, drawing all the ligatures from the other side

(Mr. Bell should rather have said, towards the other side), till that bougie is firmly braced down. Next we lay the other bougie, and make the knots of each ligature over it, and draw it also pretty firm; and thus the ligatures, in form of an arch, go deep into the bottom of the wound, and hold it close, while the bougies, or quills, keep the middle of the wound, and lips of it, pressed together with moderate closeness, and prevent any strain upon the threads, or any coarse and painful tying across the face of the wound." In a note, Mr. J. Bell says, that Dionis violently reprobates the quilled suture; but that De la Faye (the annotator on Dionis) says, it is good for deep muscular wounds. The quilled suture is now scarcely ever employed; nor has it any advantages, except, perhaps, in some wounds of the belly. (See *Principles of Surgery*, vol. i. p. 50.)

*Glover's Suture.*—This had also the name of the continued suture. It was executed by introducing the needle first into one lip of the wound, from within outwards; then into the other in the same way; and in this manner the whole track of the wound was sewed up.

It was not, however, till lately, that this suture was totally abandoned; for Mr. Sharp, and several eminent writers since his time, advised its adoption in wounds of the stomach and intestines. From what has been said in the articles *WOUNDS OF THE ABDOMEN* and *HERNIA*, the reader will perceive that, even in such particular instances, the glover's suture would not be advisable; so that it may, in every point of view, be now considered as totally disused in every case of surgery which can possibly present itself. When we remember, in making this suture, how many stitches are unavoidable; how unevenly, and in what a puckered state, the suture drags the edges of the skin together; and what irritation it must produce; we can no longer be surprised at its now being never practised on the living subject. It is commonly employed for sewing up dead bodies; a purpose for which it is well fitted; but, for the honour of surgery, and the sake of mankind, it is to be hoped, that it will never again be adopted in practice.

*False, or Dry Suture.*—Modern surgeons commonly understand by this expression nothing more than the plan of bringing the sides of a wound together by means of adhesive plaster; nor did Mr. Sharp attach any other meaning to the phrase, which he sets down as highly ridiculous, as there is no sewing employed. For the following remarks, I am indebted to Mr. Carwardine, of Earls Colne Priory, near Halstead, Essex. Alluding to what was stated in the third edition of this Dictionary, concerning the dry suture, he observes: "You do not appear to be aware, any more than Mr. Sharp, of the precise mode of its application, or why it was so called. Indeed, it is a curious circumstance, how this method of dry suture should have been so lost, as not to be described by any modern surgeons, who laugh at the very term, speaking of it as a mere application of a strip of adhesive plaster. In the *sutura sicca*, so called in opposition to the *sutura cruenta*, where blood followed the needle, some adhesive plaster was spread on linen, having a selvage. A piece of this was applied along each side of the wound (the selvages being opposed to each other), and then drawn together by sewing them with a common needle, without bloodshed. Hence the term *sutura sicca*."



The dry suture was used in all wounds of the face, to avoid scars. You will find it thus described by our countryman, Thomas Gale, in his *Enchiridion*, 1563; and also by A. Paré, who gives a figure of it in his folio work, 1579." I feel much obliged to my friend Mr. Carwardine for this explanation, without which the expression *dry suture* is undoubtedly absurd. As the common way of dressing wounds with sticking-plaister will come under consideration in a future part of this work (see *WOUNDS*), I shall not here detain the reader upon that topic.

Sutures made with a needle and ligature were much more frequently employed by the old surgeons than by the moderns. The best practitioners fifty years ago never resorted to this method of holding the sides of a wound in contact, except in cases in which there was a real necessity for it, and other modes would not suffice.

There were, indeed, certain instances, in which the employment of sutures was forbidden. Of this kind were envenomed wounds, in which accidents the destruction of the poison always formed a principal indication in the treatment. Wounds, accompanied with considerable inflammation, were not deemed proper for the use of sutures, as the stitches had a tendency to increase the inflammatory symptoms. Also, as contused wounds necessarily suppurated, and, consequently, could not be united, sutures were not recommended for them; nor were they judged expedient for wounds attended with such a loss of substance as prevented their lips from being placed in contact. Formerly, wounds penetrating the chest were not united by sutures; nor were those in which large blood-vessels were injured; at least, until all danger of hæmorrhage was obviated by the vessels being tied.

Pibrac's dissertation on the abuse of sutures, inserted in the third volume of the *Memoirs of the Academy of Surgery*, had considerable effect in rendering the employment of sutures less frequent. This judicious and enlightened practitioner opposed the method of uniting wounds by means of sutures, which he contended ought never to be adopted in practice, except in certain cases, in which it was absolutely impossible to keep the sides of the wound in contact by means of a suitable posture, and the aid of a methodical bandage. Such circumstances Pibrac represents as exceedingly rare, if they ever occur at all. He speaks of sutures as seldom fulfilling the intention of the surgeon, who, in the majority of cases, finds himself necessitated to remove them before they have accomplished the wished-for end. Pibrac believes that sutures are generally more hurtful than conducive to the union of wounds; and that when they succeed, they do not effect a cure more speedily than a proper bandage. He cites numerous cases of extensive wounds of the abdomen, neck, &c., for the cure of which a bandage proved effectual, and this even in many instances in which sutures had previously failed, and cut their way through the flesh. M. Louis, who adopted the opinions of Pibrac, published, in the fourth volume of *Mém. de l'Acad. de Chirurgie*, a valuable dissertation, in which he endeavours to prove that even the hare-lip can be better united by means of the uniting bandage than with sutures; a case, however, which every practical surgeon now rightly agrees to consider, for particular reasons elsewhere noticed (see *HARE-*

*LIP*), as an example in which a suture is advisable. So far as I can judge, the fair statement of the matter is, that sutures are by no means requisite for the generality of wounds; but that there are particular cases in which either their greater convenience, or superior efficacy, still makes them approved. Since they cannot be practised without additional wounds being made, and pain occasioned; and since the threads always act as extraneous bodies in the parts, exciting more or less inflammation, and suppuration round them, there can be no doubt that their employment is invariably wrong, whenever the sides of a wound can be maintained in contact by less irritating means, with equal steadiness and security. For what is it which generally counteracts the wishes of the surgeon, and renders his attempts to make the opposite surfaces of wounds grow together, unavailing? Is not the general cause too high a degree of inflammation, which necessarily ends in suppuration? Are not sutures likely to augment inflammation, both by the additional wounds of the needles, and the still more pernicious irritation of the threads, which always act as foreign bodies, sometimes producing not merely an increase of inflammation and suppuration in their track, but frequently ulceration, or sloughing of the parts; and, in particular constitutions, an extensive erysipelatous redness?

But even admitting, that, by the general adoption of sutures, some wounds would be united, which could not be so were this means abandoned, still it must be allowed, on the other hand, that the cause of other wounds not uniting is entirely ascribable to the irritation occasioned by the sutures themselves. Hence, if it be only computed, that as many wounds are prevented from uniting by the irritation of sutures, as other wounds which are united by their means, and could be united by no other methods, we must still perceive, that mankind would be no sufferers, and surgery undergo no deterioration, were sutures rejected from practice. I believe, however, that every man, who has had opportunities of observation, and has made use of them with an unprejudiced mind, will feel persuaded that more wounds are hindered from uniting by sutures than such as are healed by them, and *could not be united by other means*.

But we are not obliged either to condemn or praise the use of sutures, in every instance, without exception. Men of independent principles will always adopt the line of conduct which truth points out to them as that which is right; nor will they obstinately join Pibrac and Louis, in contending that sutures are always improper and disadvantageous, nor imitate other bigoted persons, who may use sutures in every kind of wound whatever. Perhaps, sutures are still rather too much employed, and, in all probability, will long be so. It will be difficult entirely to eradicate the prejudices on which their too frequent use is founded, so long as teachers of surgery are seen holding up the practice for imitation in every principal hospital in the kingdom. Such surgeons, however, as are ready to imbibe fair and candid sentiments on the subject, and to qualify themselves for practising this part of surgery with judgment, should by no means neglect to read what Pibrac and Louis have written on the subject. I know that the latter authors are too sanguine in

their representations; but, as I have already remarked, sutures are still rather too much used, and something is yet necessary for the abolition of a certain unwarranted habit of having recourse to them without real necessity. Nothing will tend to produce this desirable change so effectually, as the perusal of every argument against their employment.

I find it exceedingly difficult to lay down any fixed principles for the guidance of the surgeon, in respect to when he ought, and when he ought not, to use sutures.

Perhaps, sutures should be made use of for all cuts and wounds which occur in parts of the body subject to an unusual degree of motion, such as would be apt to derange the operation of bandages, sticking-plaster, and compresses. Hence the propriety of using the twisted suture for the hare-lip.

Sutures are probably, for the most part, advantageous in all wounds of the abdomen, of a certain length, and attended with hazard of a protrusion of the bowels. In this situation, the continual motion and action of the abdominal muscles in respiration, besides the tendency of the viscera to protrude, may be a reason in favour of the use of sutures.

When two fresh-cut surfaces positively cannot be brought into contact by sticking-plaster, bandages, the observance of a proper posture, &c., there can be no doubt of the advantages of using sutures, if they will answer the purpose. Some wounds made for the cure of certain fistulous communications between the vagina and bladder, or others for the cure of similar affections in the perineum, afford instances of cases to which I allude. Sutures are generally resorted to after the operation of removing a diseased breast, castration, and operations for strangulated hernia. The reason for using sutures in the scrotum arises from the difficulty of keeping the edges of the wound in contact, owing to the great quantity and looseness of the part. Sutures are likewise employed after flap and circular amputations. Here they are serviceable in giving a degree of steadiness to the flap, not easily to be obtained at first by other means. When used in such cases, however, they should be withdrawn as soon as the isinglass or adhesive plaister affords sufficient support to the flap.

SYMPATHETIC BUBO. See BUBO.

SYNCHYSIS (from *συνχύνω*, to confound). The term SYNCHYSIS sometimes denotes the confusion of the humours of the eye, occasioned by blows, and attended with a rupture of the internal membranes and capsules. Beer understands, by the expression, a dissolution of the vitreous humour, or the state of it in which its consistence is entirely destroyed. (See *Lehre von den Augenkr.* b. ii. p. 257.)

SYNECHIA. SYNECHIAE, or adhesions of the iris to other parts, are divided into anterior and posterior synechia. 1st, *Anterior*—meaning adhesions of the iris to the cornea, or to textures occupying its place. These, if occurring without perforation of the cornea, are often observed near the insertion of the iris, and are the result of the prolonged contact of the swollen and inflamed iris with the cornea. Swelling of the inflamed cornea facilitates these synechia. 2nd, *Posterior Synechia*—or adhesions of the iris to the parts situated behind its uveal surface. These varieties are by far the most frequent. To see them thoroughly, atropia

should be applied, and lateral illumination used. *Circular Posterior Synechia* exist if the margin of the entire pupil is adherent to the capsule of the crystalline lens, the area of the pupil being free from effusion, or nearly so. *Total Posterior Synechia* signifies that the entire posterior surface of the iris is adherent to the capsule of the crystalline lens.

SYNICESIS of the pupil, signifies its closure by a more or less opaque membrane, which is continuous with the surface of the iris.

SYNTHESIS (from *σύν*, together, and *θέσις*, position, situation). A generic term, formerly used in the schools of surgery, and comprehending every operation by which parts that had been divided were reunited.

SYPHILIS. Lues Venerea. The venereal disease. (See *VENEREAL DISEASE*.)

[TALIPES (from *talus*, the ankle, and *pes*, a foot)—probably supposed to mean any distortion of the foot taking place from the ankle-joint; but as the transverse tarsal joint, mechanically considered as a centre of motion in the production both of varus and valgus, is at least of equal importance with the ankle-joint, the term is badly chosen. Dr. Little, *On Club-foot and Analogous Distortions*, p. 2, by W. J. Little, M.D. (London, 1839), proposed to employ the term talipes (previously applied to varus only) as a generic one, to include all the varieties of foot-deformity produced by muscular contraction, and his example has been generally followed. Talipes, therefore, may now be considered as including all the congenital and non-congenital distortions of the feet.

Deformities of the foot occur both as congenital and non-congenital affections, but the latter are by far the more numerous—the proportion, according to the statistics of the Royal Orthopædic Hospital, being as 7 to 10.

Modern science has proved that all these affections, i.e. the congenital and non-congenital distortions of the foot, are essentially and intimately allied; that the deformities occurring in intra-uterine life do not depend upon arrest of development, or malformation of the bones, as formerly supposed, though of course exceptional cases with malformation do occur; but that, as a general rule, like the deformities we so frequently see produced after birth, they depend essentially upon alterations in the relative position of the bones, in consequence of irregular muscular action, position, pressure, &c. However difficult it may be to determine primary causes, and to say in any given case, seen long after the production of the deformity (for it must be remembered that many of the congenital cases occur at a very early period of uterine life), which of several possible causes operated most in the production of the deformity; still, the existing conditions, when the deformity is fully developed at the period of birth in congenital cases, have been satisfactorily determined by pathological investigations, and upon this knowledge we have been led to a scientific and successful treatment of such cases as were previously considered to be incurable.

So long as the older surgeons were satisfied with the supposed cause of club-foot residing in arrest of development, or malformation of the bones, they were deterred from venturing upon its cure. Partial success under mechanical treatment, empirically adopted, first threw doubt on the correctness of this theory, and subsequent dissection, especially by Scarpa, who in 1803 published an



excellent though not quite correct account of the anatomy of congenital club-foot, proved the inaccuracy of the malformation theory.

Practical surgery then advanced, though very slowly, towards the means of cure; the turning-point in science was the discovery of subcutaneous tenotomy, an operation first performed by Stromeyer of Hanover, in the year 1831, though in the performance of this operation, Stromeyer freely and generously admits that he was guided by the principles laid down by Delpech of Montpellier, in 1828. From the date of Stromeyer's operation, orthopædic surgery, of which he may be considered the founder, has advanced rapidly to its present position, and the successful treatment of deformities of the feet is now one of the greatest triumphs of modern science.

There are four principal varieties of club-foot, viz. :—

**TALIPES EQUINUS**,—characterised by elevation of the heel, with extension of the foot and the toes pointed downwards.

**TALIPES VARUS**,—inversion of the anterior part of the foot, with elevation of the heel.

**TALIPES VALGUS**,—eversion of the anterior part of the foot, with elevation of the heel in severe cases.

**TALIPES CALCANEUS**,—depression of the heel, with the foot drawn upwards in the flexed position in severe cases.

And there are also three compound varieties, or intermediate forms, viz. :—

**TALIPES EQUINO-VARUS**,—when the foot is somewhat inverted as well as extended.

**TALIPES EQUINO-VALGUS**,—when the foot is everted as well as extended.

**TALIPES CALCaneo-VALGUS**,—when the foot is everted, with depression of the heel.

Let us now consider the first-mentioned variety of club-foot, viz. :—

#### TALIPES EQUINUS,

so named from the resemblance in position of the tarsus to that of the horse. In a severe case the heel is raised and the foot extended, so that it is continuous in a straight line with the leg without any lateral inclination; and the individual walks apparently upon the toes, but really upon the extremities of the metatarsal bones, the heads of which, under the weight of the body, become more or less separated from each other, so that the anterior part of the foot acquires an increased breadth.

The *longitudinal arch* of the foot becomes contracted—i.e. its extremities approximated, so that the foot is shortened and the concavity of the sole increased. In proportion as this proceeds, so a prominence of the head of the astragalus takes place on the dorsal surface. In some cases of talipes equinus, in which all the anterior muscles are completely paralysed, the foot becomes retroverted and bent upon itself in the direction of its length; the toes and metatarsal bones being, as it were, folded backwards, so that the individual walks upon the instep. In this condition, however, the foot more frequently turns inwards, when the case would become one of non-congenital varus or equino-varus.

From the severe degree of deformity above described, we have every gradation down to the slightest elevation of the heel without any de-

mity of the foot. Cases also in which the heel comes well to the ground in the erect position, but in which the tendo-Achillis is contracted (or, more properly speaking, the muscles of the calf which terminate in it) sufficiently to prevent flexion of the foot taking place beyond a right angle, are also classified with this deformity, and described as cases of talipes equinus, though we speak of these more commonly as cases of *right-angled contraction of the tendo-Achillis*. This condition gives rise to a certain amount of lameness, and even very moderate exercise induces fatigue. It is a condition of more practical importance than would at first appear, and when it has existed any length of time, and the muscles are in a healthy condition, the tendo-Achillis may require division. When the muscles are either paralytic or rigid from spasm, little good will result; but in some of the latter cases, where there is no general affection of the muscles of the lower extremity, tenotomy is useful.

When severe talipes equinus exists only in one limb—its most frequent condition—an extreme degree of lameness is produced, far beyond that caused by the severest form of congenital varus, because practically the length of the leg is increased; and the patient generally resorts to the use of a crutch.

When both limbs are affected, the patient may become totally unable to walk even with the assistance of crutches, but progression is seldom accomplished without this amount of assistance.

**MORBID ANATOMY**.—The anatomical deviations in this deformity are extremely simple, and as it is essentially—by some authorities considered to be invariably—a non-congenital affection, we should not expect to find the bones materially altered in form; they have never been found, by dissection, to be altered sufficiently to prevent complete restoration of the foot to its natural form, which has been accomplished in patients beyond sixty years of age.

The *deviations in the bones* relate to position rather than form. The os calcis assumes a more or less completely vertical position, from contraction of the gastrocnemius and soleus muscles; it comes in contact with the posterior margin of the articular surface of the tibia, and, as a necessary result of this movement, the *astragalus* is thrust forwards and obliquely downwards—partially luxated from the ankle-joint—so that its head projects in front on the dorsum of the foot. The *metatarsal bones* assume, more or less, a vertical position in proportion to the elevation of the os calcis, and in the more severe forms become separated from each other laterally towards their distal extremities—thus increasing the breadth of the foot at the part through which the weight is directly transmitted to the ground.

The *bones generally* are found to be light, thin-walled, and atrophied, with the cancelli enlarged and filled with oily matter, in cases of long standing, and especially those of paralytic origin; these conditions are obviously the result of defective nutrition and disuse.

The *articular cartilages* on the exposed and extruded portions of the articular surfaces of the astragalus become thinned, and completely removed at the articular borders, exposing the osseous surfaces.

The *ligamentous structures* in front of the ankle-joint, and on the dorsal aspect of the foot, es-

pecially the ligament between the astragalus and navicular bone, are found to be elongated in proportion to the degree and duration of the deformity; while those on the plantar aspect of the foot are contracted and shortened to a corresponding extent. The lateral ligaments of the ankle-joint are also elongated in their anterior, and contracted in their posterior portions. The posterior ligaments of the ankle-joint also become structurally shortened, in adaptation to the altered relations of the os calcis and tibia, which at the margin of the ankle-joint are in contact in severe cases.

The muscles are found in very variable conditions, corresponding to the cause producing the deformity, whether paralytic, spasmodic, or merely mal-position; and also to the length of time the deformity has existed. They will be found to present every possible deviation from the standard of health, through all the changes of fatty degeneration, and some other obscure structural changes, to the complete destruction and removal of their proper tissue, in place of which fatty and fibrous tissue are chiefly substituted. The changes of fatty degeneration are most marked in the cases of paralytic origin. In spasmodic cases, even of many years' duration, the changes of fatty degeneration appear to be very slowly and imperfectly developed, but they are found in the most contracted and least-used muscles.

The contracted muscles, which become permanently shortened by adapted atrophy, are the gastrocnemius, soleus, and plantaris, in the calf of the leg, producing elevation of the os calcis; and the short flexor in the sole of the foot, producing or keeping up the contraction in the longitudinal arch. In this condition the plantar fascia is also contracted.

**PATHOLOGY.—Etiology; congenital origin.**—It is considered by some orthopædic authorities in this country that talipes equinus never occurs as a congenital deformity. My colleague Mr. Tamplin observes, "I have never met with pure talipes equinus congenital;" and my late colleague, Mr. Lonsdale—who published in the *Lancet* (September 1, 1855) a statistical account of 3,000 cases of various deformities which had been treated by him, conjointly with myself, in the Orthopædic Hospital—did not record any example of congenital equinus. It is frequently said to be of congenital origin by unobserving parents, but upon close enquiry we generally learn that the heel was not observed to be raised until "the child began to put his feet to the ground." Nevertheless, Drs. Little, Duval, Guérin, and other authorities have recorded cases which they believe from satisfactory evidence to have been of congenital origin, and I have seen two or three cases of the same kind, i.e. cases of congenital equinus, in which there has been no marked tendency either to inversion or eversion of the foot, and in which the tendo-Achillis has been the only contracted tendon. Therefore, I admit that talipes equinus does occasionally, though very rarely, occur as a congenital deformity.

Talipes equinus, in its ordinary non-congenital form, may be produced by any of the numerous causes upon which the other non-congenital deformities of the foot are known to depend, and which have been arranged by Dr. Little in two series—viz., first, those *indirectly affecting the ankle-joint* through the muscular or nervous system; as

spasm, paralysis, wounds of muscles, scrofulous abscesses in the course of the muscles and in the neighbourhood of the joint, long-retained position, &c.,—and secondly, those *directly affecting the joint*, as chronic inflammation, scrofulous disease, rheumatic and gouty inflammation of the joint, injuries of the joint, &c.

**PROGNOSIS.**—The prognosis in cases of talipes equinus must have reference to two very distinct points—viz., the cure of the deformity; and the probability of the patient gaining complete voluntary power over the foot and the muscles of the lower extremity, many of which are frequently involved in the general affection of which the deformity is the result.

With respect to the cure of the deformity, the prognosis may always be favourable, except where bony ankylosis has taken place—a very rare condition. The age of the patient and duration of the deformity will, of course, influence the duration of the treatment, extending the time from six weeks, which is generally sufficient in young persons, to three or four months in some rigid cases in the adult.

With respect to the second point—viz., the probability of the patient gaining complete voluntary power in the foot, and usefulness of the limb, after the cure of the deformity—the prognosis must depend upon a variety of circumstances, more especially the cause producing the deformity, whether indirectly or directly affecting the articulation; and in the former class, which are principally of spasmodic or paralytic origin, more particularly must it depend upon the number of muscles involved, and the precise condition of such muscles.

**TREATMENT.**—The means employed to remedy this distortion of the foot may be arranged under the three following heads, viz.—operative, mechanical, and physiological; a combination which also applies generally to all deformities of the foot, but in very variable proportions in different cases.

**Tendons, &c. requiring division.**—The only important tendon requiring division is the tendo-Achillis, with its small accompanying tendon the plantaris; the latter is generally included in the section of the tendo-Achillis, but sometimes yields before the knife without division, and may be felt as a very tense little cord which had better be divided. In many cases, also, it is necessary to make a free division of the plantar fascia and short flexor muscle in the sole of the foot. In the more severe cases in which the arch of the foot is much increased, this had better be done as a separate stage of treatment, before dividing the tendo-Achillis, which serves the purpose of fixing the os calcis, so as to offer a firm resistance to the pressure exerted against the anterior portion of the foot with the object of expanding, or as it were unfolding, the arch of the foot from the transverse tarsal joint—the mechanical centre of motion in this contraction.

After the division of the tendo-achillis, a compress of lint should be applied and retained in position by a strip of adhesive plaster. The foot and leg should then be bandaged, and a well-padded splint applied along the anterior part of the foot and leg, so as to keep the foot in an extended position, and the divided ends of the tendon approximated. This should not be disturbed till the third day, unless the pressure becomes uncomfortable, or the foot swells. The cutaneous punc-



ture will then be found to have healed, and gradual mechanical extension may commence.

**MECHANICAL TREATMENT.**—The apparatus by which gradual mechanical extension is made for the purpose of restoring the foot to its proper position, is that still known as the Scarpa's shoe, though it has been in course of time so materially altered and modified that, as now made, it possesses but little resemblance to that invented by the distinguished surgeon whose name it bears. In addition to several modifications in form and the arrangement of the straps, the footpiece of this instrument is made to move in the direction of flexion and extension, and also of inversion and eversion, by two cog-wheels placed at the side opposite the ankle-joint, and connected with the perpendicular steel bar, from the upper extremity of which a broad circular strap, containing a semi-circular steel plate on its posterior half, passes round the leg.

*Rate of Extension.*—By means of the modified Scarpa's shoe, the foot may be gradually brought into its natural position. The rate at which it is desirable to accomplish this should be regulated by the activity of the reparative process in the divided tendon; but, practically, it is often limited by the ligamentous rigidity of the articulation. In well-nourished infants, the full length required in the divided tendo-Achillis should, according to my observation, be obtained in a fortnight, if practicable; in a well-nourished leg in the adult, it should be obtained in from three to four weeks; but in atrophied paralytic limbs, it should not be obtained in less than from four to six weeks.

*The object of gradual extension* is not to elongate or stretch the new material uniting the divided extremities of the tendon, as generally supposed: but to regulate the length of new material, or (as it may be called) the new tendon, whilst we have the opportunity of so doing, during the period of its formation or regeneration. This important part of the treatment must therefore be left to the judgment of the surgeon.

**PHYSIOLOGICAL TREATMENT.**—When the reparative process in the divided tendon appears to be sufficiently perfect, and the required length of new tendon has been obtained—in the tendo-Achillis this may be judged of by feeling its continuity—and the foot brought into its natural position by mechanical means, passive motion should be employed with the object of restoring the functions of the joint, and bringing the muscular and other structures into a healthy condition; to some extent also it will assist in restoring the natural form of the foot. The movements required in cases of talipes equinus are simply those of flexion and extension of the foot, which in children I direct the parents or nurse to do for a quarter of an hour two or three times a day. In cases in which the deformity has been severe, motion is at first always attended with more or less pain, which in children appears to be referred to the neighbourhood of the tendon, or around the ankle-joint, but in adults is always referred to the anterior part of the ankle-joint; this may perhaps depend upon the edges of the articular surfaces of the bones, which become more or less denuded of their articular cartilage, coming into contact with each other. In a little time, however, this disappears, and the functions of the joint are restored.

When the foot has been thus far restored, the

patient may begin to use it in walking, but with some caution at first. With the object of supporting the joint, and of preventing any accidental twisting of the foot when the ligaments are weak, it is advisable to attach two light steel supports to the boot, each having a joint corresponding to the ankle-joint; these side-steels must extend about halfway up the leg, and be connected above by a calf-plate behind, and in front by a leather strap. When the muscular power of the leg is unimpaired, I frequently dispense with these steel supports, and from the first allow the patient to use common boots, or only continue the use of the supports a few weeks. In cases in which the anterior muscles of the leg, the extensors of the foot, are paralysed, it is necessary to have what is called a *stop joint* at the ankle, so contrived as to prevent the foot falling beyond a right angle with the leg, and the patient may be obliged to wear this as long as the paralysis lasts.

The existence of paralysis in the muscles of the leg must not be considered as counter-indicating the cure of the deformity by operative means; some additional mechanical support may be required in these cases to compensate for the loss of power in certain muscles, as for example when the rectus muscle is paralysed, in which case it will be necessary to continue the steel support to the waist; but by such means patients may be enabled to walk even when both legs are affected, when they have never walked before, or when they have been deprived of the power of walking for many years. In paralytic deformities, atrophy from disuse is superadded to atrophy from paralysis; and by curing the deformity, and bringing such limbs into use, not only is atrophy from disuse prevented, but the cure of the paralysis is also materially promoted. Galvanism, shampooing, and warm clothing must also be employed in such cases. Speaking generally, the benefit obvious to the patient will be in proportion to the severity of the case, and the length of time the paralysis has existed; though, as respects the ultimate condition of the limb, the benefit will be in proportion to the early period at which the operation is performed, after the contraction has become confirmed.

There are two compound varieties of club-foot, termed equino-varus and equino-valgus.

#### TALIPES EQUINO-VARUS.

This deformity is but a slight modification of talipes equinus. When, in addition to the ordinary characters of equinus, there is a certain amount of inversion of the anterior portion of the foot, the deformity partakes somewhat of the external characters both of equinus and varus, and is therefore termed equino-varus. The elevation of the heel is the predominant condition, but, according to the extent of the inversion, the patient walks more or less on the outer metatarsal bones.

*The anatomical deviations* are essentially the same as in talipes equinus; but the navicular bone is somewhat displaced inwards, leaving the outer part of the head of the astragalus exposed on the dorsum of the foot. When the deformity has existed any length of time, structural shortening of the anterior tibial muscle is generally produced, and sometimes the same condition also occurs in the posterior tibial muscle.

*The pathology* of this deformity is essentially the

same as that of talipes equinus. It is a non-congenital affection—cases of slight varus must not be confounded with it—and is produced by the same causes which gave rise to talipes equinus. The great majority of cases met with in practice will, therefore, be found to depend either upon spasmodic or paralytic affections, and the muscles will be found in the same conditions as described in talipes equinus. This deformity most frequently affects the right foot only; secondly, the left foot only; and thirdly, both feet.

The treatment is the same as that required for talipes equinus, but in some cases the anterior tibial, or the posterior tibial tendon, or both, may require division; and in the mechanical treatment it is the more necessary to make use of the Scarpa's shoe with a double cog-wheel, by which the lateral inclination of the foot may be controlled.

The deformity described as NON-CONGENITAL VARUS so closely resembles that just described, with respect to its general pathology and principles of treatment—the paralysis being usually more complete, and the inversion of the foot more marked—that no special description of this deformity need be given.

#### TALIPES EQUINO-VALGUS.

This deformity is characterised by a certain amount of eversion of the anterior portion of the foot coexisting with contraction of the tendo-Achillis and elevation of the heel. It is, therefore, a compound variety between the simple form of talipes equinus and talipes valgus, and is generally regarded as the opposite condition to equino-varus; but this difference exists, viz., that whilst in the latter deformity, elevation of the heel is the predominant condition—it is, in fact, but a slight modification of talipes equinus—in talipes equino-valgus the elevation of the heel is comparatively very slight, and eversion of the anterior portion of the foot is the predominant condition—it is, in fact, but a slight modification of talipes valgus; and a certain amount of contraction of the tendo-Achillis is so constantly present in all the more severe forms of talipes valgus, whether of congenital or non-congenital origin, that the description of equino-valgus may be considered as included in that of talipes valgus, the pathology and treatment being essentially the same in both forms of distortion.

#### TALIPES VARUS.

Talipes varus occurs both as a congenital and non-congenital distortion, and the anatomical conditions, as well as the general pathology of this deformity, vary in so many respects, according to its congenital or non-congenital origin, that it is necessary to describe these varieties separately. The description of non-congenital varus has, however, essentially been included in that of talipes equino-varus, with which it is intimately allied.

#### CONGENITAL TALIPES VARUS.

This is by far the most frequent form of congenital distortion of the foot, and that to which the term *club-foot* is ordinarily applied.

**EXTERNAL CHARACTERS.**—The external characters of this deformity vary in several important respects, according to the age of the patient, whether infant or adult, and the extent to which the foot has been used in sustaining the weight of the body in walking. They also vary

according to the degree or original severity of the deformity, so that for the purpose of description a well-marked and moderately severe form of the infantile and of the adult distortion should be taken.

#### EXTERNAL CHARACTERS OF CONGENITAL VARUS IN THE INFANT.

1st. *The anterior portion of the foot is turned inwards*, and in this direction forms a right-angle with the leg. In a very severe case the foot may be drawn upwards, so that its inner border may be parallel to, and even in contact with, the inner side of the leg.

2nd. *The sole of the foot looks directly backwards*, and the dorsum directly forwards.

3rd. *The inner edge of the foot looks directly upwards*, and the outer edge directly downwards.

4th. *The foot is necessarily shortened*, because its inverted position depends upon the anterior two-thirds being turned inwards; the angle of flexion corresponding to the transverse tarsal joint in front of the astragalus and os calcis, so that the foot is bent laterally upon itself, and not turned inwards from the ankle-joint.

5th. *The heel appears to be very small*, as if imperfectly developed, and misshapen; in fat children the tuberosity of the os calcis can scarcely be felt, owing to the nearly vertical position assumed by this bone.

6th. *The internal malleolus is less prominent than natural*, and in severe cases its outline cannot be traced; this depends upon the navicular bone being drawn underneath, and in contact with, the inner malleolus, by the posterior tibial muscle; and not upon any imperfect development of the inner malleolus, which has been supposed to exist, and even assigned as a cause of the inversion of the foot. *The external malleolus in a thin child appears to be more prominent than natural*, in consequence of the inversion and obliquity of the foot—and also it appears to be situated farther backwards towards the heel; but this depends upon the lateral obliquity of the os calcis, the tuberosity of which inclines towards the fibula, and is sometimes nearly in contact with it.

Although the external characters above described bear a general relation to the severity of the case, yet, for practical purposes, in reference to the prognosis and result of treatment, we judge of the severity of a case, not so much by the external form of the foot, as to whether it forms more or less than a right-angle with the leg, but by the amount of resistance offered to the restoration of the foot by manipulation to its natural form and position. This resistance, or rigidity (as we generally express it), arises from contraction, and adapted shortening of both muscles and ligaments, conditions which are found to exist in every degree of severity at the period of birth, but which do not certainly bear a definite relation to the external deviations in form. Some apparently severe cases in the infant are very flexible, whilst others, presenting the same external appearance, are extremely rigid and unyielding; this rigidity, however, after birth increases with the advance of age, and in the adult bears a pretty constant relation, in congenital cases, to the external form of the foot.

*External Characters superadded, or acquired, in the Adult.*—After the congenital club-foot has been



used for some years in sustaining the weight of the body in progression, the external characters, as above described, become materially modified. In consequence of the weight being thrown upon the outer border of the foot, the metatarsal bones gradually yield in a direction backwards, so that the individual at last walks completely on the dorsum of the foot. Two modifications in external form result from this:—

1st. The aspect of the sole of the foot looks upwards and backwards, and the dorsum is directed forwards and downwards.

2nd. *A deep longitudinal furrow*, or depression, is gradually formed in the sole of the foot, in consequence of the narrowing of the transverse arch of the foot; and a *transverse, or obliquely transverse, depression* across the sole of the foot at its posterior part is formed in consequence of the lateral bending of the foot upon itself in the direction of its length, by which the sole of the foot is brought into opposite relation with the lateral aspect of the os calcis.

*A dorsal cushion*, of condensed fat and cellular tissue, is formed on the convexity of the foot which has to sustain the weight of the body in progression, and a large bursa is frequently formed between this cushion and the surface of the tarsal bones. This compensative provision is attended with peculiar disadvantages, such as cutaneous and bursal inflammation, liable to be followed by a most intractable ulceration, sometimes rendering amputation necessary.

*Atrophy of the leg* from disuse takes place when the deformity is allowed to remain up to the period of youth or adult life; the growth of the leg below the knee is defective in every respect, so that it presents the appearance of an atrophied or dwindled extremity. The length of the club-footed leg in the adult is always diminished from this cause; and shortening from half an inch to an inch below knee always exists, the foot itself also being an inch, or more than an inch, shorter than the opposite foot.

#### MORBID ANATOMY OF CONGENITAL TALIPES VARUS.

The anatomical deviations in congenital varus are materially modified by the age of the patient, and it is obviously of so much importance to accurately determine the essential and acquired conditions in the morbid anatomy of this deformity, that it is advisable to describe—1st. The deviations which essentially belong to the deformity at the period of birth; and 2nd. The superadded or acquired conditions met with in the adult.

##### 1st. Morbid Anatomy of Talipes varus in the Infant.

THE BONES are found to present the following important deviations in respect both of their position and form:—

The *os calcis* is much altered in position, but only slightly in form; it occupies a very oblique and, in severe cases, almost vertical position, from its tuberosity being drawn upwards by the gastrocnemius and soleus muscles. Its direction is also somewhat changed laterally, the tuberosity being inclined towards, and in severe cases in contact with, the fibula. In form the *os calcis* is slightly altered, being regularly arched in the direction of its length, with the convexity out-

wards, in adaptation to the curved position of the foot.

The *astragalus* is very materially altered, both in position and form. In position it is tilted obliquely forwards and downwards, and to a certain extent displaced from its socket, so as to assume, in a severe case, almost a vertical position, in consequence of the oblique position of the *os calcis*, and elevation of its tuberosity. The *astragalus* is also in some degree rotated outwards, so that the external lateral articular facet is firmly in contact with the fibula, and appears to be somewhat increased in size; whilst the internal lateral articular facet is scarcely to be traced, and in severe cases is not at all in contact with the articular surface of the inner malleolus.

The *astragalus* is very much altered in form—indeed, this is the only bone which presents any important deviations from the natural form; and these are observable in its head and neck, its articular surfaces, and its posterior border.

The neck of the *astragalus*, instead of being continued directly forwards, as in the healthy bone, inclines abruptly inwards towards the inner malleolus, forming an obtuse angle with the body of the bone.

The articular head of the *astragalus*, instead of presenting a regularly convex surface, looking directly forwards, as in the healthy bone, has an antero-lateral aspect; and in a severe case is divided into two articular facets, placed nearly at right-angles to each other, and separated by a distinctly angular ridge. One surface, the larger, looks directly inwards, and articulates with the displaced navicular bone; the other looks directly forwards, and is left exposed on the dorsum of the foot, by the altered position of the navicular bone, and is covered only by the elongated portion of the ligaments normally passing from the neck of the *astragalus* to the edge of the navicular bone.

The lateral articular facets are both partially extruded from the ankle-joint, and appear in front of the malleoli, in consequence of the altered position of the *astragalus*, and present some deviations already adverted to.

The superior articular surface of the *astragalus* is partially extruded from the socket of the ankle-joint, and exposed on the dorsum of the foot. This surface is also elongated by the articular cartilage extending quite to the posterior edge of the bone, which is thin, attenuated, and wedge-shaped: a transverse line or ridge traverses this surface, separating the posterior two-thirds which are included in the ankle-joint from the anterior third which has been extruded from the joint.

The *navicular bone* is altered in position to an extreme degree, but is very slightly, if at all, altered in form. This bone is drawn inwards and upwards by the tibialis posticus muscle directly, and by the tibialis anticus and extensor proprius pollicis muscles indirectly, so far as to bring its inner border, or tuberosity, directly under and in contact with the inner malleolus. The navicular bone, in its displaced position, articulates with the lateral articular facet of the head of the *astragalus* above described, and therefore holds a lateral instead of anterior position with respect to the *astragalus*; in fact, the long axes of these two bones are parallel, instead of being at right-angles to each other. The long axis of the navicular bone is, therefore, parallel with the long axis of

the leg, instead of being at right-angles to it. The peculiar position assumed by this bone does not result from a movement of transverse rotation, as described by Scarpa and other authorities, but depends upon the vertical, or nearly vertical, position assumed by the astragalus.

The cuboid bone is neither altered in form nor position in any material degree.

The cuneiform and metatarsal bones are very little, if at all, altered in their normal relations to each other, and to the navicular and cuboid bones. The inverted position which the anterior part of the foot holds with respect to the leg, essentially depends upon the altered position of the navicular bone and of the os calcis and astragalus.

The malleoli are neither altered in form nor position. The inner malleolus is of its full natural form and size in infantile varus, a fact of great importance, as Dr. Little informs us: "The inward inclination of the fore-part of the foot, which constitutes the difference between talipes varus and talipes equinus, has, by Stromeyer, been attributed to deficiency of the inner malleolus. Delpech and Cruveilhier are likewise of opinion that this cause also greatly contributes to the persistence of talipes varus. The author (Dr. Little) has never observed, in foetal or adult instances of dissected talipes varus, any material deficiency of this process." *On Deformities*, p. 250; by Dr. Little (London, 1853). In adult cases, however, the inner malleolus will be found to be very much below its natural size, and flattened where it has rested upon, and imperfectly articulated with, the navicular bone, and it was probably from the dissection of adult specimens that the observations were made. Such changes may, however, be regarded as belonging to the series of acquired or superadded conditions from age, and the use of the foot.

With respect to the bones generally, it may be observed that at the period of birth, they are a little below the full natural size, and that the astragalus is considerably malformed. This does not depend upon any defective power of development in the bone itself, but is determined by the malposition of two of the bones with which it articulates—viz., the navicular bone and the os calcis. The altered form of the astragalus, therefore, is a result, rather than a cause, of the deformity, and one from which the only chance of recovery is in proportion to the early period at which the deformity is cured. The displaced navicular bone and os calcis may be brought into their natural position by tenotomy, as soon after the first month from birth as the circumstances of the case permit.

**LIGAMENTS.**—In slight cases of varus, and even in cases of a moderate degree of severity, none of the ligaments are found to be contracted to an extent sufficient to interfere with the restoration of the foot, after division of the tendons of the contracted muscles; but in severe and rigid cases, the ligaments will be found, at the period of birth, to have adapted themselves in length and form to the altered position of the bones they naturally serve to connect; and so firmly do they maintain the bones in the deformed position of the foot, that even after division of all the contracted tendons, the foot cannot be restored to its natural form. The rigidity, therefore, with which the foot is held in its deformed position at birth, depends, not only upon muscular contraction,

but also upon the extent to which this adapted shortening of the ligaments has taken place during the latter part of the intra-uterine growth of the bones.

The most obviously shortened ligaments in severe cases of varus at the period of birth are—the deltoid, the anterior portion of which prevents the navicular bone being drawn sufficiently outwards from the inner malleolus; and the posterior ligamentous bands of the ankle-joint, which prevent the os calcis being depressed to its normal extent. In some cases, the ligaments in the sole of the foot—the calcaneo-cuboid, calcaneo-scapoid, and the other ligamentous bands passing between the tarsal bones—are also shortened, and the plantar fascia is shortened and contracted to a very marked degree. The ligaments on the convexity of the foot, and in front of the ankle-joint are found to be elongated, more especially the outer portion of the ligament passing between the neck of the astragalus and the navicular bone, by the displacement of which this ligament is stretched over the exposed portion of the head of the astragalus; and also the anterior portion of the capsular ligament of the ankle-joint, which is stretched over the extruded portion of the superior articular surface of the astragalus.

**MUSCLES.**—As a general rule, both in slight and even severe cases of varus, all the muscles are found to be in a healthy condition, and developed to very nearly, if not quite, their normal size at the period of birth; though, if the deformity be allowed to continue, the muscles do not grow—from their state of inaction—as in healthy limbs, and therefore remain of small size.

In some very severe cases, important structural changes in the muscles occur; the muscles on the anterior and outer aspects of the leg have been found to be very imperfectly developed in several instances. In one case examined by the late Professor Quekett and myself, the muscular fibres in these structures were all but absent; we found no trace of muscular structure in the situation of the tibialis anticus, extensor proprius pollicis, or peronei muscles, and only a few small fibres connected with the tendon of the extensor longus digitorum. The place of the muscular structure in the above situations was occupied by fibrous and adipose tissue. The posterior muscles were well developed. The fibres of the tibialis posticus were larger than in any other specimen examined. The muscular fibres in the external half of the soleus muscle were in a state of granular and fatty degeneration. In another case the gastrocnemius muscle was unsymmetrically developed, the internal head and half of the muscle being hypertrophied, and the external head and half of the muscle imperfectly developed, and in a state of fatty degeneration. The tibialis anticus and posticus muscles were fully developed and apparently hypertrophied. The extensor longus digitorum and peroneus tertius might almost be said to be absent, as far as their muscular fibres were concerned, only an extremely attenuated layer of muscular fibres representing the extensor muscle. The peronei were moderately well developed. (See *Trans. Path. Soc.* vol. iii.)

However difficult it may be to explain the arrest of development and degeneration of certain muscles, or portions of muscles, in some cases of talipes



varus, the occasional existence of such conditions must be borne in mind when giving a prognosis in any severe case.

**TENDONS.**—In foetal and infantile specimens of varus, the tendons will always be found to be somewhat displaced, in adaptation to the altered position of the bones of the foot, the displacement varying according to the severity of the case. The tendon of the tibialis anticus muscle, as it crosses the ankle-joint (the point we select for its division), is displaced very much to the inner side; and the tendon of the tibialis posticus muscle is in some cases situated on, rather than behind, the inner malleolus, so that at the point we select for its division (viz., just above the malleolus) this tendon is relatively much more forward than in the healthy foot. In reference to the second part of its course—between the inner malleolus and its insertion into the navicular bone—it is very important to observe that in severe cases the posterior tibial tendon does not pass beneath the inner malleolus, and then obliquely downwards and forwards, in front of this process, towards its insertion into the navicular bone, as in the healthy foot; because the navicular bone itself is displaced by the contraction of the tibialis posticus muscle, so as to be held in contact with the inner malleolus.

In severe cases, therefore, the posterior tibial tendon passes directly downwards from the inner malleolus to its insertion into the navicular bone, which it immediately reaches. This anatomical fact determines the position in which the posterior tibial tendon must be divided—viz., just above the inner malleolus before it enters the dense tubular sheath; and it also proves that this tendon cannot be divided “a little below and in front of the inner malleolus,” the situation in which Mr. Syme (see a *Clinical Lecture on Tenotomy*, by Mr. Syme; *Lancet*, March 17, 1855) recommends the operation to be performed, and where some surgeons still attempt to divide the tendon. In slight cases of varus, and where there is no rigidity of the feet—i.e., in cases in which the foot can be restored by manipulation nearly to its natural position before the operation—the navicular bone can no doubt be drawn from the inner malleolus nearly, if not quite, into its normal position, and the posterior tibial tendon may be divided in the second part of its course, i.e., “a little below and in front of the inner malleolus;” but in such cases the division of this tendon is usually not required, and moreover the situation is physiologically objectionable, in consequence of the dense sheath in which the tendon lies, and to which the divided extremities of the tendon are very apt to become adherent, without any direct connexion with each other; the true reparative process is thus arrested, and complete non-union established.

The tendo-Achillis, in severe cases of infantile varus, does not occupy its normal position with respect to the axis of the leg, or its relations to the malleoli. In all cases of varus the os calcis has a lateral obliquity, the tuberosity of this bone inclines towards the fibula, and is sometimes even in contact with it; it follows, therefore, that the tendo-Achillis, as it passes towards its insertion into the tuberosity of the os calcis, must incline towards the fibula, in a degree proportionate to the severity of the case. There is some difficulty in judging of the exact relations of this tendon by

external examination, in consequence of the diminished prominence of the inner malleolus, and the posterior surface of the tibia being brought into what might be regarded as the lateral aspect of the foot; but if the position of the tendo-Achillis be judged of by its relation to the outer malleolus, which can always be felt, the difficulty disappears, and the tendon will be found to deviate towards the fibula in proportion to the severity of the case, and therefore is further removed from the posterior tibial artery than in the healthy foot.

**VESSELS AND NERVES.**—As the vessels and nerves, in their course from the leg to the foot, follow the direction of the deformity, they necessarily deviate to a corresponding extent in their normal direction and relations; but, practically, these deviations are of little importance, as they do not very materially alter their relations with respect to the tendons.

From the description above given, of the morbid anatomy of talipes varus at the period of birth, it will be seen that this deformity is by no means so simple and uncomplicated with organic lesions as might be inferred from the account given by most writers on this subject. It is not simply a displacement of certain bones, whether from muscular action or malposition in utero, which have previously been well-formed, and accompanied with contraction and structural shortening of certain muscles, as first taught by Scarpa, and since adopted by nearly all authorities on this subject; but, on the contrary, malformation—consecutive or adapted malformation, it may be called—of the astragalus is always present in a degree proportionate to the severity of the deformity. Very important ligamentous alterations from adapted growth are also present in severe cases. Deviations in the direction and relative position of the tendons are constantly present, and a variety of abnormal conditions in the muscular structures are sometimes met with.

#### *2nd. Morbid Anatomy of Talipes varus in the Adult.*

The effect of allowing the deformity to remain unrelieved must necessarily be, that during the growth and ossification of the bones, all the deviations in form above described as existing at the period of birth, become confirmed; and the ligaments also, in their adapted growth, most materially tend to render the deformity permanent and incurable. It is to be observed also that the bones do not grow at their normal rate, or attain their full proportionate development—nor do they acquire their natural degree of density; they remain thin-shelled, light, cancellous, and fatty. These changes result from a generally defective state of nutrition, constantly present in the legs of club-footed individuals, and essentially depending upon muscular disuse. With respect to the

**BONES.**—The os calcis is altered in position to an extreme degree, and is also much altered in form. The tuberosity is elevated, so that this bone occupies a very oblique or nearly vertical position; and it has also a marked degree of lateral obliquity, the tuberosity being immediately behind the fibula. The superior surface of the os calcis is in contact with the posterior border of the articular surface of the tibia, and also with the fibula, both of which rest upon it, so that the os calcis appears to enter into the composition of the ankle-joint.

The anterior surface of the os calcis is left exposed, to two-thirds or more of its extent, by the lateral displacement of the cuboid bone.

The *astragalus* is much more altered than the os calcis, both in position and form. This bone is completely vertical in position, only a portion (about half) of its superior articular surface, together with its posterior border, which is attenuated and wedge-like, entering into the composition of the ankle-joint; the anterior half of this surface, extruded from the joint, is exposed on the dorsum of the foot. The head of the astragalus is ill-defined and much misshapen. Instead of presenting a regularly convex surface directed anteriorly, it has two articular facets at right-angles to each other, and divided by an abrupt line or angular ridge: one, the larger, looking directly inwards, and articulating with the displaced navicular bone; the other, looking directly downwards, is left exposed by the altered position of the navicular bone, and is covered only by the elongated portion of the ligament normally passing from the neck of the astragalus, which in this bone is very ill-defined, to the edge of the navicular bone.

The articular surface for the external malleolus is distinct, but that for the inner malleolus is very indistinct, and sometimes not traceable.

The posterior border of the astragalus is attenuated and wedge-like, in consequence of its being compressed between the elevated os calcis and the articular surface of the tibia.

The *navicular bone* is altered in position to an extreme degree, but very little in form. Its internal extremity, or tuberosity, is drawn completely under the inner malleolus which rests upon it, thus transmitting to the ground a portion of the weight of the body; and a flattened articular facet is found on each bone.

The general direction of the long axis of the navicular bone is quite vertical, like that of the astragalus, with the body and part of the head of which, in its distorted form, it is in direct lateral relation. The long axes of these two bones are, as near as may be, parallel instead of being at right-angles to each other, as in their normal relations. This relative position constantly obtains in all severe cases, and is of the utmost importance to be borne in mind in deciding upon the direction in which mechanical force is to be employed for the cure of the deformity.

The *cuboid bone* deviates very considerably in position, and is also a good deal altered in form. It is displaced laterally inwards from its articulation with the os calcis, but retains its articular connexion with the navicular bone, which it follows in its lateral displacement, inwards and upwards. As this bone in its displaced position is somewhat below the level of the other tarsal bones, it must necessarily sustain the greater part of the superincumbent weight; its dorsal surface looks directly downwards, and its plantar surface looks backwards and upwards. The tendon of the peroneus longus has no connexion with the cuboid bone, but passes obliquely across the os calcis to the sole of the foot.

The *cuneiform bones* retain their normal relations to the navicular and cuboid bones, and to each other.

The *metatarsal and phalangeal bones* deviate to an extreme degree in their normal directional relations with respect to the leg, but they retain

their normal articular relations with the cuneiform and cuboid bones, and with each other. It is the general direction of the anterior portion of the foot which gives the external character to the deformity. The *fourth and fifth metatarsal bones* are so displaced in the altered relations of the anterior part of the foot to the leg, that their dorsal surfaces look directly downwards, and rest flatly upon the ground, forming, together with the dorsal surface of the cuboid bone, the most prominent part of the very imperfect and irregular base of support which the club-footed adult possesses. By the weight of the body being thrown upon these bones, they are further displaced backwards so as to narrow, or to produce a contracted condition of, the transverse arch of the foot.

**LIGAMENTS.**—All the ligaments of the foot become adapted, more or less, in their length and direction, to the abnormal relations of the bones, which they serve to connect so firmly as to constitute the chief obstacles to the cure of the deformity. At the ankle-joint, if we speak of all the ligaments collectively, it may be said that anteriorly, and on the outer side towards the front part, the ligaments are extremely elongated; and posteriorly and laterally, on both sides, extremely shortened or contracted. The internal lateral, or deltoid ligament, is also contracted in its anterior portion, and powerfully assists in retaining the navicular bone in contact with the inner malleolus.

At the tarsal joints, it may be said, generally, that the ligaments on the dorsal aspect are elongated, whilst those on the plantar aspect of the foot are shortened to an extreme degree. The plantar fascia is also very much shortened, and its tense and contracted condition offers a formidable obstacle to the restoration of the form of the foot.

**MUSCLES.**—During the persistence of club-foot, the muscles of the leg, below knee, destined to regulate the movements of the foot, are almost entirely thrown out of action, and, in consequence of the immovable condition of the ankle-joint, very defective growth is the result; probably also some structural degeneration takes place, but this is certainly not considerable, as the muscles, though small in size in the club-footed leg of the adult, acquire, after the cure of the deformity and a few months' exercise, their natural degree of firmness and power proportionate to their bulk.

**TENDONS.**—The observations previously made in reference to the tendons in severe infantile cases of varus, are, for the most part, applicable to this deformity in the adult, especially as to their deviation in direction and altered relations in adaptation to the deformed position of the foot; but in the adult, all these deviations become more confirmed. The tendons are also longer and more slender than in the healthy leg, in consequence of the small size of the bellies of the muscles, and the defective nutrition of these limbs generally.

In a severe case of adult varus, the anterior tibial tendon, as it crosses the ankle-joint—the point we select for its division—is not only displaced very much to the inner side, but also passes from the inner malleolus in an oblique direction behind rather than in front of this process. And the posterior tibial tendon is lodged in a groove on, rather than behind this process, and then passes directly downwards from the inner





*Deficiency in the length of the leg* is met with as a rare complication of varus, and is then usually associated with some malformation of the foot; and in some instances the lower end of the fibula appears to be deficient, or fused with the tibia, which is generally bent at an angle forwards in the lower third.

*Spina bifida, and Malformation of the Brain and Spinal Cord.*—In anencephalous fœtuses, and also in spina bifida occurring in the lumbar region, varus is of frequent occurrence, as well as other deformities affecting the upper and lower extremities. M. Guérin, who has carefully studied these cases, adduces them in favour of the dynamic theory of the production of varus.

#### TREATMENT OF CONGENITAL TALIPES VARUS.

The great objects of treatment of congenital club-foot, as well as of all other deformities of the limbs, are—

- 1st, the restoration of form; and
- 2nd, the restoration of function.

The means we have at our disposal for accomplishing these objects may be arranged in three classes—viz., the *mechanical*, the *physiological* (including chiefly gymnastics, shampooing, and galvanism), and the *operative*.

Before the discovery of subcutaneous tenotomy (1831) brought the treatment of deformities immediately under the care of the surgeon, the method of treatment generally adopted, consisted of a combination of the mechanical and physiological means; and these were sufficient for the cure of the slighter forms of varus, but completely failed in the more severe and rigid cases, even when the treatment was continued for several years. In some cases, even when severe, the inversion of the foot was by such means more or less completely corrected, but the elevation of the heel was seldom if ever overcome; so that the cases remained as examples of talipes equinus or equino-varus, and either continued in this condition, or relapsed to the original deformity.

The scientific treatment of talipes varus, when severe, can only be accomplished by a judicious combination of the mechanical, physiological, and operative means; and many of the failures frequently witnessed, even in the practice of those who have devoted much attention to the subject, are due to the want of this combination of principles, too frequently considered as antagonistic to each other, but which modern science teaches us are only valuable in so far as their mutual dependence may be recognised by the surgeon. In the orthopædic practice of the present day in England, the operative and mechanical means are too generally combined, to the exclusion of the physiological, in the treatment of club-foot and other deformities of the limbs; and the mechanical means alone too much relied upon, to the neglect of the physiological means, in the treatment of spinal deformities.

If the operative and mechanical means in combination are admitted to be inadequate to the cure of club-foot, without the aid of the physiological means, so also is it equally true that the operative treatment (i. e. tenotomy), without the assistance of the mechanical means, is the most mischievous and unscientific that can be adopted. There is no greater error than to suppose that club-foot is curable by tenotomy alone. Although

in the slight congenital, and many of the non-congenital cases, the foot can be immediately restored to its normal position, after division of the tendons—by so doing great danger is incurred of non-union, or very feeble union, of the tendo-Achillis in the non-congenital cases, especially when of paralytic origin; and of complete non-reunion of the posterior tibial tendon in the congenital cases, so that the condition of the patient may be rendered much worse than if the deformity had never been submitted to treatment.

Assuming, then, as proved that operative treatment is indispensable in all but the slightest forms of congenital club-foot, the question arises—

*At what age should Tenotomy be performed?*—Very different opinions are still entertained on this point, but it is generally recommended that the operation be deferred till about the walking period—viz., the tenth or twelfth month, and sometimes later. Probably this has been influenced by the opinion given by Dr. Little, that “the most favourable period for the division of tendons, in infantile cases of talipes, is a few months before the time when the child may be expected to make the first attempts to walk—about the age of six or eight months, until which time, in cases of talipes varus, mechanical apparatus should be used to turn the toes outwardly, reducing the deformity to the condition of talipes equinus.” (*Op. cit.*, p. 284.)

The late Professor Lizars, of Edinburgh, attached the greatest importance to the assistance to be derived from “the due exercise of the muscles, ligaments, and articulations of the foot” in walking; and on this account, as well as from the liability of the apparatus to fret the skin in infancy, postponed the operation to a much later period than Dr. Little. He observes:—“Two or three years of age is the earliest time at which division should be attempted. I prefer three years.” *Practical Observations on the Treatment of Club-foot*, third edit., page 9. (Edinburgh, 1855).

But to me it appears that the age at which the operation should be performed is to be determined by the anatomical and physiological conditions of the structures involved in the deformity. There can be no doubt that the malformed condition of the astragalus at birth is determined by the malposition of the os calcis and the navicular bone, and that its altered form is in evident adaptation to the altered position of these bones.

The effect of allowing the deformity to remain during the period of active growth and ossification of the bones, is not only to induce the persistence of these abnormal conditions, but a positive increase both in the deviations of the bones and the adapted shortening of the ligaments. Arrest of development of the muscles of the leg is a constant and most important effect of the persistence of the deformity, and one from which the individual never recovers. The longer the deformity remains uncured, the less will be the ultimate size of the muscles of the leg.

To avoid these grave evils, the only course is to cure the deformity at as early a period as may be consistent with the general health and strength of the child. The operation may be performed between the first and second month. Delay beyond the second month is unnecessary, and



certainly acts prejudicially upon the ultimate result of the case. It is, moreover, a great advantage to get the treatment of the club-foot over before the commencement of dentition, during which process children are generally fretful, and become liable to so much illness, that interruptions from this cause may be feared.

*Operations required.*—In the great majority of cases of talipes varus, it is necessary to divide the tendons of the tibialis anticus, tibialis posticus, and flexor longus digitorum muscles, and also the tendo-Achillis. The plantar fascia also frequently requires division in infantile cases, and constantly in adult cases.

*Order in which the Tendons should be divided.*—In all severe cases of varus, it is absolutely essential to divide the operative treatment into two stages; the second operation being performed after an interval of a few weeks or months, according to the age of the patient, and the severity of the case. The great practical point is to overcome the inversion of the anterior portion of the foot; or, in other words, to convert the varus into equinus, and thus reduce a compound to a single deformity, before dividing the tendo-Achillis. With this view the tendons of the tibialis anticus, tibialis posticus, and flexor longus digitorum should be divided at the first operation, and the foot subsequently everted by mechanical means. There is no greater error in the treatment of severe varus than to divide the tendo-Achillis at the first operation, either by itself, as is frequently done, or conjointly with the division of the other tendons. It is now an established rule in orthopædic practice that the tendo-Achillis is the last tendon to be divided, and that its division should be delayed till the equinus alone remains to be cured—i. e., in the second stage of the operative treatment. The plantar fascia may be divided at the second operation, in cases of moderate severity; but in more severe cases its division should be made a separate stage in the treatment, after the division of the anterior and posterior tibial tendons, and before the section of the tendo-Achillis, the contracted condition of which may be rendered serviceable by fixing the os calcis during the process of unfolding the longitudinal arch of the foot by mechanical means.

*Mode of performing the Operations.*—It is the established practice at the Orthopædic Hospital to divide all tendons from below upwards towards the skin. The knife is introduced obliquely downwards, with the flat surface parallel with the tendon to be divided. The point is then carried behind the tendon, as close to it as possible, and the handle of the knife depressed; the cutting edge is now turned against the tendon, which, in infants, yields before a little direct pressure, the tendon being simultaneously made tense by an assistant who has charge of the foot. After division of the tendon the foot should be instantly restored to its deformed position, so as to approximate the divided extremities of the tendon, and the wound covered by a compress and adhesive plaster. The foot should then be bandaged, and a softly-padded splint applied, so as to retain it in the deformed position; and thus it must remain for three or four days, when the extending process should be commenced by the special apparatus employed.

For the division of the posterior tibial tendon,

two knives are necessary—viz., a narrow scalpel-pointed tenotome, and a blunt-pointed tenotome. The scalpel should be thrust straight down to the tendon, a little above the inner malleolus, and the sheath of the tendon opened; then the blunt-pointed knife should be introduced in the same track, and passed behind the posterior tibial tendon, towards which the cutting edge may then be turned, and by a very gentle movement the tendon will be divided. If the point of the knife is moved about too freely, or thrust too deeply, there will be a fear of dividing the posterior tibial artery.

#### THE MECHANICAL TREATMENT OF INFANTILE VARUS.

In slight cases, in which all the tendons requiring division are divided at one operation, the Scarpa's shoe, or any other apparatus preferred by the surgeon, may be applied on the third day, and extension commenced, the foot being gradually brought into its natural position in about three weeks; but in the more severe cases, in which the operative treatment is divided into two stages, different mechanical means must be employed in each stage. For the purpose of everting the foot, and bringing it into the condition of talipes equinus, nothing answers better than a simple straight splint, softly padded and applied along the outer side of the leg, below the knee. To this splint the foot should be gradually drawn by a bandage, till it is brought to a straight line with the leg, and a complete equinus produced.

When the eversion of the foot is complete, and the second stage of treatment commenced by the division of the tendo-Achillis, then the object of mechanical treatment will be to flex the foot at the ankle-joint, and in so doing to gain the required amount of elongation of the tendo-Achillis. This must be accomplished gradually, but in about a fortnight the foot may be brought into its natural position, and the required elongation of the tendo-Achillis obtained. This time applies only to cases of varus in healthy infants, where the reparative process proceeds quickly; in feeble children three weeks may be taken, and in the non-congenital cases of club-foot associated with paralysis, at least a month should be allowed.

The apparatus best adapted for this second stage of treatment, i. e., after division of the tendo-Achillis, is the Scarpa's shoe, or the apparatus known as a varus-splint, which combines the advantages of the Scarpa's shoe with those of the outside splint continued to the thigh, and controls the tendency to inversion of the foot, frequently present after the division of the contracted tendons, and even after the case is considered to be cured. The varus splint is decidedly the best apparatus. After the foot has been brought into its natural position, this splint must still be constantly worn for at least a fortnight, whilst the new tendinous structure is acquiring more perfectly its true fibrous character, and during this time passive motion may be allowed for a quarter of an hour twice a day.

About the end of the fourth or fifth week, if the tendo-Achillis should appear to be strong, the varus-splint should be worn only at night; and in the daytime the child may wear an ordinary kid boot with a steel spring attached to the outer side to keep the foot everted. This spring should have

a free-joint corresponding to the ankle-joint, and not a stop-joint, as generally recommended, as more good will be derived from the frequent and regular employment of passive motion than from any mechanical aid.

THE MECHANICAL TREATMENT OF CONGENITAL VARUS, AFTER THE PERIOD OF WALKING, AND IN THE ADULT.

It has been already explained that the severity of talipes varus becomes much increased after the period of walking, not only in consequence of the adapted growth of the ligaments, and the persistence of the deviations in the bones, but by the influence of the superincumbent weight which, in the act of progression, is transmitted to the ground—at first through the outer border of the foot, and subsequently through the exposed anterior articular surface of the os calcis; the exposed portion of the head of the astragalus; the cuboid and the two outer metatarsal bones.

A straight wooden splint, softly padded, and applied along the outer side of the leg, may be used during the first stage of the treatment, the object of which is to evert the foot, and reduce the deformity from varus to equinus.

The Scarpa's shoe is the apparatus generally employed during the second stage of treatment—i.e., after division of the tendo-Achillis when the object is to flex the foot; but some special contrivance, such as that known as a *screw-pad*, must be used for “unfolding the transverse arch of the foot,” as we generally express the movement required to restore the cuboid bone and the two outer metatarsal bones to their normal position. For several adult cases, however, the writer prefers an apparatus of his own construction, which he has described and figured in his work on Club-foot (p. 261), and this may be employed both in the first and second stages of the treatment.

AFTER-TREATMENT.

By this is meant the treatment necessary, in infantile as well as adult cases, after the complete removal of the deformity, to retain the foot in its natural position, and to improve its physiological condition, with respect to the joints, muscular action, &c., so as to prevent relapse, and render the cure complete and permanent. The after-treatment, therefore, is both *mechanical* and *physiological*: the first consisting in the employment of some mechanical support to retain the foot in its normal position—a retentive apparatus; and the second in the use of active and passive exercises, shampooing, &c.

In some slight infantile cases, where the muscles are strong, and the ligaments have not become adapted in their growth to the deformed position of the foot, no retentive apparatus may be required to keep the foot in its new position; but, in all the more severe cases, the deformity will certainly return unless the foot be retained in its normal position by mechanical means for a sufficient length of time, and appropriate measures be adopted to promote its physiological improvement.

It is always necessary to employ a retentive apparatus, consisting of a light steel support attached to the foot below, and passing upwards to the calf of the leg, round which a circular band, made partly of steel and partly of leather, passes.

In this steel support there should be a free-joint corresponding to the ankle-joint.

When a decided tendency to inversion of the foot and leg exists during walking, this can only be effectually controlled from the hip-joint, and, for this purpose, a steel support must be carried up to the waist, and connected with a pelvic belt, a free-joint being placed opposite the knee. In children this apparatus may have to be worn from two to four years. In children above the age of six or seven years, much may be done by drilling; and as the tendency to inversion is generally within the power of voluntary control, the retentive apparatus above described is seldom required. In youth and in the adult it is never necessary.

The *physiological means* consist of active and passive exercises, with rubbing and shampooing. In infantile cases passive exercises, i. e. “working the foot” in the direction of flexion and extension, should be conducted by the nurse for a quarter of an hour twice a day at least. In older children this is assisted by the exercise of walking, but the passive exercise must not be neglected, because, if any stiffness at the ankle-joint remains, children run about without flexing the ankle-joint, and then relapse of the deformity is certain. In adults active and passive motion must be persevered in with the utmost attention and regularity.

NON-CONGENITAL TALIPES VARUS.

Talipes varus is sometimes met with as a non-congenital deformity, generally resulting from infantile paralysis during teething, but sometimes produced by other causes. Although the cause upon which this deformity depends dates, generally, from infancy, yet, as the distortion of the foot is slowly produced, we seldom see these cases in childhood, but generally in youth or in the adult. The coexisting paralytic condition of the limb is considered to be the more important affection, and the surgeon is frequently not consulted till such inconveniences have arisen as to render walking very painful, if not impracticable, either from ulcerations on the foot, to which these paralytic extremities are especially liable, or from increase of the distortion, so that the boots and supports generally used can no longer be worn.

EXTERNAL CHARACTERS.

The external characters of non-congenital varus resemble, or rather approach in resemblance to, those of the ordinary congenital form of varus, but they are never so distinctly marked, for two reasons:

1st. Not being congenital, there is an absence of the characteristic deformity of the bones, more particularly of the astragalus, which exists even at birth in the congenital form.

2nd. Being nearly always of paralytic origin, the foot is pushed or forced into its deformed position by the superincumbent weight of the body in walking, rather than drawn into it by the active tonic contraction of the muscles, and its retention in this position is the result only of a slow adaptation of the ligaments and muscles.

The foot, therefore, although it may assume the inverted position sufficiently for its classification with varus as a variety, presents a generally rounded and smooth external surface, without any of the marked irregularities on the dorsal aspect, and without the longitudinal and transverse depressions on the plantar aspect described as charac-



teristic of the congenital form in the adult; and, with this absence of the external markings, there is also an absence of the rigidity of the foot constantly present in the adult congenital cases.

These peculiarities, together with the paralytic and extremely wasted condition of the limb usually coexisting with this deformity, are sufficient to enable the surgeon to diagnose the non-congenital from the congenital cases of varus.

#### MORBID ANATOMY.

In non-congenital varus of paralytic origin—its ordinary cause—the bones, ligaments, muscles, tendons, nerves, vessels, and skin undergo all the changes of defective growth, atrophy, and degeneration known to occur in paralytic limbs, and gradually become adapted to the deformed foot.

**BONES AND LIGAMENTS.**—The deviations in the form and direction of the bones, articular surfaces, and ligaments, in non-congenital varus, partake of the same general characters already described as existing in the congenital form; but are all much less in degree, obviously for the reason that the development of these structures has proceeded without interruption up to the period of the commencement of the deformity, i.e. early childhood. Hence we find that, in the non-congenital form, the astragalus never presents the peculiar malformation which it certainly exhibits in congenital varus, and the adapted shortening of the ligaments is always materially less. This at once explains why the deformity in adult cases of non-congenital varus can be removed in two or three months, while in congenital cases more than a year is frequently required to produce the same result.

**MUSCLES.**—When the deformity of the foot is associated with paralysis of the limb, fatty degeneration of the muscular structure commences as an early change, and rapidly advances to an extreme degree; but as all the muscles of the leg are not equally paralysed, so the degeneration proceeds unequally. Generally, the tibialis anticus, and sometimes the tibialis posticus, will be found to be in a comparatively healthy condition. When the deformity is not associated with paralysis the muscles are generally healthy in structure.

#### PATHOLOGY.

*a. Etiology and mode of production.*—Non-congenital varus is generally the result of infantile paralysis, occurring during dentition or some of the febrile disorders of childhood. In some cases, only some of the muscles of the leg are paralysed, generally the peronei, extensor longus, and sometimes the extensor pollicis; the deformity then takes place more rapidly, in consequence of the unbalanced action of the tibialis anticus and posticus muscles assisting in the inversion of the foot during progression.

Non-congenital varus is also said to arise from spasmodic affections, but, as a permanent condition, this has not fallen under my observation, though, as a temporary condition, the foot is sometimes drawn into the position of this deformity in cases of hysteria, strychnine-poisoning, &c.

*b. Numerical importance.*—Amongst the non-congenital deformities, complete inversion of the foot is the least frequent, occurring only in the proportion of sixty in a thousand cases, and in nearly half the cases only one foot is affected.

#### PROGNOSIS.

From the pathological history of this deformity, and especially from the fact that it is generally the result of a paralytic affection, and seldom comes under the notice of the surgeon till the adult period of life, the prognosis, with respect to the power and general usefulness of the foot after the removal of the deformity, must be as unfavourable in this non-congenital form of varus, as it is favourable in the congenital form. The deformity itself can be very easily cured, and doubtless this is, in most cases, worth doing; but sometimes the ultimate advantages of curing the deformity by orthopædic treatment will have to be balanced against those of amputation and the substitution of an artificial leg.

#### TREATMENT.

If, after considering all the circumstances of the case, it be determined to cure the deformity, as a means of improving the condition of the patient, the case must be treated upon the same general principles as the congenital form, but in many cases it is unnecessary to divide the posterior tibial tendon. It is always advisable to divide the treatment into two stages; the object of the first stage being to reduce the deformity to simple equinus, and of the second to flex the foot and bring it into the position of a right-angle with the leg.

During the first stage of treatment, the straight splint applied along the outer side of the leg is the best form of apparatus, and, in the second stage, after division of the tendo-Achillis, the Scarpa's shoe will be found the most useful. The mechanical treatment throughout must be conducted with extreme caution, in order to avoid sloughs from pressure, which readily take place in these cases in consequence of the paralytic condition of the limb, and when they occur are extremely difficult to heal.

**AFTER-TREATMENT.**—In consequence of the paralytic condition of the limb, it will be necessary for the patient to wear some form of retentive apparatus, probably for the rest of life. The precise form of mechanical support must depend very much upon the extent of the paralysis, and especially whether extension of the leg from the knee-joint has been lost by paralysis of the rectus muscle; if so, then a steel support must be carried from the foot up to the hip-joint, and connected with a steel belt round the pelvis, motion being allowed only at the hip-joint during walking; but the patient may have the power of bending the knee whilst sitting by means of a spring-joint at the knee. If the rectus muscle is not paralysed, the steel support need not extend beyond the calf of the leg.

#### CONGENITAL TALIPES VALGUS.

Talipes valgus, or (as it is generally termed) flatfoot, occurs rarely as a congenital, but very frequently as a non-congenital affection; and, as there are some important differences both in pathology and treatment in these two forms, it will be desirable to consider them separately. First, then, with regard to the congenital form of valgus.

#### EXTERNAL CHARACTERS.

In a case of congenital talipes valgus in an infant, the foot is always more or less everted, and the longitudinal and transverse arches flattened.

The inner margin of the foot is depressed and the outer margin raised, evidently by the contraction of the peronei and extensor-communis muscles, the tendons of which are felt to be tense and prominent. In some cases the heel is raised, or the os calcis rigidly fixed in a right-angled position with respect to the axis of the leg, so that the motion of the ankle-joint is very limited; or the heel may be depressed, and therefore the external characters are modified by the condition of the tendo-Achillis.

In cases of congenital valgus accompanied with contraction of the tendo-Achillis, the arch of the foot is really reversed by the anterior portion of the foot being bent upwards from the transverse tarsal joint, at the same time that the tuberosity of the os calcis is elevated, and this bone held in a very oblique position by the contraction of the muscles of the calf, so that the entire foot has a boat-shaped appearance. This complication necessitates the division of the tendo-Achillis, and renders the treatment more difficult.

An elongated condition of the tendo-Achillis does not exist so frequently as is supposed, and the appearance of depression of the heel is often deceptive; but when it does exist, such cases may be grouped with the deformity described as talipes calcaneus or calcaneo-valgus. This complication, however, is of little importance, and does not at all interfere with, but rather facilitates, the cure of the case.

#### MORBID ANATOMY OF CONGENITAL VALGUS.

In the dissection of a confirmed and tolerably severe case, the following deviations affecting the bones and soft tissues will be found:—

**BONES.**—Speaking generally, much less deformity and displacement of the bones exist in congenital valgus than have been described in congenital varus.

**Os calcis.**—The tuberosity of the os calcis is elevated to a variable extent; the deviation of this bone is frequently slight, but in a severe case it has been found to be nearly as much elevated as in a severe case of congenital varus—a fact which argues strongly against the theory of this deformity being produced by any pressure resulting from *position in utero*, the favourite cause of this, and other congenital deformities adopted by several orthopædic authorities.

**The astragalus** is tilted forwards and downwards, with a degree of obliquity proportionate to the elevation of the tuberosity of the os calcis, when this condition exists. There is no very material alteration in the form of the head and neck of the astragalus at the period of birth, as in talipes varus; but in one very severe case, I have seen the articular surface of the head of the astragalus a little altered in shape, in adaptation to the altered position of the navicular bone.

**The navicular bone** undergoes a movement of transverse rotation; its inner extremity being depressed so as to leave exposed a portion of the globular head of the astragalus, and its outer extremity being somewhat raised.

**The cuboid bone**, like the navicular, undergoes a movement of transverse rotation, but only to a slight extent.

**The navicular, cuneiform, and cuboid bones**, together with the *tarsal extremities of the metatarsal bones*, are all somewhat altered in their relations to

each other, in consequence of the longitudinal and transverse arches of the foot being completely destroyed, and, as already explained, sometimes even reversed; so that the plantar surface of the foot presents a convex instead of a concave appearance, the prominences of the head of the astragalus, the inner borders of the navicular and of the inner cuneiform bones, being felt on the inner and under side of the foot, with depressions between them, caused by the separation of the articular surfaces of the corresponding joints.

**The toes and the metatarsal bones** are drawn upwards and outwards, so that the anterior portion of the foot is flexed upon the leg with a greater or less degree of eversion and transverse rotation outwards—the outer metatarsal bones being raised, and the inner depressed.

Thus it is evident that, in a severe case of valgus, the transverse tarsal joint is a much more important centre of motion than is generally supposed. The eversion of the foot, or, more properly speaking, of the anterior portion of the foot, appears to have been too frequently regarded as taking place from the ankle-joint, just as the inversion appears to have been similarly regarded in varus, and the apparatus employed for the treatment constructed accordingly; but it is quite clear that the ankle-joint takes very little share in the production either of the inversion, or eversion characteristic of these deformities.

**LIGAMENTS.**—The exact deviations of the ligaments have not been described from dissections, but in one case I found that the calcaneo-scapoid ligament, and ligamentous bands connecting the astragalus and the navicular bone on the inner side were elongated, so as to allow of the rotation and uplifting of the navicular bone, and exposure of the inner portion of the articular surface of the head of the astragalus previously described. The other ligaments connected with the tarsal bones are found to be altered in length and direction, in adaptation to the deformed position of the foot, and in severe cases offer great resistance to its restoration.

**MUSCLES.**—In this deformity, as in cases of congenital varus, with the rare exceptions already described, the muscles appear to be quite healthy in structure, and also free from any physiological defect; so that, after curing the deformity in an infant, the muscular power of the limb is perfect.

**TENDONS.**—In consequence of the displacement of the bones being so much less in congenital valgus than in varus, there are no important deviations in direction and altered relations of the tendons in valgus, such as previously described as existing in varus. The deviations in direction which exist in adaptation to the deformed position of the foot, are of no surgical importance.

**The tendons which require division**, in cases of a moderate degree of severity, accompanied with rigid muscular contraction, are the peronei and extensor longus digitorum, and in cases of greater severity, the tendo-Achillis.

**Vessels and Nerves.**—No abnormal conditions, or deviations in direction of any surgical importance of the vessels or nerves, exist in this deformity.

#### PATHOLOGY OF CONGENITAL VALGUS.

**a. Etiology.**—The various theories in reference to the cause and mode of production of this, as well as of the other forms of congenital club-foot, have



been already referred to. Here, therefore, it need only be remarked that the advocates of the mechanical theory—i.e. position and pressure *in utero*—urge its application very strongly in explanation of congenital talipes valgus.

Possibly this theory may apply to some slight cases of valgus, especially when associated with depression of the heel—cases which might be classed as examples of calcaneo-valgus; but to me it appears very unlikely that the mechanical cause could operate so as to produce the elevation of the os calcis, which generally, if not always, exists in severe cases of valgus. I am, therefore, essentially an advocate for the dynamic theory, i.e. spasmodic muscular contraction, as applied equally to the production of valgus, and of all the congenital forms of club-foot.

*b. Numerical importance.*—It has already been stated that, as a congenital affection, talipes valgus is of comparatively rare occurrence; out of 764 cases of congenital club-foot of all varieties, only forty-two cases of simple talipes valgus are recorded, and fifteen cases of talipes valgus of one foot associated with varus of the other foot. In the forty-two cases of simple valgus, the right foot only was affected in fifteen instances, the left foot only in ten instances, and both feet in seventeen cases. Congenital valgus, therefore, more frequently affects one than both feet—the reverse occurs in congenital varus, and in the non-congenital form of valgus.

*c. Coexistence of talipes valgus with other deformities of the opposite foot.*—In fifteen cases above referred to, talipes valgus of one foot was associated with talipes varus of the opposite foot.

*d. Coexistence of talipes valgus with malformation of the bones of the leg:* such as—

1. *Defective growth of the leg-bones*, below the knee, the tibia and fibula being from half an inch to an inch shorter than the corresponding bones of the opposite leg; of this several instances have fallen under my observation.

2. *A sharp curvature forwards of the tibia and fibula* in the lower third.—This complication is occasionally met with, and the legs thus affected do not continue to grow at their normal rate, so that the patients are permanently lame. In these cases also there is generally some malformation, and, as a rule, a deficiency of some of the toes.

3. *Malformation of the outer malleolus*, probably with fusion of the fibula with the tibia. This complication has fallen under my observation in a few instances, but it has been impossible to ascertain the precise character of the malformation.

**PROGNOSIS.**—Except in the cases last mentioned, in which the deformity is associated with malformation of the bones of the leg, a favourable prognosis may always be given in cases of congenital valgus, as there are no defects calculated permanently to interfere with the anatomical and physiological perfection of the foot.

**TREATMENT OF CONGENITAL VALGUS.**—Slight cases of eversion of the foot, unaccompanied with rigid muscular contraction, are frequently rectified by the manipulations adopted by experienced nurses. Cases of a more severe degree of deformity, but still without rigid muscular contraction, may be cured mechanically, within a few months of birth, without tenotomy. For these cases it is frequently sufficient to employ a simple

metal splint, softly padded, and capable of being bent to any shape, applied along the inner side of the foot and leg; to this the foot is bandaged, and with occasional alteration in the form of the splint, the eversion may be overcome and the arch of the foot restored. The Scarpa's shoe with the spring placed on the inner side, and a pad placed so as to support the arch of the foot, also answers very well; but I prefer the apparatus known as the valgus splint, with a pad to support the arch of the foot, attached to a spring at the end of the splint.

The cure of congenital valgus, when severe, even in the infant, can only be accomplished by a combination of the same general principles of treatment, including the operative, mechanical, and physiological means described as necessary to the successful treatment of congenital varus and other deformities.

In cases of a moderate degree of severity, but accompanied with rigid muscular contraction, all the tendons requiring division—i.e. the peronei and extensor longus tendons, with or without the tendo-Achillis—may be divided at once; but in the most severe and rigid cases, it is advisable to divide the treatment into two stages, as in varus; the object of the first stage being to overcome the eversion, transverse rotation, and bending upwards of the anterior portion of the foot,—to bring the foot on a straight line with the leg,—and when contraction of the tendo-Achillis exists, to convert the valgus into simple equinus; and the object of the second stage being to obtain the natural extent of flexion at the ankle-joint when this is limited by contraction of the tendo-Achillis.

The mechanical appliances necessary after division of the tendons must vary according to the severity of the case. In the slighter cases, the valgus splint, with a pad to support the arch of the foot, will be sufficient; but in the more severe cases occasionally met with in youth, or at a later period of life, in which the treatment is necessarily divided into two stages, the splint and pad may be employed for the first stage, and the Scarpa's shoe, with the addition of a spring and pad on the inner side, for the second stage.

**PHYSIOLOGICAL TREATMENT.**—As soon as the foot is restored to its natural position, passive exercise should be commenced, as in varus, with the object of bringing the muscles into play, and obtaining a well-balanced state of muscular action, such as is essential to the preservation of the form of the foot in a healthy condition.

**AFTER-TREATMENT.**—After the removal of the deformity, it will be necessary for the patient to wear some form of retentive apparatus, in order to allow all the structures—bones, ligaments, and muscles—to adapt themselves to the improved position of the foot, and to guard against relapse.

In the daytime, walking exercise of course being permitted, the patient should wear a boot with a steel support on the outside, carried up to the calf of the leg, and having a free-joint at the ankle; inside the boot a pad of vulcanised indiarubber should be placed, so as to support the arch of the foot, and a leather strap, attached to the inner side of the boot, should pass across the ankle-joint, and be connected by a buckle with the steel support on the outer side of the leg. This apparatus will hold the foot in its natural position during progression, and will effectually support the arch of the

foot. It will be required to be worn for at least a twelvemonth, or more.

It is also desirable that the patient should continue to wear some form of retentive apparatus at night, for six months or more after the deformity has been cured. This may consist either of the Scarpa's shoe, or simply of a metal sole-plate, with a steel bar connected with it, and carried up to the calf of the leg in imitation of the Scarpa's shoe, but without any cog-wheels, so that it may be light and of little inconvenience.

#### NON-CONGENITAL TALIPES VALGUS.

Non-congenital talipes valgus, or flatfoot, is an affection of very frequent occurrence; and exists under such a variety of circumstances, and gives rise to so much personal inconvenience, that it demands special attention.

**EXTERNAL CHARACTERS.**—The only essential external character of non-congenital valgus is a flattened condition of the longitudinal and transverse arches of the foot. *The inner margin* of the foot comes flatly in contact with the ground, but, except in severe cases of long standing, or in spasmodic cases, the *outer margin* of the foot is not raised, as in the congenital form. *The natural convexity or prominence of the instep* is diminished in proportion to the severity of the case. *The inner malleolus* is more prominent than natural, in consequence of the yielding and elongation of the deltoid ligament; and is also nearer to the ground, so that the *flat-footed* child is commonly said "to walk on the inner ankle." A little below and in front of the inner malleolus, two bony prominences are observed with a depression between them—one formed by the inner portion of the head of the astragalus, left exposed by the altered position of the navicular bone, and the other by the tuberosity of the navicular bone itself.

**Increase of Distortion.**—During progression the foot is everted, and the weight of the body thrown upon the inner margin, so that the ankle-joint is called but little into play, and flexion and extension very imperfectly performed. As a consequence of this, contraction, or adapted shortening, of the tendo-Achillis, as well as in some cases of the peronei and extensor-communis muscles, takes place; so that the foot is rigidly held in the deformed position, and the deformity becomes increased. In severe cases of long standing the arch of the foot is not only depressed but really reversed—the foot being bent upon itself in a boat-shaped form.

**SPECIAL EFFECTS OF THIS DEFORMITY.**—Talipes valgus is undoubtedly the most painful and seriously inconvenient deformity of the foot. When even of moderate severity, it frequently deprives the sufferer of the power of walking more than a short distance, or of standing for any length of time, and therefore incapacitates him for many of the ordinary duties and occupations of life. Occasionally, the deformity increases slowly, and continues many years without producing pain, but these are exceptional cases. In consequence of the limited flexion and extension at the ankle-joint, a very ugly gait and awkward mode of walking is always produced; and in growing girls it sometimes gives rise to curvature of the spine.

#### MORBID ANATOMY AND ETIOLOGY.

So far as relates to the deviations in the relative position of the bones, &c., the morbid anatomy of non-congenital valgus is identical with that of the congenital form already described; but whilst congenital valgus is accompanied with, and generally produced by, active contraction of the muscles; in the non-congenital form there is generally, but not invariably, a coexisting muscular debility in the early stage, the contraction being a secondary and late result. Non-congenital valgus, however, occurs under such a variety of circumstances, depending upon such different causes, that, instead of considering the morbid anatomy and etiology separately, it will be better to arrange all the cases in the six following classes, and to mention the anatomical peculiarities in each class:

1st Class. Valgus depending upon *ligamentous and muscular debility*.

2nd. Rachitic valgus.

3rd. Paralytic valgus.

4th. Spasmodic valgus.

5th. Traumatic valgus.

6th. Valgus consequent upon disease of the ankle-joint or surrounding tissues.

**Class 1, arising from Ligamentous and Muscular Debility.**—Non-congenital valgus from this cause occurs at different periods of life, most frequently in childhood and youth, but it is by no means of uncommon occurrence in young adults.

*In children*, when they begin to walk, we frequently see the feet turn outwards, and the arch become depressed from the superincumbent weight; and, a few months later, knock-knee becomes developed in these children. This condition is always recoverable, sometimes without any artificial assistance, but in most cases mechanical support to the feet is required; if neglected, however, and a feeble constitutional condition exists, it may lay the foundation of a confirmed valgus.

*In boys and girls* (but more frequently in the former) of delicate constitution and lax fibre, between the ages of 14 and 18, when growth is rapid, flatfoot frequently becomes developed, and remains as a persistent deformity unless removed by art. In girls the constitutional causes above mentioned more frequently predominate; but in boys, circumstances arising from their occupations—which, in the working-classes, frequently compel them to stand from twelve to fourteen hours every day, and in addition oblige them to carry heavy weights—act even more powerfully than the constitutional causes. This deformity, however, is not confined to the working-classes, but is frequently met with among schoolboys, junior city-clerks, and cadets; in the latter class the drilling, marching, and carrying of guns evidently tend to produce the deformity, or more frequently to increase it when it already exists in a slight degree.

*In adults* flatfoot frequently becomes a confirmed and persistent deformity, having generally existed in a slight degree from an earlier period, and been neglected in consequence of the absence of inconvenience. A considerable number of policemen are annually discharged from the force in consequence of being incapacitated from their duties by flatfoot; and, although great care is taken not to enlist flatfooted men into the army, soldiers are not unfrequently obliged to leave the service from this cause. Waiters at taverns are



proverbially flatfooted, and frequently suffer from its worst effects. Dancers frequently exhibit this condition, but suffer less in consequence of their great muscular strength, in some degree, compensating for the weakness of the feet.

*Class 2.—Rachitic valgus* is, at the time of its production, essentially similar to the form just described as depending upon ligamentous and muscular debility, but becomes of a more severe and intractable nature in consequence of alterations occurring in the form of the bones. It is always associated with rachitic curvature of the long bones, especially with the sharp, flattened, anterior curvature of the tibia and fibula in their lower and middle thirds. Rickets being an affection peculiar to childhood, rachitic valgus can only take place at this period of life, and, like the other deformities of rickets, remains as a persistent condition after the spontaneous cure of the disease and solidification of the bones.

*Class 3.—Paralytic valgus.*—In that peculiar and obscure form of paralysis which occurs only in childhood, and has been already described as *infantile paralysis*, and which furnishes us so large a proportion of all the non-congenital deformities of the foot, the anterior tibial is sometimes the only muscle paralysed, and then the foot becomes everted, producing valgus. Occasionally, the muscles of the calf, as well as the tibialis anticus and posticus muscles, are also paralysed; in such cases the tuberosity of the os calcis falls down, and calcaneo-valgus is produced—a most intractable deformity. Paralytic valgus of one foot frequently coexists with paralytic equino-varus of the opposite foot.

*Class 4.—Spasmodic valgus.*—This is undoubtedly the rarest form of non-congenital valgus, but it occasionally occurs in the class of cases already described as *deformities with rigid muscles*, generally consequent upon fits or convulsions during teething; the deformity, however, more frequently produced in this class of cases, is talipes equinus or equino-varus.

*Class 5.—Traumatic valgus.*—Persistent eversion of the foot is a frequent result of injuries involving the ankle-joint and the lower extremities of the tibia and fibula, such as fractures of these bones, or fracture and dislocation combined. In these cases, eversion of the foot from the ankle-joint is first produced, a condition different from that described as essential to valgus, in which the transverse tarsal joint is the principal centre of motion. However, in these traumatic eversions of the foot, the arch gradually gives way, in consequence of the weight of the body being thrown upon the inner border, and a true valgus is produced, in consequence of which the patient is sometimes unable to walk more than a short distance, even some years after the accident.

*Class 6.—Valgus consequent upon disease of the ankle-joint or surrounding tissues.*—Persistent eversion of the foot, which subsequently becomes flattened in the form of valgus, is a common result of chronic inflammatory affections of the ankle-joint, and also of strumous abscesses in the neighbourhood of the joint, periostitis, caries, or necrosis of the fibula, etc. The causes named, therefore, either directly or indirectly affect the joint in the production of the deformity, and the prognosis and treatment of such cases will vary accordingly.

NUMERICAL IMPORTANCE. — Non-congenital

valgus is the most frequent deformity of the foot, next to talipes equinus, which constitutes nearly half of all the non-congenital cases of talipes. In the table of 1009 cases of non-congenital deformities of the foot previously referred to, 181 cases of talipes valgus are recorded. In more than half these cases both feet were affected.

**TREATMENT.**—In the different forms of non-congenital valgus above enumerated, the treatment will necessarily vary; but essentially it will consist of the mechanical, operative, and physiological means, either separately or in combination, already described as necessary to the cure of the congenital form of valgus. The principles and, in most respects, the details of the treatment are essentially similar in both the congenital and non-congenital forms of valgus; but in the different classes in which these cases have been arranged, some special points of treatment require to be adverted to.

*Class 1.—Depending upon muscular and ligamentous debility.*—Cases of valgus depending upon this cause are frequently seen in children from two to five years of age; in youths from fourteen to eighteen years of age; and in young adults. In delicate children of lax fibre the eversion of the foot is readily controlled by what is known as a *valgus boot*; a convex pad made of vulcanised indiarubber is placed inside the boot, in the normal situation of the arch of the foot which it is intended to support or remodel. The heel of the boot must be carried forwards on the inner side, so as to give it an oblique instead of transverse direction, and it may also be raised on the inner side about a quarter of an inch, so as to twist the foot inwards, and throw the weight on the outer rather than the inner side of the foot. In these cases no steel supports are ever necessary, nor is there any muscular contraction to call for tenotomy. The *valgus boot* will probably be required to be worn for about two years.

In youth, when the cases are seen at the commencement of the deformity, the same treatment is indicated, and is generally sufficient not only to prevent increase, but completely to restore the form of the foot. In girls it is seldom necessary to do more. The walking exercise must be diminished, and frequent rest enforced. Horse-exercise should be ordered, and every means taken to improve the general health by appropriate tonics, country and sea air, &c.

In more severe cases, especially in boys, but previous to the stage of fixed deformity with contraction of muscles, it is necessary to add a steel support attached to the outer side of the boot, and carried up the calf of the leg, where it is connected with a semicircular steel plate, and a strap which encircles the leg. A free-joint should correspond to the ankle-joint; and a leather strap, attached to the inner side of the boot, should pass across the ankle-joint and buckle outside the steel support.

In the next grade of the deformity—viz., that in which the arch of the foot is more completely flattened, and extension of the foot cannot be performed to the natural degree—*muscular contraction* will be found to have taken place; and in the erect position, or when extension of the foot is attempted by manipulation, the tendons of the extensor-longus and peronei muscles will appear more or less prominent and tense.

Now these cases may be treated either by

mechanical means alone, or by tenotomy and mechanical means combined. The advantage of tenotomy is, that it materially shortens the period of treatment. If mechanical means alone be decided upon, it will certainly occupy six months or more, during which time the patient must not be allowed to walk, except with the aid of crutches; whereas by the assistance of tenotomy, this will certainly be shortened to six weeks. In the mechanical treatment you may use an ordinary Scarpa's shoe, with the vertical steel spring placed on the inside of the leg, or the steel bar with a double cogwheel movement. The horizontal steel bar, to which the toe-strap is fastened, is also placed on the inner side of the sole-plate, so that the anterior part of the foot may be drawn inwards. A leather pad, or a large linen roller, should be placed under the arch of the foot.

If tenotomy be employed, the tendons of the extensor-longus and peronei muscles should be divided, and in the more severe cases the tendo-Achillis will also require division at a later period, the treatment being divided into two stages.

*The after-treatment* in these cases will consist in the constant use, for about two years, of the *valgus boot* above described—the use of the Scarpa's shoe being also continued at night, till the arch of the foot has not only been completely restored, but has acquired a fair amount of strength—the employment of frictions, diminished walking exercise or long standing, and other measures to improve the general health.

In the more severe forms of valgus in the adult tenotomy is indispensable, and several tendons will require division. It will not be sufficient to divide the extensor-longus and peronei tendons, but in some cases it will also be necessary to divide the anterior tibial, the extensor pollicis tendons, and also the tendo-Achillis; the latter operation being done at a later stage of treatment.

In such cases it is necessary to divide the treatment into two stages; and either the Scarpa's shoe, or a modified form of valgus splint apparatus, may be employed.

*Class 2.*—In *rachitic valgus* it is seldom necessary to divide any tendons, mechanical support alone affording all the relief of which these cases are susceptible.

*Class 3.*—In *paralytic valgus*, when of long standing, the tendo-Achillis frequently requires division, because the foot cannot be flexed beyond the right-angle, but it is seldom necessary to divide the extensor or peronei tendons. Mechanical support will, in these cases, frequently be required during the remainder of life.

*Class 4.*—In *spasmodic valgus*, when severe and of long standing, it may be necessary to divide all the anterior and outer tendons, and also the tendo-Achillis.

*Class 5.*—In *traumatic valgus*, i.e. after fracture of the lower end of the tibia and fibula, and injuries involving the ankle-joint; and also

*Class 6.*—In cases consequent upon disease of the ankle-joint or surrounding tissues, such as scrofulous abscesses, connected or not connected with periosteal or bone-disease, the probability of regaining motion will depend very much upon the condition of the ankle-joint. The extent to which the joint has been implicated and its structures destroyed must therefore be carefully considered before deciding on tenotomy; but in many cases

in which the ankle joint has not been primarily involved, and even when motion at the ankle-joint is extremely limited, and the foot much everted, with more or less elevation of the heel—a very frequent condition—an unexpected amount of improvement will follow division of the tendo-Achillis, either by itself, or conjointly with the extensor and peronei tendons. When the ankle-joint has been primarily diseased, or when it has been materially involved in the inflammatory mischief resulting either from accident or disease; and a condition of ankylosis, whether fibrous or osseous, has become established, all operative procedures will be counter-indicated as a general rule, and mechanical support will be alone relied upon to prevent increase of the deformity, and afford some assistance in walking.

*The after-treatment* in all these different classes of cases will be essentially similar to that previously referred to, varying, of course, according to the circumstances in individual cases. It will consist in the continuance of mechanical support, special exercises, manipulations, frictions, and the employment of galvanism in some cases of paralysis, especially in infantile paralysis, where some indications of spontaneous improvement exist. By attention to these means the *tendency to relapse* will be effectually controlled.

#### EQUINO-VALGUS AND CALCNEO-VALGUS.

*Equino-valgus* is characterised by elevation, and *calcaneo-valgus* by depression, of the os calcis, co-existing with eversion of the anterior part of the foot. In *equino-valgus*, eversion of the anterior portion of the foot—the valgus portion of the deformity—is the predominant condition; but in *calcaneo-valgus*, depression of the os calcis—the calcaneus portion of the deformity—is the predominant condition. Hence I have considered it advisable to make the few observations called for in the description of these compound varieties, when describing in detail the external characters and morbid anatomy of the simple forms of talipes—viz. *valgus* and *calcaneus*, of which these compound varieties are but slight modifications.

The influence of contraction of the tendo-Achillis in modifying the external characters of *valgus*, and in materially adding to the complexity of this deformity as to its mechanical conditions, and the alterations in the relative position of the bones in severe cases, I have especially adverted to in describing both the congenital and non-congenital forms of valgus. In consequence of the frequency of contraction of the tendo-Achillis in both the congenital and non-congenital forms of valgus, it would seem advisable, in the nomenclature of deformities of the foot, either to do away with *equino-valgus* as a separate variety, or materially to add to its importance by classifying under this term a very large number of the cases hitherto described as simple valgus. My own inclination is to adopt the former course, and therefore I generally speak of cases of talipes valgus as existing without contraction of the tendo-Achillis.

**CALCNEO-VALGUS**—depression of the heel, with eversion of the anterior portion of the foot—is but a slight and unimportant modification of talipes calcaneus, a variety of club-foot which I am about to describe. The description of this compound variety, therefore, if it were of sufficient importance to require any special description,



would with propriety be deferred till the simple form, i. e. calcaneus, had been described; but, like equino-valgus, I regard it as almost unworthy of being retained as a variety in the classification of deformities of the feet. In cases of calcaneus, both in its congenital and non-congenital forms, more or less eversion of the anterior portion of the foot is almost constantly present; it very rarely happens that, simultaneously with depression of the heel, the anterior portion of the foot is drawn upwards, and retained in the flexed position in a perfectly straight line with the axis of the leg. Some degree of eversion nearly always exists, and therefore, as in equino-valgus, the compound variety must be either magnified in importance, so as to exceed that now attached to the primary form; or the modification afforded by the eversion be disregarded in classification, and assumed to be a frequent condition of the primary form—and the latter appears to me by far the better course. The only advantage in retaining the name is to enable the surgeon in some cases more correctly to indicate the precise deviation of the foot. The pathology and treatment in both the simple and compound varieties are essentially similar.

#### TALIPES CALCANEUS.

**TALIPES CALCANEUS** occurs both as a congenital and non-congenital affection; and in these two forms it differs so essentially in its pathology and treatment, that a separate description of the congenital and non-congenital forms of talipes calcaneus is absolutely necessary.

#### CONGENITAL TALIPES CALCANEUS.

**EXTERNAL CHARACTERS.**—The only essential character of talipes calcaneus, whether in its congenital or non-congenital form, is depression of the os calcis, so that in the erect position this is the only portion of the foot which would come into contact with the ground; but this, in congenital cases, is always associated with elevation of the anterior portion of the foot, which is generally also a little everted and flexed upon the leg; so that the dorsal aspect is in contact with the anterior surface of the leg, and in severe cases the foot is rigidly held in this position by contraction of all the anterior muscles. The position of the foot is, in fact, nothing more than an extreme degree of flexion from the ankle-joint—a position which any healthy foot can be made to assume, more especially in infants, and therefore not involving any alteration in the relative position of the bones; but the peculiarity in congenital cases is that the foot is fixed in this position, with more or less rigidity, by muscular contraction. This deformity is therefore, as far as external form is concerned, exactly the reverse of talipes equinus, consisting of elevation of the os calcis, with depression of the anterior portion of the foot—an extreme degree of extension of the foot.

**MORBID ANATOMY.**—There are no material deviations either in the relative position or forms of the bones of the foot in this deformity. The ankle-joint is the centre of motion, and it is alone from this articulation that the movements of flexion and extension of the foot can take place.

In the great majority of congenital cases the foot is not very rigidly held in this flexed or, as we should call it, calcaneous condition; and by a little manipulation it can be brought down, or extended

to a right-angle with the leg. By perseverance in manipulation and passive motion, the natural degree of extensions can generally be obtained in a few months; and this fact alone proves that in such cases neither the muscles nor ligaments have undergone that change of structural shortening, or adapted growth, which produces the rigidity in other congenital deformities, and constitutes the obstacle to the restoration of the form of the foot—an obstacle which we have to overcome either by operative or mechanical treatment.

In some of the most severe cases of congenital calcaneus, however, in which the right foot is rigidly held in the deformed position—cases of extreme rarity—there can be no doubt that the ligaments at the posterior part of the ankle-joint, and the posterior portions of the lateral ligaments, are elongated, as I found them on dissection in a case of non-congenital calcaneus of long standing, although, from the nutrition of the tissues not being interfered with in the congenital cases, it is not probable that this change would take place to the same extent. In these severe congenital cases also, the anterior muscles of the leg—the flexors of the foot—doubtless undergo structural shortening, and their tendons are easily to be felt tense and prominent as they pass over the ankle-joint.

**PATHOLOGY.**—The cause and mode of production of congenital talipes calcaneus are by no means clearly understood.

Slight cases of calcaneus, with very little muscular rigidity, such as we ordinarily meet with in practice, may not unlikely be produced by *position and pressure in utero*; but the severe cases, associated with other contractions—as of the rectus muscle when the legs are rigidly maintained in the extended position, etc.—are probably of dynamic origin, and depend upon some abnormal condition of the nervous system.

**NUMERICAL IMPORTANCE.**—Talipes calcaneus is the rarest form of congenital club-foot. In 764 cases of congenital club-foot, of which I have given a tabular arrangement (*Medical Times and Gazette*, Nov. 1, 1856) there were only nineteen cases of talipes calcaneus, and these were distributed as follows:

Affecting the right foot only . . .	3
“ “ left . . . . .	4
“ “ both feet . . . . .	12

Both feet are much more frequently affected in cases of this deformity than one foot—a condition which also exists in congenital varus, but in a less proportion.

**PROGNOSIS.**—There is no deformity of the foot, congenital or non-congenital, in which a more favourable prognosis can with confidence be given than in congenital talipes calcaneus. I have never seen this form of club-foot, when congenital, except in infancy or early childhood; nor do I find any orthopaedic authority who has witnessed it as a persistent condition at a later period of life. The explanation of this fact seems to be, that the deformity—which is very rarely accompanied with rigid contraction of the muscles or ligaments—undergoes spontaneous cure soon after the period of walking, if it be not previously removed by manipulation and simple mechanical means.

The strong muscles of the calf of the leg, together with the other powerful muscles on the posterior aspect of the leg, which act as extensors of the

foot, are all in a healthy condition, and by their action tend to overcome the slight contraction of the flexors. If the balance of muscular action be not thus restored before the period of walking, the weight of the body still further assists the action of the extensor muscles by pressing up the heel, and keeping the foot at a right-angle with the leg.

The favourable action of the weight of the body in restoring this deformity of the foot is worthy of remark, especially when contrasted with the unfavourable influence which it exerts in talipes varus, the severity of which it aggravates to a severe degree.

**TREATMENT.**—Very little treatment is required in the ordinary cases of congenital talipes calcaneus. Frequent manipulations and passive exercise—i. e. extending the foot, and rubbing over the anterior muscles of the leg, which may be best conducted by the nurse or mother—will be all that is necessary in ordinary cases. With this should be combined the use of a softly-padded splint applied in front of the leg and foot. A splint made of block-tin, which can be gradually straightened as the foot improves, is the best that can be employed. In the exceptional cases, however, of greater severity, in which the anterior muscles are much contracted, and the tendons tense and prominent over the ankle-joint, tenotomy should be adopted as a means of hastening the cure, and thus rendering it more certain and perfect at an earlier period of life—a principle which we must recognise in the treatment of all congenital deformities, with a view to the ultimate perfection of the limb, and development of the muscular structures.

*The tendons which require to be divided*, in the severe cases above adverted to, are the tibialis anticus, extensor proprius pollicis, extensor longus digitorum, and peroneus tertius. The division of all these tendons may be easily effected through a single puncture made close to the inner borders of the extensor longus digitorum tendons, as they pass over the ankle-joint, where they will be found tense and prominent. The smallest sharp-pointed tenotomy-knife may be passed first outwards beneath the extensor and peroneus tertius tendons, which may be divided towards the shin, as we divide all tendons; and then being withdrawn and reintroduced, the knife may be passed inwards beneath the extensor pollicis and anterior tibial tendons, which may be divided in the same way. If care be taken to keep the point of the knife close to the tendons to be divided, there will be no fear of wounding the anterior tibial artery. A small pledget of lint should be immediately applied, and retained in position by a strip of plaster, and the foot bandaged to a bent tin splint in front of the ankle-joint.

**THE MECHANICAL TREATMENT** need only consist in the continued use of a well-padded metal splint, which, after the third day, may be gradually straightened, till the complete extension of the foot is obtained. This should be done very slowly at first; and should not be accomplished in less than three weeks, in order to insure the formation of a direct and well-formed connecting bond of new material, between the divided extremities of the tendons.

**THE AFTER-TREATMENT** will consist merely in the continued use of the physiological means, viz. : manipulations and passive motion, upon which

we so much rely during the treatment of this deformity. It will very rarely be necessary to employ any mechanical support, or retentive apparatus; but in some cases, after operation, a light steel support may be attached to the foot in walking.

**RELAPSED CASES.**—There is no tendency to relapse in cases of congenital talipes calcaneus after treatment. I have never met with any case in which the deformity has even partially returned.

#### NON-CONGENITAL TALIPES CALCANEUS.

The non-congenital form of talipes calcaneus differs very essentially from the congenital form of this distortion. In non-congenital calcaneus, the anatomical conditions are more complicated; in the great majority of cases this affection is of paralytic origin, and therefore the prognosis is essentially unfavourable, and the treatment only palliative, though the foot may be improved in form and usefulness. Altogether, the non-congenital cases of calcaneus are as unsatisfactory as the congenital cases are satisfactory in their results.

**EXTERNAL APPEARANCE.**—Assuming the case to be one of the ordinary kind, i. e. depending either upon paralysis of the muscles of the leg, the external characters are—1st, depression of the tuberosity of the os calcis, which, in a severe case, when the patient is in the erect position, is the only part of the foot which comes in contact with the ground; 2nd, the anterior portion of the foot is not flexed and drawn upwards so as to touch the anterior surface of the leg, as in cases of congenital calcaneus; but in an early stage is slightly raised, and more or less everted. At a later period the anterior portion of the foot becomes depressed, or falls down, from the tarsal joint; so that the foot presents the appearance of being bent upon itself in the direction of its length, and the sole of the foot becomes deeply arched. In such cases the leg is always much wasted, in consequence of the long-standing paralysis of which the deformity is the result; and the tendo-Achillis, instead of being tense and prominent, as it generally is in other deformities of the foot, can scarcely be felt.

**MORBID ANATOMY.**—In non-congenital calcaneus the bones undergo very little alteration in form, but their deviations in position are very considerable. In a severe case, the os calcis becomes quite vertical in position, and the astragalus very oblique—so much so, indeed, that the greater part of the trochlea of the astragalus is separated from the ankle-joint, and projects posteriorly, a condition which I have witnessed on dissection of one of these cases. As a necessary consequence of this obliquity of the astragalus, the articular surface of the tibia rests partly on the anterior portion of the trochlea, and partly upon the neck of the astragalus.

The next important deviation in the relative position of the bones takes place in consequence of the foot becoming bent upon itself from the transverse tarsal joint, which in this deformity becomes almost as important a centre of motion as the ankle-joint. The anterior portion of the foot, including all the bones in front of the transverse tarsal joint, is, in a severe case, depressed or bent downwards, so as to approximate more or less towards the os calcis in its vertical position, and produce an abruptly arched and shortened condition of the foot.



**Ligaments.**—The important deviations described in the relative positions of the bones necessitate some important changes in the ligaments connected with the ankle and transverse tarsal joints. The ligamentous structures at the posterior part of the ankle-joint, and the posterior portions of the lateral ligaments, become much elongated and attenuated, this condition being in some degree dependent upon the defective state of the nutrition of the limb. The ligamentous structures in front of the ankle-joint become shortened by a process of adaptation during growth, and, when the deformity has been of some years' duration, largely contribute to the persistence of the distortion. All the deep ligaments in the plantar aspect of the foot and the interosseous bands of ligament I have found, by dissection, to be shortened, in adaptation to the abrupt flexion of the foot from the transverse tarsal joint above described. These ligaments and ligamentous bands are thick and strong, and, as it has appeared to me, offer the greatest resistance to the restoration of the form of the foot.

As allied to the ligamentous structures, I may here advert to the condition of the *Plantar fascia*, which in this deformity will be found to be shortened or contracted, as it is called, to an extent corresponding to the general shortening of the foot, which, as already explained, is produced by the os calcis assuming a vertical instead of a horizontal position, and by the anterior portion of the foot being depressed, or bent downwards from the transverse tarsal joint.

**Muscles.**—In cases of non-congenital talipes calcaneus, the muscles are found to be in different conditions, according to the causes producing the deformity; but when this distortion has been produced by paralysis, its most frequent cause, the muscles of the leg and foot are found to be in a wasted and atrophied condition. The calf of the leg is extremely attenuated, in consequence of the complete and persistent paralytic condition of the gastrocnemius and soleus muscles. In cases of long standing, these muscles, and sometimes all the muscles of the leg, are found to be in the most advanced stage of fatty degeneration; the muscular structure being completely destroyed, and replaced by fatty tissue, free oil-globules, and fibrous tissue, in varying proportions in different muscles.

**Vessels and Nerves.**—There are no deviations in direction, of surgical importance, in the vessels and nerves, such as have been described in the more complicated distortion of varus; but in adult cases, these structures become atrophied and diminished in size, as Cruveilhier described them in a case of adult non-congenital paralytic varus.

**RESEMBLANCE OF THIS DEFORMITY TO THE DISTORTION OF THE FOOT ARTIFICIALLY PRODUCED AMONG THE CHINESE.**—Dr. Little has furnished us with "an anatomical drawing of the bones of the foot of a Chinese lady, obtained during the late China Expedition," which exhibits conditions very analogous to those above described as existing in the severe adult cases of the non-congenital form of calcaneus of paralytic origin. The os calcis holds a completely vertical position, and the anterior portion of the foot is bent downwards from the transverse tarsal joint; so that the foot is folded upon itself in the direction of its length, the ankle joint and the transverse tarsal joint being the two centres of motion. In the Chinese distortion, however, which is pro-

duced by tightly bandaging the foot in early life, the phalanges of the great toe alone remain extended, and give a pointed form to the compressed and distorted foot.

**PATHOLOGY.**—*Etiology and mode of Production.*

1. Non-congenital talipes calcaneus is most frequently the result of *infantile paralysis*, occurring during the first dentition, from sixteen months to six years of age, and producing complete and persistent paralysis of the muscles of the calf, and sometimes also complete or partial paralysis of all the muscles of the leg below the knee; but in the latter cases, recovery of the anterior muscles to some extent usually occurs.

2. It may also be the result of imperfect union of the tendo-Achillis, or union through the medium of an excessive length of new connecting material, in such cases often imperfectly formed, either after accidental rupture of this tendon, or after its division, probably for the cure of the opposite deformity—viz. talipes equinus.

Talipes calcaneus has also been produced by the contraction of a burn-cicatrix on the leg and dorsum of the foot, but I have never witnessed any example of this form.

**NUMERICAL IMPORTANCE.**—In the table of 1,009 cases of non-congenital deformities of the feet, previously referred to, 110 cases of non-congenital talipes calcaneus and calcaneo-valgus are recorded, and were thus distributed:

Affecting the right foot	.	.	35
" left "	.	.	39
" both feet	.	.	22

and 14 others coexisting with other deformities or paralytic affections. Thus, in 74 cases out of 110, only one foot was affected; and additional confirmation of the general statement that infantile paralysis, upon which this deformity nearly always depends, generally affects only one side of the body.

**PROGNOSIS.**—As non-congenital talipes calcaneus is usually the result of infantile paralysis, especially affecting the muscles of the calf, but sometimes also the other muscles of the leg, and persistent in its character, as evidenced by the existence of the deformity, the prognosis must generally be unfavourable. The foot may be improved in form, and rendered more useful, but there can be no hope of curing the paralysis. In some cases dependent upon other causes than paralysis, as above described, the prognosis may be more favourable, but it is unnecessary further to allude to the conditions in these exceptional cases; they will be at once recognised by the surgeon.

**TREATMENT.**—If detected in the early stage, increase of the deformity may be prevented by the patient wearing a high-heeled boot in the daytime, with a light steel support on each side, furnished with what is known to the instrument maker as a "stop-joint" at the ankle—i.e. a joint which will not allow of flexion of the foot (though in the early stage this will not always be necessary), and the foot should be kept flat in a slipper with a metal sole-plate at night.

If deformity has taken place to a moderate extent only, the form of the foot may be restored by a Scarpa's shoe with a transverse joint in the sole-plate, regulated by a rack-and-pinion movement. The same kind of walking boot, but always with a stop-joint, may be used.

In the late stage, when the depression of the os calcis and contraction of the arch of the foot are well-marked, the general adaption of the ligamentous and muscular structures to the deformed position of the foot, frequently gives to it a degree of firmness very useful to the patient.

Some operative procedures have been attempted with the object of shortening the tendo-Achillis, and of producing a contraction of the skin above and behind the os calcis. Dr. Little removed a portion of the tendo-Achillis, together with some of the skin above the os calcis, in two cases, but with very little benefit. I should strongly oppose the repetition of any such operation.]

William Adams, F.R.C.S.

**TALPA** (a mole). A tumor under the skin compared to a mole under the ground. Such is the etymology. Sometimes it means an encysted tumor on the head. (See **ATHEROMA**, and **TUMORS, ENCYSTED**.)

**TAPPING**. See **PARACENTESIS**.

**TARAXIS** (from *ταράσσω*, to disturb). A slight inflammation of the eye.

**TAXIS** (from *τάσσω*, to put in order). The operation of reducing a hernia with the hand. (See **HERNIA**.)

**T BANDAGE**. A bandage so named from its figure. It is principally used for supporting the dressings after the operation for the cure of fistula in ano, in diseases of the perineum, and those of the groin, anus, &c. It is composed of two longitudinal pieces of linen or calico, of greater or lesser breadth, according to circumstances. The transverse piece serves to go round the body above the hips; the perpendicular piece is sewed, at one of its ends, to the middle of the latter; and, in general, its other extremity is slit into two portions, or tails, about six or eight inches long. The perpendicular piece of the T bandage extends over the sacrum to the perineum; and its two ends are carried between the thighs and the pudenda to the right and left, and fastened to the transverse piece surrounding the body. Besides the common T bandage, there is another one, named *double*, which has two perpendicular pieces, sewed to the transverse one, about four inches apart. The double T bandage is said to be more particularly applicable to the diseases of the perineum, because one may make the two perpendicular pieces cross each other on the part affected, and leave the anus uncovered—an advantage which the simple T bandage certainly has not. (See **BANDAGE**.)

**TENACULUM**. A very sharp-pointed fine hook, with which the mouths of bleeding arteries are seized and drawn out, in order that they may be tied. It has the advantage of holding the vessel without any chance of the latter slipping away; and as soon as the artery has been seized, the instrument may be held by any person, even a child, while the surgeon applies the ligature. A tenaculum forceps (which is kept shut with a spring) is much employed at the present day for taking up bleeding arteries. Arteries above a certain size, and whose mouths are perfectly visible, are generally taken up with the common arterial forceps, their coats being very liable to be torn with a tenaculum. (See *Dupuytren, Clin. chir. t. iv. p. 396.*) When the forceps is employed, it is better, instead of introducing the end of one of its blades into the mouth of the artery, to take completely hold of

the extremity of the vessel between both the blades, for reasons specified in the article **HEMORRHAGE**.

**TENDONS, WOUNDS AND OTHER INJURIES OF**. A tendon, after being divided, or ruptured, if properly treated, readily unites. "The surrounding cellular membrane is thickened by an infiltration of coagulable lymph, which forms a bed that contains and adheres to the divided ends. This bed of thickened membrane shapes itself into a callus, which gradually coheres inseparably with the ends of the tendon; and acquiring strength and firmness, after a time shrinks to the size of the neighbouring tendon, and assumes its white colour and fibrous character." (See *Mayo's Human Pathology*, p. 120.)

The tendons are susceptible of inflammation, and, if injected with fine injection in this state, their vessels are seen to be enlarged. In University College Museum are some good specimens of the change here referred to. Like other fibrous textures, tendons exhibit a backwardness to ulcerate. The length of time required for the separation of a dead portion of tendon is a proof of this fact.

The tendons liable to be broken by the violent action of the muscles with which they are connected, are the tendo-Achillis, that of the extensor muscles of the leg, and the tendon of the triceps extensor cubiti. Mr. M'Intyre, of Newcastle, once mentioned to me a case in which he believed the tendon of the long head of the biceps had been ruptured.

The superficial situation of the tendo-Achillis always renders the diagnosis of its rupture exceedingly obvious; and the accident can only become at all difficult to detect when there is a considerable degree of swelling, which is very rare. When the tendon has been cut, the simultaneous division of the skin even brings the injury of the tendon into view. At the moment when this tendon breaks, the patient hears a sound like that of the smack of a whip. In whatever way the division of the tendon has been produced, there is a sudden incapacity, or at least an extreme difficulty, either of standing or walking; and the patient sometimes falls down and cannot get up again. There is a palpable depression between the ends of the tendon, which depression is increased when the foot is bent, and diminished, or even quite removed, when the foot is extended. The patient can bend his foot very well, none of the flexor muscles being involved; the power of extending it is also still possible, as the peronæi muscles, the tibialis posticus, and the long flexors of the toes (see *Case by J. L. Petit*) remain perfect, and may perform this motion. (*Œuvres chir. de Desault*, p. 1.)

The indications are, to bring the ends of the divided part together, and to keep them so, until they have become firmly united. The first object is easily fulfilled, by putting the foot in a state of complete extension; the second—namely, that of keeping the ends of the tendon in contact—is more difficult.

In order to have a right comprehension of the indications, we should consider what keeps the ends of the tendon from being in contact. The flexion of the foot has this effect on the lower portion; the contraction of the gastrocnemius and solæus, on the upper one. The indications then are, to put the foot in an unalterable state of ex-



tension, and to counteract the action of the above muscles.

The action of the muscles may be opposed :—  
1. By keeping them in a continual state of relaxation. For this purpose, the leg must be kept half-bent upon the thigh.—2. By applying methodical pressure to the muscles; methodical, because it is to operate on the fleshy portion of the muscles, and not on the tendon, the ends of which, being depressed by it, would be separated from each other, and, instead of growing together, would unite to the adjacent parts. The pressure should also operate so as to prevent the ends of the tendon from inclining either to the right or left.

J. L. Petit first devised the plan of treating the ruptured or divided tendo-Achillis, by keeping the leg and foot in a particular posture, with the aid of an apparatus. Seeing that the extension of the foot brought the ends of the tendon into contact, it occurred to him that such extension should be maintained during the whole of the treatment, in order to bring about a permanent union. This aim is, in fact, the common basis of all the numerous methods which have since been recommended.

Dr. Alexander Monro (primus) happened to rupture his tendo-Achillis. When the accident took place, he heard a loud crack, as if he had suddenly broken a nut with his heel, and he experienced a sensation as if the heel of his shoe had made a hole in the floor. This sensation, he says, has also been observed by others, though some have complained of a smart stroke, like what would be produced by a stone or cane. Immediately suspecting what had happened, the doctor extended his left foot, in which the injury had taken place, as strongly as he could with his right hand; while with the left he pressed the muscles of the calf downward, so as to bring the ends of the broken tendon as near together as possible. In this position he sat, until two surgeons came to his assistance. They applied compresses and a bent board to the upper part of the foot and forepart of the leg, both which they kept, as nearly as possible, in a straight line, by a tight bandage made with a long roller. But as this mode of dressing soon became very uneasy, it was changed for the following one:—A foot-sock, or slipper, was made of double-quilted ticking, from the heel of which a belt or strap projected, of sufficient length to reach over the calf of the leg. A strong piece, of the same materials, was prepared of sufficient breadth to surround the calf, and this was fastened with lacings. On the back part of this was a buckle, through which the strap of the foot-sock was passed, so that the foot could be extended and the calf brought down at pleasure. The leg and foot were wrapt up in soft flannel, fumigated with benzoin, and the bandage was kept on day and night—the belt being made tighter when the doctor was about to go to sleep, and loosened when he was awake and on his guard. For a fortnight he did not move his foot and leg at all, but was conveyed in a chair on castors from one part of the room to another. After this he began to move the ankle-joint, but in such a gentle manner as not to give any pain. The degree of motion was gradually increased, as the tendon became capable of bearing it, care being taken to stop when the motion began to create uneasiness. The affected limb was moved in this way for half an hour at a

time. In a few days the hollow, between the separated ends of the tendon, became imperceptible, though the part continued soft much longer. It became, however, gradually thicker and harder, until a knot was at last formed in it, apparently of a cartilaginous nature. Though this was, at first, as large as a middling plum, and gradually became softer and smaller, yet it did not disappear entirely. Having occasion to go out six weeks after the accident, the doctor put on a pair of shoes, with heels two inches high, and contrived a steel machine to keep his foot in the proper position. This machine, however, he afterwards changed for another, made of the same materials as the former. It was not till five months after the accident that he thought proper to lay aside all assistance and to put the strength of the tendon to a trial. (See *Monro's Works*, p. 661.)

The following was Desault's method, which, though it was expressly designed to fulfil the above-mentioned indications, may not be a more valuable practical plan than what was adopted by Dr. Monro. After the ends of the tendon had been brought into contact by moderate flexion of the knee, and complete extension of the foot, Desault used to fill up the hollows, on each side of the tendon, with soft lint and compresses. The roller, applied to the limb, made as much pressure on these compresses as on the tendon; and hence this part could not be depressed too much against the subjacent parts. Desault next took a bandage, about two inches broad, and long enough to reach from the toes to the middle of the thigh, and placed it under the foot, over the back of the leg and lower part of the thigh. He then began to apply a few circles of a roller round the end of the foot, so as to fix the lower extremity of the longitudinal band. After covering the whole foot with the roller, he used to make it describe the figure of 8, passing it under the foot, and across the place where the tendon was ruptured; and the method was finished by encircling the limb upward, with the roller, as far as the upper end of the longitudinal bandage.

At the present day, it is usual not to confine the patient in bed very long; but after the inflammation, immediately following the accident, he is permitted to sit up, the heel being kept upwards and the foot extended by means of a slipper and a strap, or band, which is connected to another strap, or band, applied round the lower part of the thigh. He should also soon avail himself of the aid of a high-heeled shoe.

A rupture of the tendon of the extensor muscles of the leg requires nearly the same kind of treatment as a fracture of the patella. However, pressure exactly on the broken part of the tendon should be avoided; the limb should be kept extended, and somewhat raised; cold lotions applied, and afterwards bleeding and leeches employed, if necessary, with other antiphlogistic measures. No bandage should be put on till the inflammation has subsided. In the course of two or three weeks, the surgeon should cause the joint to be gently moved, without any muscular exertion on the part of the patient himself.

When the tendon of the triceps extensor cubiti is ruptured, the limb is to be kept straight; cold applications are to be used for a few days; and, if necessary, strict antiphlogistic treatment pursued.

The operation of dividing the tendon of Achilles

is occasionally performed. It has sometimes happened that, after a portion of the foot has been amputated by Chopart's method, the remaining part of it is drawn permanently backward by the powerful action of the gastrocnemius and solæus. For the relief of such a case, the proposal has been made to divide the tendon of Achilles.

The same proceeding was resorted to, more than twenty years ago, by Thilenius in an example of club-foot, which could not be rectified by other means. This practice, which was afterwards followed by Delpech, is founded on the fact, that, in all cases of rupture of this tendon, an encircling bond of connection is formed, instead of direct union taking place between its extremities; and that such uniting medium then becomes lengthened and thinned, so that, at this point, the tendon ultimately loses a part of its original diameter. M. Delpech used to introduce a straight bistoury between the tendon and the os calcis, completely through the part, dividing the skin at the inner and outer side of the heel and cellular tissue in front of the tendon, to the extent of an inch. Having withdrawn the bistoury, the tendon was next cut through from before backwards, with another knife, that had a very convex edge. The two ends of the tendon were then kept in contact. In about a month the external wounds were nearly healed; and the union of the tendon being sufficiently firm, and the part elongated by a few lines, an apparatus was applied to bring the foot forwards, and gradually lengthen the tendon.

Stromeyer's plan, which is more simple, and deserving of preference, is executed with a curved, very sharp-pointed bistoury. This is introduced two or three inches above the insertion of the tendon, between it and the tibia—the back of the knife being turned towards the bone, and the edge towards the tendon. The point should only just pass through the skin on the opposite side of the limb. The ends of the tendon are to be brought together by extending the foot; and the wound generally heals by the first intention. On the tenth day, the further extension of the foot may commence. As M. Malgaigne observes, this plan is preferable to that followed by Delpech, because the tendon remains free under the skin, whereas after the other method the two incisions suppurate, and the cicatrix is liable to become united to that of the tendon, and to be hurtfully drawn and irritated when the limb is exercised. (See *Malgaigne, Manuel de Méd. opér.* p. 152, ed. 2.) It is scarcely necessary to remark, that the division of the tendon of Achilles is only applicable to certain forms of club-foot, in which the action of the great muscles of the calf is decidedly concerned in preventing the part from assuming a better position, and machinery, bandages, and long-continued manual pressure will not avail.

I lately heard of a contracted knee, in which the proposal of dividing the tendon of the biceps was under consideration, as a means of relief. Of course, success would not attend such practice, unless that muscle were particularly the cause of the permanent flexion of the knee. (See *TALIPES* and *ORTHOPÆDIC SURGERY.*)

**TENT.** A roll of lint for dilating openings, sinuses, &c.

**TESTICLE, DISEASES OF THE.** According to Sir Astley Cooper, the body of the testicle is less prone to disease than the mammary

gland in the other sex; he acknowledges, however, that it is often the seat of disease, and that the spermatic cord, and the coats of the testicle, are also subject to a great variety of affections. The reasons assigned by him for the frequency of diseases in these parts are the following:—1. The pendulous situation of the testicles, which renders them very liable to inflammation; for the blood gravitates into them, and returns with difficulty by the veins.—2. The excitement to which they are liable from passion, and which, often not admitting of being immediately gratified, leads to an accumulation of seminal secretion, and to a painful and excessive distension of the seminiferous tubes, followed by inflammation.—3. The testicles are greatly exposed to blows and pressure.—4. They are frequently involved, secondarily, in consequence of diseases of the urethra and prostate gland.—5. The changes which the organ undergoes in old age, and at puberty, sometimes bring on disease of it.—6. The liability of the testicle to be interrupted, or altogether arrested, during its descent into the scrotum. This process, though usually completed before birth, is often delayed for years, and the testicle may then remain at the lower part of the abdomen, or in the groin, in which last situation it is much exposed to injury. (See Sir A. Cooper, *On the Structure and Diseases of the Testis*, part ii. p. 5.)

The affections to which this organ and its appendages are liable conveniently admit of being referred to four heads:—1. Diseases of the testis; 2. Of the tunica vaginalis; 3. Of the cord; and 4. Of the scrotum. The reader will find an account of the three last classes of diseases in the articles *HYDROCELE*, *HÆMATOCELE*, *SCROTUM*, and *VARICOCELE*, so that these subjects will not receive particular notice in this place.

It would perhaps be difficult to cite any department of surgery in which greater improvement has taken place of late years than in that which relates to the diagnosis and more judicious treatment adopted with regard to diseases of the testicle. The result is that castration, which at one period used to be very frequently performed in the hospitals of London, is now a comparatively rare proceeding. The same beneficial reform, through the influence and practice of Dupuytren, at the Hôtel-Dieu, has been also made in France, and of the numerous patients annually admitted into the French hospitals for such diseases, most are cured without operation. In the majority of instances, Dupuytren ascertained that the enlargement of the testicles proceeded from external violence, syphilis of long standing, or from scrofulous or some other unfavourable state of the general health; and hence, he made it a rule never to resort to castration without having first tried, for a full month or six weeks, some method of treatment adapted to the cause of the complaint. (See *Dupuytren*, in *Clin. chir.* t. i. p. 86-88.)

*Acute Inflammation of the Testicle; Orchitis* (from *orxis*, a testicle); or *Hernia humoralis*, an absurd, though formerly a common, name for the complaint, which being founded, as Sir Astley Cooper justly observes, upon mistaken pathological principles, ought to be abandoned.

[Until somewhat recently inflammation of the body of the testicle and inflammation of the epididymis were confounded together, and described under the common term *Orchitis*, but, with an im-



proved knowledge of the pathology of these parts, a separation has been made between these two really distinct affections. This division has long been insisted on by the French surgeons, who first pointed out the different causes which produce, and the different symptoms which follow, inflammation in these two portions of the testicle. (*Velpeau, Dict. de Méd. t. xxix. article Testicule; Ricord, Traité des Mal. vén. 1838.*) The term *Orchitis* is now limited to an inflammation of the body of the gland, whilst a similar action in the epididymis has received the name of *Epididymitis*.

*Epididymitis* may be caused by a direct injury, but it usually results from some irritation of the urethra or neck of the bladder, such as an urethral discharge, the introduction of a catheter or bougie, the passage of a calculus, inflammation of, or injury to, the prostate gland and base of the bladder, obstruction to the flow of urine in consequence of a stricture, &c.

The affection usually commences in one testicle, and, as this is recovering, the other often takes on a similar action, but it is rare to find both attacked simultaneously. If the disease be occasioned by gonorrhœa, it is seldom during the acute stage, but rather when the discharge is becoming chronic, and the inflammation has reached the prostatic part of the urethra, from which it passes by continuity along the vas deferens to the epididymis; and, when this is involved, the urethral discharge commonly ceases, or is much diminished. Since, in many cases, no pain is experienced along the course of the cord, some writers, and amongst them Sir Benjamin Brodie, incline to the belief that there is a direct translation, or a metastasis, of the inflammation from the urethra to the epididymis, but he also admits that there is sometimes "an extension of the inflammation of the urethra and vasa deferentia to the testicle." (*Lond. Med. Gaz. vol. xiii. p. 218.*) Sir Astley Cooper's observations have led him to concur entirely in this latter opinion, and Mr. Curling is also inclined to discard the theory of a metastasis.

Occasionally pain along the track of the spermatic cord indicates the commencement of the attack, but more commonly tenderness and swelling of the epididymis are the first symptoms; these rapidly increase, and are followed by effusion into the tunica vaginalis, which soon becomes distended, and causes considerable discomfort by its weight and dragging upon the cord, constituting what has been termed an *acute hydrocele*. The fluid within this serous cavity soon conceals the body of the testicle, which, so long as it can be felt, remains soft and natural to the touch, whilst moderate pressure upon it does not produce pain; the epididymis can usually be well defined, as a hard knotted cord at the posterior and lower part of the scrotum; it is extremely sensitive, and, when touched, a sharp pain is produced, passing up into the groin. Sometimes also the vas deferens may be felt swollen and tender whilst lying in the inguinal region.

When the tunica vaginalis is much inflamed, the skin covering it becomes red, tumid, œdematous, with its veins prominent and turgid. The dartos tissue is infiltrated with fluid, and the scrotum forms an even uniform swelling of ovoid shape, which completely masks the outline of the gland. There is much pain when the parts are handled or compressed, as in walking, &c., and, when unsupported, intolerable aching is caused in the groin

from the great weight of the swelling; if, however, the patient be at rest, and especially in the horizontal posture, but little suffering is experienced. Usually the constitutional disturbance is inconsiderable, but, if the reverse be the case, or the local pain excessive, the body of the testis is then probably involved also by extension of the inflammation into the seminiferous tubes; this, however, is not of common occurrence.

As the disease subsides, the accumulation within the tunica vaginalis is rapidly absorbed, as is also the serous exudation into the cellular tissue of the scrotum; it happens occasionally, though, that the fluid will remain and a hydrocele result.

When the testicle can again be made out, it probably will be harder and rather larger than before, owing to congestion of its vessels; and the epididymis will be felt greatly enlarged, especially at its upper and lower extremities, which are generally more swollen than the intervening part of the tube. This thickening will often remain for a length of time after all inflammation has passed away, and, if it persist in or around the globus minor, may produce occlusion more or less complete of the duct, and thus occasion serious impairment to the function of the gland; such is the case, though to a less extent, when the globus major is at fault, and it is not uncommon to find this portion of the organ after sexual excitement more swollen and tender than the rest of the epididymis, in consequence of a partial retention of the seminal secretion.

Epididymitis, however, does not often cause permanent injury to the function of the testis, although the reverse may be the case. In some instances neuralgia and that condition of the gland known as "irritable testis" have been traced to this affection, but these painful maladies have usually occurred in weakly persons who have largely indulged their sexual instincts.

In the treatment of epididymitis, as in all inflammatory affections, *rest* is of the first importance, and, if possible, in the recumbent posture, with a pillow between the thighs to support the scrotum; if this cannot be obtained, the testicles must be supported by handkerchiefs carefully adjusted, or by a large suspensory bandage. Six or a dozen leeches, repeated if necessary, will generally give much relief, and evaporating lotions or a cool poultice should be applied to the part. As the pain and swelling subside, a weak lotion of tincture of iodine, or blue ointment with extract of belladonna, may be advantageously used, but they should be discontinued during several hours in the day lest they irritate the scrotum. Internally, tartarised antimony with opium and mildly purgative doses of sulphate of magnesia, or some other laxative saline are useful. When the affection has become chronic, and there is much thickening, iodide of potassium or small doses of mercury will aid in promoting the absorption of the inflammatory exudation.

Strapping the scrotum with adhesive plaister as practised by Fricke, of Hamburg (*Gaz. méd. de Paris, 1839*), has been much praised by some surgeons, but few patients can bear the pressure upon the inflamed part, even when the strips have been skilfully applied, and if this be not the case, the pain caused by the uneven compression is intolerable.

Puncturing the tunica vaginalis with a fine lancet, as recommended by Velpeau (*Dict. de*

*Med.* p. 458, vol. xxix.), or evacuation of its contents with a small trocar, will relieve the pain and tension greatly when the collection of fluid is large.

Local venesection, by opening one of the distended scrotal veins, has been advantageously practised; it reduces the vascular engorgement of the skin, and therefore diminishes the symptoms.

Blistering the scrotum and the application of other counter-irritants have been tried in the more chronic cases, but this mode of treatment causes great suffering to the patient, and should not be employed except the affection be very obstinate, and other remedies have failed.

*Orchitis, or Inflammation of the body of the Testicle*, may be of two kinds, *acute* and *chronic*.

The *acute* variety is of rare occurrence, and generally results from an injury to the testis; it may, however, follow an attack of epididymitis, in consequence of the inflammation reaching the body of the organ; in mumps, also, as the swelling is subsiding in the salivary glands, one or both of the testicles may become inflamed; this is supposed to be due to a metastasis of the inflammation.]

Acute orchitis commences with swelling of the gland and tenderness, so that the pressure of the thigh can scarcely be borne. This is succeeded by pain of a constant dull aching character, which soon becomes very severe; and, the weight of the testis being much increased, the spermatic cord is drawn painfully downwards, so that the patient seeks to obtain some relief by supporting the part with his hands. The pain is obtuse, resembling the suffering caused by squeezing the testicle. The pain and swelling extend along the spermatic cord into the inguinal canal, and great uneasiness is experienced in the groin, hip, inner part of the thighs, and especially the loins, in consequence of the origin of the spermatic nerves from the lumbar plexus of the sympathetic. "From the communication between the renal and spermatic nerves, with the nerves of the stomach by the solar plexus, and with those of the intestines through the mesenteric plexus, the stomach is affected with nausea, and sometimes severe vomiting," whilst pain in the intestines and obstinate constipation are usually experienced. (*Sir Astley Cooper, Op. cit.* part ii. p. 8.)

[The sudden vomiting and faintness which nearly always ensue from an injury to the testicle may also be explained in the same way.

The pain in the loins is occasionally very intense, and is aggravated by the least movement, so that the patient walks with difficulty, inclining his body forwards, seeking thereby to relax the muscles and gain some slight relief from suffering.]

In some cases it happens that the pressure made by the tendon of the external oblique on the swollen cord is the occasion of great pain, which sometimes undergoes severe exacerbations from spasms of the cremaster muscle, adding much to the distress.

The flattened oval shape of the enlarged testis, with the epididymis unaffected at its posterior border, can be well made out, until effusion has taken place into the tunica vaginalis; this, however, is not so constant, and is far less in amount than when the epididymis is inflamed, and, unless this be the case, the skin of the scrotum is ordinarily but little altered in appearance.]

During the violence of the inflammation, the

constitution is often greatly disturbed; the tongue becoming furred, the pulse quick and hard, the skin hot, the bowels confined, and general febrile irritation. It has been observed that, when acute inflammation of the testicle arises from sympathy with the urethra, it rarely proceeds to suppuration; but when it is the effect of a blow, or of vicissitude of temperature, suppuration sometimes, though not frequently, follows; and then all the symptoms are aggravated, and shiverings added to those already described. In fact, the purulent matter being confined by the fibrous covering of the tunica albuginea, a texture that ulcerates with difficulty, much time elapses before the abscess bursts; and when this happens, several openings and sinuses are frequently formed, which discharge both pus and seminal fluid, and are difficult to heal. (*Sir Astley Cooper, Op. cit.* p. 10-12.)

[Suppuration is an unusual termination of inflamed testis, and when it does occur, it is nearly always in scrofulous persons, or in those whose health has become much impaired. Sloughing of the testicle has been occasionally met with as the result of acute orchitis, and even gangrene, but they are of very rare occurrence. When the abscess has given way and discharged its contents, it may heal up, as in any other part of the body; but commonly the gland protrudes through the opening formed in the skin, and adheres firmly to its margins, giving rise to a red granular-looking swelling, which has been called "the granular swelling of the testis," *fungus testis*, and *hernia testis*, under which latter name the affection will hereafter be specially described.]

Sir Astley Cooper has remarked that "a wound of the testis does not produce the pain and inflammatory effects which might be anticipated; for I have several times known a lancet, and even a trocar, thrust into its substance. It is followed by a sickening pain, and the patient sometimes vomits; but the wound heals readily, and without suppuration. In one case, however, in which the trocar was twice thrust into a testis, violent inflammation and suppuration succeeded." (*Op. cit.* p. 19.)

[Although a contusion will sometimes lead to destructive inflammation, or even complete disorganisation of the texture and function of the testicle, yet the effects of a punctured or incised wound are seldom of a severe character, and so little does the organ resent this kind of injury that the treatment of orchitis by repeated punctures into the body of the gland has been recommended by M. Vidal de Cassis, according to whom it has been attended by the most satisfactory results. (*Treatise on Venereal Diseases, Translation by Blackman*, p. 138.) M. Cullerier has also practised this method, and has not found any ill-effects follow the punctures. (*Des Affections blennorrhagiques*, p. 112.)]

The testicle, not yet descended into the scrotum, may inflame from a blow, or the pressure of a truss, and give rise to excessive pain, with vomiting, constipation, tenderness in the abdomen, and severe febrile disturbance.

[When lodged in the inguinal canal, the testicle appears to be more prone to disease than when it has reached its normal position in the scrotum; and not only is it more subject to inflammation when retained in the groin, in consequence of the pressure exercised upon it by the abdominal



muscles, and the various movements of the thighs, but the pain is thereby rendered more violent and the attacks more frequent than under ordinary circumstances, so that on this account it has occasionally been found necessary to remove the gland.

In some cases the symptoms will be very severe, and simulate those of a hernia, or of a bubo. Inflammation may also be excited in the testis during its descent, by its arrest and constriction at the external abdominal ring, in which case great pain and swelling result.

Spasm of the cremaster muscle will sometimes be excited by retention of the testicle in the narrow space between the abdominal rings, and if the organ be inflamed, much additional suffering is occasioned.

Orchitis may be met with in infants and very young children, and in these cases it is often difficult to assign a cause for the attack. "The symptoms were acute, and the swelling considerable," Mr. Curling remarks of certain cases which occurred in his practice, "but the disease soon subsided, and it was always confined to one testicle." (*A Practical Treatise on Diseases of the Testis*, p. 272.) Inflammation of the epididymis, or of the tunica vaginalis, *Vaginalitis*, as it has been termed by M. Rouchoux, is, however, far more frequent at this age than inflammation of the gland itself.]

A patient with acute inflammation of the testicle should wear a suspensory bandage, and keep himself quiet on a sofa, or even in bed in the recumbent position. Leeches should be applied to the scrotum, or along the course of the spermatic cord; and, if the local and general symptoms be severe, it may be necessary to take blood from the arm, or from the loins by cupping. When leeches cannot be obtained, the surgeon may puncture three or four veins of the scrotum, with the point of the lancet introduced transversely with respect to these vessels, which will then bleed freely, more especially if the parts be placed in warm water; but this will not afford so much benefit as in epididymitis, unless the scrotum be also inflamed.

The recumbent position does not obviate the necessity for supporting the testicle with a suspensory bandage or handkerchief; and the inflamed part should thus be brought towards the abdomen, and not suffered to fall between the thighs, which would destroy the salutary influence of the recumbent posture. When the patient has not a regular suspensory bandage, he may support the part very well with a handkerchief, which should be fastened at each end to another handkerchief, or band, placed round the loins.

With respect to local applications, cold evaporating lotions sometimes answer best; and the use of ice has been strongly recommended, but it cannot be borne when the pain is very severe; in most instances, warm fomentations and poultices are preferable. When leeches are used, it is an excellent plan, after they drop off, to apply a poultice, into which the bites will still continue to bleed for some time very freely, without any occasion for the surgeon or patient to take further trouble to promote the hæmorrhage. Warm emollient applications are supposed to act beneficially, by their relaxing effect, on the fibrous textures covering the swollen testicle.

In addition to the foregoing means, the bowels

should be kept open with antimonial saline purgatives; and, during the prevalence of severe pain, or great nervous irritation, opium or morphia should be freely administered.

The liquor plumbi subacetatis dilutus, with or without a small quantity of spirit of wine added to it; or the liquor ammon. acet., if no leech-bites are present; or a solution of one drachm of the muriate of ammonia in a pint of water, are all of them applications in common use, when cold is judged advantageous. Should the inflammation not yield quickly, the local bleeding may be repeated, and even in some cases venesection. Emetics and nauseating doses of tartrate of antimony are occasionally resorted to. Mr. Hunter states that he has known vomiting to remove the swelling almost instantaneously. "The effects of the vomit most probably arise from the sympathy between the stomach and the testicle." (*On the Venereal Disease*, p. 91.)

[Full doses of tartar emetic, frequently repeated, are of great value, and, generally, when nausea is produced, the pain is much alleviated; in most cases opium may be advantageously combined with the antimony. Hot or vapour baths commonly afford relief and may be frequently resorted to. When there is pain or a colicky sensation in the bowels, hot fomentations, with opium or turpentine, applied to the abdomen will speedily allay these symptoms. As previously mentioned, several punctures with a lancet into the body of the testicle, and repeated, if necessary, are said to be of great service in relieving the pain, by diminishing the tension of the tunica albuginea; when there is much fresh effusion into the tunica vaginalis, removal of the fluid has been recommended, as in epididymitis.]

Sir Astley Cooper notices certain irritable constitutions, in which the continuance of depletion will not succeed. "Here," he says, "the best practice, when the pulse is jerking, the patient irritable, and the part painful, is to give the submuriate of mercury with pulvis ipecacuanhæ comp."

As the inflammation subsides, ointments containing iodine or the iodide of mercury may be employed with the view of dispersing the induration; so likewise the emplastrum ammon. cum hydrargyro, or a mercurial ointment with the extract of opium or belladonna.

Sir Astley Cooper combines with local means constitutional treatment, as small doses of the bichloride of mercury, or pil. hydrarg. gr. ij., ant. tart. gr.  $\frac{1}{4}$ ; or extract. colocynth. comp. gr. iij. with ipecacuanh. gr. ij., made into a pill, and taken every night. If nausea be excited, this he deems advantageous. He speaks also favourably of the effects of the liquor potassæ, the pil. hydrarg. chloridi comp., and the tincture of iodine, its effects being carefully watched.

[In this stage the iodide of potassium is often of great use, or if a mercurial treatment be indicated, the protoiodide or biniodide of mercury in small doses may be advantageously exhibited.]

If, as sometimes happens, after the acute attack has passed away, a disposition to a periodic return of inflammation in the testis be left, quinine, or arsenic, in the form of Donovan's or Fowler's solutions, will be of service in checking it.

When orchitis occurs in young children, rest, with a purgative saline and evaporating lotions, is usually a sufficient treatment.]

The induration left after inflammation of the testicle is described by Sir Benjamin Brodie as dependent upon effusion of lymph into the interstices of the glandular structure, and as not producing any permanent injury of the functions of the organ. In six or twelve months, the hardness disappears; "but," he adds, "there are a few cases, in which the inflammation is so severe as actually to injure some portion of the glandular structure. I examined the body of a gentleman who had had inflammation of the testicle from a gonorrhœa twenty years before. The testicle, which had been inflamed, was from that time smaller than the other, and a part of it remained considerably indurated. I knew these facts previously, and I was curious to examine the state of the testicle by dissection. On making a section of it, I found that about two-thirds of the tubuli testis remained in their natural condition, while the remainder had been converted into a white substance, having the consistence, but not the fibrous structure, of ligament." (See *Lond. Med. Gaz.* vol. xiii. p. 219.)

It is generally a long time before the swelling of the testicle entirely subsides; previously to its becoming less, it usually becomes softer. "It is still much longer (as Mr. Hunter observes), sometimes even years, before the epididymis returns to its natural state; sometimes it is never reduced to its natural size and softness; however, this is not of much consequence, as no great inconvenience results from the continuance of the hardness simply, though sometimes, perhaps, such testicles are rendered totally useless. I never had an opportunity of examining the testicle of one that was known to have this complaint, but have examined testicles where the epididymis has had the same external feel, and where the canal of the vas deferens has been obliterated. But this, I suspect, seldom happens; for there are people who have both testicles swelled, and, notwithstanding, discharge their semen as before. It is in this stage of the complaint that resolvents may be of service, such as mercurial friction joined with camphor." (*Hunter on the Ven. Disease*, p. 92.)

In cynanche parotidea, there is occasionally a transfer of the inflammation to the testicle; a case requiring the exhibition of liq. ammon. acet., with sulphate of magnesia, or the saline mixture with tartarised antimony, and a pill containing calomel and antimonial powder. Leeches, with a poultice, or cold lotion, are also proper.

[Orchitis not unfrequently supervenes upon an attack of mumps, especially about the time of puberty, and is considered to depend upon a metastasis of the inflammation. It generally occurs as the affection is leaving the salivary glands, and appears suddenly in one of the testicles, or sometimes in both. The inflammation is not severe, and runs its course quickly; it very seldom passes on to suppuration, or results in any permanent injury to the organ. The scrotum may perhaps be slightly reddened, but there is no effusion into the tunica vaginalis, unless the epididymis be also inflamed. This peculiar inflammation has been observed to commence in the testicle without any previous affection of the salivary glands, and in some cases, during an epidemic of mumps, the testicular swelling has been the only evidence of the disease.]

It has been asserted that atrophy of the testicle frequently follows an attack of inflammation

during this complaint. Gross states that he has seen several such cases (*System of Surgery*, vol. ii. p. 473), and other instances are alluded to by various writers. (*Hamilton, Trans. of the Roy. Soc. of Edin.* vol. ii. p. 59.) On the other hand, not a single example of this has come under the observation of Sir Astley Cooper or of Mr. Curling, and the experience of most other surgeons is so fully in accord with theirs, that wasting of the testicle after mumps must be regarded as a very exceptional circumstance.]

If suppuration occur, fomentations and poultices are to be applied; and, as soon as matter can be detected, it should be discharged by a free and deep incision, as otherwise the secreting substance of the testis will be destroyed, and several openings, instead of one, produced.

Atrophy, or a wasting away, of the testicle is an occasional consequence of inflammation, and according to Sir Astley Cooper it takes place more frequently at puberty than at any other age. A person receives a blow on the part, or the testicle inflames spontaneously; or more rarely the atrophy follows inflammation of the epididymis resulting from gonorrhœa. The change consists in an absorption of the whole of the glandular structure, the tunica vaginalis being left adherent to the tunica albuginea, with the septa alone remaining within the latter.

[*Chronic Orchitis* may result from a local injury, or remain as a sequence of acute inflammation, and this is especially the case in strumous or cachectic persons; it may also be induced by masturbation or sexual excess.]

It is frequently the product of a constitution worn and broken by intemperance. It often follows a long course of mercury; and "it arises in habits in which the vital powers are diminished, and in which we find sloughing of the cellular membrane in the form of chronic carbuncle. Frequent exposure to wet, cold, or fatigue, and an excessive indulgence of the passions, also dispose to its production." (*Sir A. Cooper, Op. cit.* p. 39.)

[But by far the most frequent cause of this disease is some constitutional taint, such as syphilis, scrofula, rheumatism, or gout.]

The chief characteristic of the affection is its indolence and comparative freedom from pain, so that often there is no suspicion of it until the testis has attained a considerable size. Sometimes there is a dull aching in the gland at the onset, and pain is excited by the accidental pressure of the thigh, but, as the disease advances, this gradually ceases, and a sense of dragging upon the cord by the increased weight of the part forms almost the sole discomfort. So long as the affected organ remains soft and yielding to the touch, manipulation causes pain similar to, but more severe than, the ordinary sensation produced by squeezing the healthy gland; when, however, the swelling has become hard and chronic, this is no longer experienced.

The testicle may enlarge to the size of a duck's egg or more; it is very firm and inelastic, but retains its smooth oval flattened outline; the epididymis can be felt at its posterior border but little altered in shape or size. Generally there is some effusion into the tunica vaginalis, and when this occurs, the swelling is larger, more elastic, and much more sensitive, than at other times, as the epididymis is then commonly inflamed also. Both testes are often affected, but the disease seldom commences



in them simultaneously, and it is not rare to find exacerbations taking place in them alternately; when both organs are involved, loss of sexual power gradually occurs, until at last it may altogether fail.

The disease consists in an exudation of organisable lymph into the substance of the testis, and this is generally diffused equally throughout the organ so as to produce a uniform enlargement; the effusion may, however, be limited to certain portions of the gland, causing irregular nodules upon its surface.

The pressure to which the tubuli seminiferi are subjected by this deposit arrests their function, and occasions the impotency referred to; whilst pain is also produced by it, as well as by the tension upon the unyielding tunica albuginea.

As absorption of this material takes place, the pain and swelling subside, the normal sensation returns in the testicle, together with capacity for sexual intercourse.

Sometimes the exudation will degenerate and suppuration take place, but this seldom occurs in other than delicate unhealthy patients, or when the disease has resulted from violence, and a portion of the testicle has been irretrievably injured.

A more grave termination is when this plastic matter becomes organised. The gland then remains enlarged for a length of time, is altogether insensitve, and, if both are affected, there is complete loss of power. To this condition the term of *Sarcocoele* was formerly applied, and if there be an accumulation of fluid in the tunica vaginalis, it has been named a *Hydrosarcocoele*. After remaining large and useless for a varying period, the testicle begins to diminish in size, and may continue to do so until ultimately it becomes completely atrophied.

A section through a testicle with this disease shows an absence, more or less complete, of the tubular structure, and its replacement by a firm, grey-coloured, fibro-plastic, material, throughout which are scattered patches of a yellowish tinge.

Although the symptoms of chronic orchitis are very similar in all cases, yet there are important distinctive features in certain varieties of the disease which require special notice.

When it results from, or is complicated with, *gout*, the attack is subacute, with somewhat rapid swelling and considerable pain. There is also generally effusion into the tunica vaginalis. The other testis is often extremely sensitive, though not enlarged, with occasional shooting pain through it and along the cord, most marked at night. There may be other indications of a gouty tendency, and the stomach frequently sympathises with the attack.

If the inflammation of the testicle be dependent on, or associated with, *rheumatism*, a dull, though severe, aching pain is the first symptom, and the swelling will be slower and to a less extent than when arising from other causes; as in rheumatic affections generally, the fibrous covering is the part first involved, and the glandular enlargement is secondary to an extension of the inflammation along the septa. Pain is the chief characteristic of this variety, which is much aggravated at night, as also by exercise, or pressure; both testes may be attacked, but less frequently than in other forms of orchitis, and the collection of fluid in the tunica vaginalis is seldom large. The urine is generally loaded with lithates, and of a high

colour, whilst other evidences of rheumatism are frequently present. In these cases, local exposure to wet and cold is the usual cause of the attack.

But by far the most frequent form of this disease is that which is due to *syphilis*. *Syphilitic orchitis* is essentially slow in its progress, and free from active inflammation, so that the increased size of the gland is often the first symptom to attract attention; there may be slight pain at the very commencement, but this is soon lost, so that manipulation neither produces pain nor the ordinary testicular sensation; this latter will, however, return as the disease is subsiding. The testicle becomes very solid and extremely hard; it is sometimes smooth and even, but generally nodulated on the surface from masses of plastic matter irregularly deposited within its substance; it is commonly associated with hydrocele, which may reach a considerable size. The epididymis and spermatic cord are but little involved, except in cases of long duration, when they will become hard and thickened.

Both testes are often involved, although seldom simultaneously or in an equal degree, and they do not usually attain so large a size as in the non-specific varieties of the disease.

This affection is met with during the more advanced, or so-called tertiary, stage of constitutional syphilis; it may be accompanied by other evidences of the disease, but this is by no means of constant occurrence, although a history of it can generally be obtained.

Suppuration is a very infrequent result of syphilitic orchitis, and when it does occur, it is nearly always associated with tuberculous deposit. With judicious treatment, recovery may be looked for in the large majority of cases, but sometimes the secreting structure will be almost completely destroyed, and progressive atrophy will then take place.

On examining a testicle affected with syphilitic disease, the seminal tubes will be found embedded in a mass of yellowish-white deposit, which infiltrates the gland to a varying extent; and in a more chronic case, this material will occupy the interior of the organ to the exclusion of the tubular structure, which will have almost entirely disappeared.

Few affections respond more readily and satisfactorily to treatment than chronic orchitis in its earlier stages. Mildly depletive remedies at first, and afterwards alterative medicines, with tonics, and local applications, will be found most conducive to recovery. To this end, when there is much pain, and the swelling is rapid, leeches will be most useful; the patient should, if possible, be kept at rest, and evaporating lotions applied; a well-fitting suspensory bandage should also be adapted to the part, so as to support it thoroughly. As soon as the leech-bites will allow, mercurial ointment may be employed locally. The internal administration of mercury is most serviceable in this disease, when given in moderate but long-continued doses, and under its use the enlargement will rapidly disappear, unless the exudation has become organised before this method of treatment be commenced.

When, owing to a debilitated or scrofulous condition of the patient, mercury is not admissible, iodide of potassium may be substituted, and this will be found a highly useful drug in most cases, even where mercury is employed. Quinine, bark,

iron, or other tonics may be given at the same time. A nutritious but unstimulating diet may be taken, though in weakly persons wine or beer will aid by improving the general health.

If gout be present, colchicum may be given, combined with alkalies and mild opiates; the dose of mercury should be reduced, although not altogether discontinued, and special attention paid to the digestive organs.

When the affection results from rheumatism, opium in full doses, with the iodide of potassium and alkalies, will be of service; in more chronic cases, guaiacum will often answer.

Should the disease arise from syphilis, mercury is most valuable, but it must not be pushed to salivation; blue pill, the bichloride, or the iodide, of mercury will be found the most useful forms of this medicine, according to circumstances. When there is a hydrocele of any size, the fluid may be drawn off, by which means the compression upon the spermatic vessels is removed, and the dragging on the cord diminished; but the radical cure of the hydrocele should not be attempted until the testicle has nearly recovered, when very probably any further collection of fluid will be absorbed.

In the few cases of chronic orchitis where suppuration occurs, an incision should be made, and after the matter has escaped, the wound will often heal up. If the purulent collection be allowed to find its way to the surface, the testicle is often much injured by the pent-up matter, and the tunica albuginea and integuments may be largely destroyed, so that protrusion of the gland tissue takes place, forming a *hernia testis*.

*Scrofulous Disease of the Testicle.*—This affection is very slow in its progress, and is characterised by its preference for the epididymis and spermatic cord, rather than for the body of the testis, by its tendency to terminate in suppuration, and by the peculiar cachexia with which it is associated.

The disease consists in a deposit of tubercular matter between the convolutions of the epididymis, and less frequently amongst the tubuli semiferi of the gland itself. This deposit takes place not only into the cellular tissue connecting the tubular structure, but even into the tubes themselves, and according to some observers, this is its more usual seat. Under ordinary circumstances, scrofulous disease of the testicle is met with as the local expression of a constitutional taint; it may remain inactive and painless for months or years, until at length some excitant sets up inflammation in the part affected, under which the tubercular material softens, and is ultimately discharged as pus, together with the disintegrated tissues adjoining. Although this happens in the large majority of cases, yet suppuration does not invariably result. In some few instances changes occur in the material similar to those observed in the lungs or other organs, viz. an absorption of the fluid portion of the deposit, and a gradual cretification of its solid constituents.

In strumous persons tubercle is often formed in the epididymis or testis after an attack of inflammation in those parts, and suppuration then takes place much more speedily and certainly than when the disease depends upon idiopathic causes only.

Rapid disorganisation occurs sometimes when tubercular infiltration of the gland takes place in a person suffering from phthisis; in some of these

cases the miliary form of tubercle may be met with in the testis, and the inflammatory symptoms produced are then of a more acute character.

Scrofulous disease of the testis may be found at all ages, even in very young children, but it is more frequent from the period of puberty until about thirty or thirty-five years of age, that is to say, during the time when the functional activity of the gland is greatest.

Both testes may be affected, but the disease is more commonly confined to one. At first there is no pain, even on firm compression, and hardened masses can be felt studding the gland, or the cord; they are quite localised, so that the intervening tissue is soft and natural to the touch. After a varying time these swellings increase in size, and perhaps blend together, so that the whole organ may be enlarged; the most prominent nodules ultimately soften, and give an indistinct sense of fluctuation.

The epididymis may be largely infiltrated, and the testicle remain perfectly free from disease, embedded in the mass of deposit behind it. Scrofulous disease is seldom limited to the body of the gland; when, however, such is the case, the tumour rarely attains so large a size as when the epididymis is also affected. Accumulation of fluid in the tunica vaginalis is not constant, and, when present, only to a small amount.]

The following is the description given of the scrofulous testicle by Sir Benjamin Brodie. The patient experiences a slight pain in one part of the testicle, and there a little enlargement is felt, generally at the upper end of the epididymis. Then a slight pain is experienced at another part, and here is perceived another enlargement, which is commonly also in the epididymis. These small tumours increase in size, and gradually become more painful. Sometimes as many as three or four of them are found on the surface of the testicle, but they are generally connected with the epididymis. The skin becomes adherent to them, and one of them is converted into an abscess, which bursts through the external skin. A similar abscess forms in another, and runs the same course. These abscesses discharge very little matter, and they do not heal like a healthy abscess. When a probe is introduced into one of the sinuses thus formed, it passes down into the centre of the tubercle, or tumour, in which the abscess originated. In some instances, the disease will go on until the whole of the testicle is disorganised. Sometimes it is confined to one testicle; sometimes both are similarly involved. Occasionally it will completely destroy one of them; but more frequently the testicle is only partially injured, and a great deal of the glandular structure remains in a natural state. In the more advanced stage, the testicle sometimes becomes uniformly enlarged, and hard throughout; yet, on careful examination, the remains of the projecting tumours, which existed in the beginning, may be perceived. The disease is generally connected with other scrofulous symptoms; as enlarged glands in the neck, scrofulous disease of the spine or hip, or of some of the joints. (See *London Med. Gaz.* vol. xiii. p. 377.) Dupuytren remarks that, although it may not seem difficult at once to distinguish an enlargement of the testicle produced by syphilis, or by an external injury, from another which is scrofulous, yet in their beginning they sometimes absolutely



resemble one another, and their true character cannot be made out till a later period. "In general (says he), scrofulous enlargements do not yield to common treatment; they continue indefinitely, are frequently accompanied by other affections of the same nature, and are connected with a strumous constitution." He further observes that the tubercular degeneration is one of the principal characters of these scrofulous enlargements. In the majority of cases, he says, the deposit takes place in the fibro-cellular tissue surrounding the epididymis, but it may also occur in the substance of the testicle itself. The tubercles are developed slowly, and may continue without alteration for three or four years. The mode in which they commence, their progress, and their long duration, are indicative of their nature. "Scrofulous swellings of the testicle are not so hard as scirrhus ones; but they are harder than those which depend upon inflammation. They are free from heat and redness, and cause a sense of weight and numbness. The subcutaneous cellular tissue is ordinarily free," except at the points where abscesses advance to the surface. "The shape of the tumour is commonly uneven and irregular, while, in a scirrhus enlargement, the testicle is more globular, and the epididymis knobby; the spermatic cord being mostly spared, but now and then implicated. As the scrofulous disease of the testicle makes progress, certain points within the organ soften, and, when touched, seem as if they contained a soft substance. Soon after this, small bluish projections are noticed. Here the skin ulcerates, and from the openings are discharged a thin pus, and a yellowish cheese-like or pultaceous substance, evidently a product of scrofula. Fistulæ are next formed, out of which is voided a serous imperfect kind of pus. The disease may go on for years. (*Dupuytren in Clin. chir. t. i. p. 101.*)

The testicle, even in very young children, sometimes becomes enlarged and very hard, but without pain; and this indolent increase of it may remain for many weeks, months, or years, and, as the health improves, ultimately subside. More frequently the disease comes on at puberty, or between that period and the age of twenty; and, not uncommonly, it attacks both testicles. If suppuration occur, which happens even in children, but still more frequently at puberty, the matter often forms in the globus major of the epididymis, though sometimes in the globus minor. According to Sir Astley Cooper, the body of the testicle rarely suppurates; "but, after the epididymis has ulcerated, the testis becomes affected, and the scrotum assumes a livid hue; ulceration ensues, and an abscess forms, which discharges ill-formed pus, and some semen, at least after the age of puberty; and the opening is extremely difficult to heal, continuing for months, and even for years." One or both testicles at length waste, until but a small portion is left, and the seminal secretion almost entirely ceases.

In dissections of the epididymis and testis affected with scrofulous disease, Sir Astley Cooper has found a yellowish mass surrounded by a zone of inflammation in the globus major, or sometimes, though less frequently, in the globus minor. When this patch softens down, the matter which is discharged is not pure pus, but composed of fibrine and serum, and having a slight yellow

tinge. "In the testes there are several similar yellow spots, accompanied by the same kind of inflammatory zone; and several yellow streaks are also found amidst the tubuli. Scrofulous abscesses in the testes are sometimes accompanied by a granular swelling, like that which exists in the simple chronic disease." (*Sir Astley Cooper, Op. cit. p. 97—99.*)

[It is not uncommon to find a hernia of the testicle resulting from this disease; the ordinary red granular protrusion is then mixed with small masses of a yellowish-white colour, similar to the flaky curd-like material found in scrofulous glands; the margins of the skin which surround it, and to which it is adherent, are livid, undermined, and irregular.]

Nélaton and other French surgeons regard scrofulous disease as one of the most common affections to which the testicle is liable, and consider that many of the cases described by English writers as chronic orchitis are really examples of scrofulous deposit in this organ; they state that the yellow masses found in these cases are diagnostic of their scrofulous nature, as this kind of material is quite different from the exudation met with in chronic inflammation. (*Path. chir. vol. v. p. 538.*)

Mercury, which proves so efficient in the ordinary chronic enlargement of the testicle, does harm in the scrofulous disease of it. No specific remedy for scrofula is known; but the patient should have the benefit of pure air, and especially of that of the coast. The diet should be nutritious, and a moderate amount of wine or beer allowed. Sir A. Cooper strongly recommends tepid sea-bathing. Since in tubercular affections the digestive system is often at fault, such medicines should be prescribed as tend to improve those organs, and as soon as possible a tonic treatment adopted, comprising quinine, iron, and cod-liver oil. The preparations of iodine, such as iodide of potassium or iodide of iron, are often very serviceable. Sir Benjamin Brodie states that he has seen more benefit derived from the liquor potassæ than any other medicine. It is to be combined with tincture of gentian, and taken in the dose of half a drachm three times a day, blended with a wine-glass of table-beer. The acetate of potash, which may be produced by this mixture, he conceives has also a good effect, by acting as a diuretic. (*See Lond. Med. Gaz. vol. xiii. p. 378.*)

Whilst the swelling remains indolent, ointments or lotions containing iodine may be used, or mercurial applications to it. As suppuration sets in, poultices should be substituted and persevered with so long as the abscesses continue to discharge. To the resulting ulcer some slight stimulant, such as a solution of one grain of sulphate of copper in an ounce of distilled water, may be employed as a lotion, and also as an injection for the sinus, or *liq. calcis*  $\text{ʒiv}$ . and *hydrarg. chloridi*  $\text{ʒj}$ : nitrate of silver lotions are also eligible.

*Hernia Testis, or Granular Swelling of the Testicle*, as it was formerly termed, is a protrusion of the testicular structure in consequence of an abscess either of the epididymis or testis, and may be the result of acute, chronic, or scrofulous inflammation. This disease has received the names of *lipoma* and *fungus testis*, but very improperly, as it consists neither of a fatty substance, nor is it a real fungus.

[When suppurative inflammation occurs in the

testicle, adhesions are contracted between it and the skin; and during the formation of pus so much pressure is exerted upon the fibrous capsule of the testicle and the integuments which confine it, as to determine a slough at the most attenuated part. When this separates, the matter escapes, affording almost instant relief to the excruciating pain which was previously experienced. After the abscess has become emptied, if the opening should not close, as it often does not in scrofulous cases, a portion of the gland tissue will find its way through the aperture in the tunica albuginea, and form a protrusion of variable size external to the scrotal cavity.

When the fibrous coat has given way under the continuous pressure of the pent-up matter, it retracts, and in doing so first empties the abscess, and then compresses the swollen gland sufficiently to force some part of it through the opening, and, if the orifice be very large, the whole organ may in time be gradually extruded. The mass so formed is made up chiefly of the seminal tubes, which can be pulled out like fine threads, but it is increased in size by inflammatory exudation or by scrofulous matter. It has a peculiar red granular appearance; and although that part of the testicle still within the scrotum retains its natural sensation, the portion external to the skin is generally quite insensitive, so that a portion may be removed by the scissors without pain.

M. Jarjavay, however, states that in some cases, when the tumour is very large, although the contact of the clothes, &c., may cause no discomfort, yet compression will produce the ordinary testicular sensation, and the weight of the swelling occasion painful tension on the cord. (*Arch. gén. de Méd.* t. xx. 1849.)

When a piece of this excrescence is examined under the microscope, the tubuli seminiferi are most distinctly seen, and a number of exudation corpuscles, with, probably, some fibro-plastic material and scrofulous deposit.

There is some secretion of pus from the surface of this granular swelling, and a sinus can generally be found, through which a probe leads into the interior of the scrotum. The tumour is somewhat constricted where it passes through the orifice in the tunica albuginea, to be continuous with the rest of the testicular structure which is contained within its capsule.]

Sir Benjamin Brodie thus describes this affection:—"The testicle becomes adherent to the skin at one part, and here the skin inflames and ulcerates; and then a fungus, of small size at first, protrudes through the ulcerated opening, but gradually becomes larger afterwards; and, on the surface of this fungus, you find some of the same kind of yellow substance which is within the testicle itself. What is called a fungus, however, is not a fungus in reality, but the glandular structure of the testis." The same experienced surgeon joins Sir Astley Cooper in comparing its formation to that of a hernia cerebri, following ulceration of the dura mater. "If (says the former) you dissect the parts in this stage of the disease, you will find, not only that the skin has ulcerated, but that the tunica vaginalis and the tunica albuginea have ulcerated also; and that the glandular structure of the testicle projects through all these openings. You may ascertain the same thing in the living person; for, when the fungus is large, no portion of the testicle remains within the scro-

tum, and you may distinctly trace the spermatic cord into the centre of the fungus. There are a few cases in which an abscess forms in the substance of the testicle, and bursts externally, without the protrusion of a fungus; but these are comparatively rare. The disease, if it be arrested in the early stage, leaves the testicle with the glandular structure not at all impaired. If it be arrested after it has advanced some way, the glandular structure is partially destroyed; but if it be allowed to run its course, the whole of the glandular structure disappears, and you find in lieu of it a new-formed white organised substance, having the consistence of ligament, but without its fibrous character." In the early stage, the testicle is enlarged to many times its natural size; but when the disease is suffered to proceed, the body of the organ disappears, and merely a knob or tubercle is left, connected with the slender remains of the spermatic cord. (*Sir Benjamin Brodie, in Lond. Med. Gaz.* vol. xiii. p. 221.)

Sir William Lawrence first explained the real nature of this affection, and detailed so accurately the causes, symptoms, and progress of the disorder, that little has been left for succeeding writers to add to his description. (*Edin. Med. and Surg. Journ.* vol. iv. 1808.)

He states that the patient generally assigns some blow, or other injury, as the cause of the complaint; in other instances, it originates in consequence of inflammation from syphilis or gonorrhoea, and sometimes appears spontaneously. A painful but circumscribed swelling of the gland, particularly characterised by its hardness, is the first appearance of the disease. After a certain length of time, the scrotum becomes gradually thinner and ulcerates. The opening which is thus formed, after discharging matter, gives issue to a firm and generally insensible fungous growth. The surrounding integuments and cellular substance are thickened and indurated, so that there appears to be altogether a considerable mass of disease. The pain abates, and the swelling subsides considerably, when the scrotum has given way. In this state the disorder is very indolent; but if the fungus be destroyed by any means, the integuments unite, and a cicatrix ensues, which is inseparably connected with the testicle. If the part be examined while the fungus still remains, the excrescence is found to have its origin in the glandular substance of the testicle itself, and the coats of the part are destroyed to a certain extent, so that a protrusion of the tubuli seminiferi takes place through the aperture thus formed; the secreting structure of the organ may be largely destroyed if the hernia have existed for a length of time.

Sir W. Lawrence thinks that the glandular part of the testicle experiences an attack of inflammation in the first instance, in consequence of the violence inflicted on it; and that the confinement of the swollen substance, by the dense and unyielding tunica albuginea, sufficiently explains the peculiar hardness of the tumour, and the pain which is always present at this stage of the disorder. The absorption of the coats of the testis, and of the scrotum, relieves the tension of the parts, and thereby restores ease to the patient, at the same time that the fungus makes its appearance externally.

In my *First Lines of the Practice of Surgery* (p. 399) I have described the disease as "a par-



ticular affection of the testicle, in which a fungus grows from the glandular substance of this body, and, in some instances, from the surface of the tunica albuginea ;" and I further represented how unnecessary and improper it was to extirpate the testicle on account of this affection, and recommended the fungus to be cut off, or else destroyed with caustic. This advice was founded on a successful attempt of the kind which was made in St. Bartholomew's Hospital, by Sir James Earle, a little while before my book was published.

[When the protrusion is small, pressure by means of pads and strapping may be tried, but usually it will be found necessary to destroy the granular surface by means of nitrate of silver or the red oxide of mercury, applying pressure at the same time: the wound will then generally heal up, leaving the cicatrix permanently adherent to the testicle. Where the hernia is not very large, the skin around it healthy, and the rest of the gland not much diseased, an attempt may be made to save the organ in the manner recommended by Mr. Syme, of Edinburgh (*London and Edinburgh Monthly Journal*, Jan. 1845). The margins of the wound should be pared, and the testicle detached from the integument and returned into the scrotal cavity, so that the edges of the skin, having been made to meet over it, can then be united by wire sutures: if this be not possible from the size of the protrusion, or if the tension of the skin over it be too great, the substance of the testicle must be cut away sufficiently to permit of its being readily covered by the integument, and strips of plaister placed over the wound. In many cases this operation is followed by the most satisfactory result, and the gland is not only preserved, but is said to regain its function. When the skin and testicle are too much diseased to give hope of success by this proceeding, as in many scrofulous cases, nothing remains but to excise the gland, when usually a rapid recovery takes place.]

*Cystic Disease of the Testicle*, or, as it is sometimes termed, *Cystic Sarcoma*, is a comparatively rare affection, and was first carefully investigated by Sir Astley Cooper, who named it the *hydatid* or *encysted disease* of the testicle. The cysts are, however, totally distinct from true hydatids, and must not be confounded with those parasites. It is altogether a local disorder, being met with chiefly in healthy persons between the ages of eighteen and thirty-five, and when the diseased organ is removed no relapse occurs.

Sir Astley Cooper considered that this affection takes origin in the tubuli seminiferi, which becoming obstructed in some part of their course are gradually distended with fluid. Mr. Curling is of opinion that the morbid dilatation commences in the ducts which form the rete testis rather than in the seminal tubes, and that it is therefore "analogous to the sero-cystic tumours of the breast." (*Op. cit.* p. 361.)

By other observers the disease is regarded as a new formation in the body of the gland, which has its own capsule, and is quite distinct from the testicular structure; and that this growth, as it increases in size, develops cysts throughout its substance.

M. Robin is of opinion that the cysts commence in the epididymis, but this view is opposed to the observations of other pathologists.

On examining a testicle affected with this disease, it will be found to consist chiefly of cysts which vary much in size, shape, and number. Sometimes these cavities will be very numerous, ranging from the size of a hempseed to that of a large marble, or there may be only two or three of them. They contain fluid which may be serous and transparent, or viscid and thick; occasionally it is stained with blood, and lymph may be effused into or amongst them. Small polypoid growths will sometimes be met with springing from the interior of the cysts and filling them more or less completely. According to Mr. Curling, these cavities will, in some cases, be lined by tessellated epithelium, but it is not found in all.

The cysts are connected by a fibrous tissue, which is often of considerable density, and it is not uncommon to find masses of enchondroma, or even particles of bone, deposited in this structure. In old-standing cases the cartilage will sometimes be in sufficient quantity to obliterate many of the cysts, and will then form the chief bulk of the tumour. The natural tissue of the gland will sometimes be spread out as a layer over the morbid growth, or collected in bundles between the cysts themselves, or displaced and altered by the pressure of the tumour, or, when this is very large, it may have altogether disappeared. The epididymis is rarely involved, but becomes atrophied as the disease advances, and the cavity of the tunica vaginalis may be partially or entirely obliterated by adhesion of its surfaces.

The cause of the disease is not known, but in some cases it has followed an injury. At first the growth of the tumour is very slow, but it increases afterwards more rapidly, and one spot generally becomes more elastic than another. One testicle only is affected, and it is rare to find a hydrocele associated with this affection.]

There is no pain until the part is large, and the unyielding tunica albuginea makes pressure on it. When handled, there is no tenderness, unless the pressure be considerable. The frequently healthy look of the patient is apt to create suspicion of hydrocele. The spermatic veins and those of the scrotum are distended. The natural form of the testis is preserved, being rounded in front, and flattened at the sides, and not so pyriform as in hydrocele. When the swelling is handled, it communicates an impression that it contains fluid, for it easily yields to pressure, yet there is no true fluctuation. If strongly compressed, a sickening pain in the groin and loins is produced. The weight of the testicle is obviously increased, and after a time this causes pain in the lumbar region, and its bulk is a great inconvenience.

The marks of distinction between cystic disease and hydrocele are that the former is characterised rather by a yielding than a fluctuation; by a heavier swelling; by the swelling being less pyriform than a hydrocele; by the entire absence of transparency; by the sickening pain caused by strong compression of the tumour; and by the dilated state of the veins of the spermatic cord and scrotum.

The removal of the part by operation is the only means of relief; for the change of structure attending the disease manifestly amounts to a disorganisation of the part not admitting of benefit from any internal or external remedies.

[When there is difficulty in the diagnosis, an

exploratory puncture should be made with a grooved needle, or fine trocar and canula, when the fluid obtained will at once indicate the nature of the swelling.

Occasionally a collection of fluid will be found beneath that part of the tunica vaginalis which is reflected over the epididymis, or, more rarely, between the serous and fibrous coats of the testicle. To this condition, which may simulate to some extent cystic disease of the organ, the term of *encysted hydrocele of the testis* has been given. M. Gosselin has entered very fully into the development and history of these cases. (*Arch. Gén. de Méd.* t. xvi. 1848.) Sir Benjamin Brodie and Mr. Curling have also recorded examples of this uncommon affection. The treatment is by puncture and injection, as in ordinary hydrocele.

*Hydatid Cysts of the Testicle* are exceedingly rare. Sir A. Cooper, Larrey, and Dupuytren have each met with cases which they believed to be of this nature. Velpeau, however, considers that none of them are sufficiently authenticated to be accepted without reserve. (*Dict. de Méd.* vol. xxix. p. 490, article *Testicule*.)

*Dermoid Cysts.* Several instances are on record in which cysts containing foetal remains, such as hair, teeth, bone, sebaceous matter, have been found in the testicle and in the scrotum. Most of them were noticed soon after birth, and were, no doubt, congenital. (*Ollivier, Arch. Gén. de Méd.* t. xv. p. 540.) Velpeau excised the testicle of a man, aged 27, for a swelling which had existed from birth and was made up of foetal remains: the testis itself was healthy, but somewhat atrophied. (*Gaz. Méd. de Paris*, Février, 1840.) In these cases excision of the tumour or of the whole gland must be practised.]

[*Fibrous Disease of the Testicle* is very rare, and consists in the formation of fibrous tissue in the substance of the testis, which ultimately replaces the secreting structure, and converts the organ into a mass analogous to a fibrous tumour of the uterus.

The disease is painless and progresses very slowly; the gland becomes extremely hard and heavy; although enlarged, its shape is not injured, and the epididymis is small and wasted. On section, the tumour is dense, firm, and resisting, but sometimes its texture is arranged more loosely, and is infiltrated with thin serous fluid. Under the microscope it is seen to be made up exclusively of parallel bundles of fibres interlacing each other in all directions.

Cruveilhier has figured an example of this in his *Anatomie Pathologique* (livraison v. plate i.) which occurred in the practice of M. Marjolin. Mr. Travers has related a case in the *Med. Chir. Trans.* (vol. xvii.), and there is an excellent specimen in the museum of St. Mary's Hospital which was removed by Mr. Lane.]

[*Cancerous Disease of the Testicle.* This disease has received a number of appellations as—*Malignant Sarcocoele*; *Medullary Sarcoma*; *Medullary Cancer of the Testicle*; *Fungus Hematodes*; *Fungoid disease of the Testicle*; *Pulpy Testicle*, &c.

*Carcinoma of the Testis.* Although malignant disease of the testis is not nearly so common as was formerly supposed when most other enlargements of the organ were confounded with it, yet its occurrence is by no means rare.

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All the several forms of cancer have been occasionally met with, yet the *soft* or *encephaloid* variety is by far the most frequent. It commences with an enlargement of the testicle, accompanied by very slight, or perhaps not any, pain. The swelling is at first smooth, firm, and elastic, not tender on manipulation. Its shape is somewhat pyriform or rounded, the epididymis remaining free from disease. Its growth is generally rapid, but sometimes it increases slowly. The deposit may take place in separate masses, or it may be diffused more uniformly throughout the gland, infiltrating the secreting structure, which ultimately disappears under the pressure of the morbid growth. As these cancerous masses increase they form irregular projections on the surface of the testicle, and are so soft as to yield under the pressure of the finger and produce an ill-defined sense of fluctuation. A puncture into one of them gives exit to blood, or to the semi-fluid brain-like matter so characteristic of soft cancer; under the microscope this presents cells of every form, shape, and size, which are abundantly supplied with nuclei. Sometimes a glairy fluid, very similar to that found in cystic disease, and more or less stained with blood, will escape. As the disease advances, the veins of the scrotum and cord become turgid and large; sharp pains occasionally are felt in the gland which shoot up into the groin, and there is much discomfort from the weight of the tumour. Severe aching is often experienced in the lumbar region from cancerous deposit in, or sympathetic enlargement of, the glands in that part; sometimes these will compress the vena cava or iliac veins sufficiently to cause oedema of the lower extremities, and they may give rise to considerable pain along the spinal column.

The skin of the scrotum becomes distended, often red and oedematous, the spermatic cord thickened, and a little fluid generally collects in the tunica vaginalis, but in less quantity than in the inflammatory affections. The inguinal glands are nearly always enlarged, in some instances at an early period of the disease, but not, as a rule, until the subcutaneous tissue of the scrotum is involved. In extreme cases the tumour, by its size, will cause destruction of the skin and protrude through the scrotum, but it is rare to meet with this condition. The fungoid excrescence itself is not painful to the touch, although it may be productive of great suffering. A foetid sanious fluid escapes from the ulcerated surface, and attacks of hæmorrhage take place, under which the patient eventually succumbs, or dies worn out by exhaustion and suffering.

This disease may be met with at any period of life, but is most frequent in young subjects; some instances are recorded where it has occurred in infants. It is very rare for both testicles to be attacked, but its concurrence with cancerous disease of some other part is not uncommon.

There are but few examples of the epididymis being primarily affected, but it is not unfrequently involved by extension of the disease from the body of the gland.

The rapidity of growth is very uncertain. Generally the organ attains a considerable size within a few months, or even weeks, after the swelling is first noticed, but in some exceptional cases several years have elapsed before the disease has caused inconvenience. The swelling is liable to great variation in size; it does not increase steadily and



equally, but suddenly becomes very painful and enlarges rapidly for a few days; it then subsides and remains stationary for a time, but does not altogether return to the same size it possessed previous to one of these attacks.

The health of the patient suffers very seriously as the affection progresses; and the cachectic appearance and wasting so indicative of organic disease are especially well marked.

Several cases of encephaloid disease occurring in a retained testicle have been recorded. (*Med. Chir. Trans.* vol. xxx. p. 9, xlii. p. 15. *Pott's Chir. Works*, by Earle, 1808, vol. ii. p. 241.) Virchow and others have even stated that a testicle which has been arrested in its descent is more liable to malignant disease than one which has reached its usual situation in the scrotum.

On examining a testicle which has been removed for this affection, the normal tissue is found to be more or less deficient, and replaced by a semi-solid mass of whitish cancerous deposit, from which a creamy fluid exudes when pressed; interspersed with this are patches of an oily yellowish material, resulting from fatty degeneration of the cancer tissue. Blood is sometimes effused into this pulpy substance, constituting the appearance described as *fungus hæmatodes*. When the growth has been less rapid the tumour is of firmer consistence, owing to the development of fibrous tissue, and then cysts of varying size and containing blood, or blood-stained serum, are frequently formed. In some cases large masses of cartilage will be found in the midst of these fibrous and cancerous elements. This combination of enchondroma with cancer is not unfrequent, and the cavities formed during the growth of the tumour simulate very much true cystic disease of the testicle, and led to the old opinion that there was a cystic disease of a malignant character as well as the reverse. The history of the case, the condition of the cord and lymphatic glands, the pain, the rapid progress of the disease, and the health of the patient, but, above all, the microscopic examination of the matter obtained from the tumour by puncture, must be considered in the diagnosis between these two affections.]

The only prospect of cure (and this is a very poor one) must be derived from the early performance of castration, before the disease has extended to the lumbar or inguinal glands, or far up the spermatic cord. Indeed, very little hope can be placed in the removal of the testicle, for the disease is constitutional rather than local. Nearly every case on record has terminated fatally; and, upon dissection, either the liver, the lungs, the brain, the lumbar or mesenteric glands, or some other internal part, have been found affected with the same disease. In one case dissected by Sir W. Lawrence, cancerous tubercles were found in the lungs, heart, and, in short, in nearly all the thoracic and abdominal viscera, though the contents of the skull were free from disease. (See *Cases recorded by Wardrop, Earle, Lawrence, and Langstaff*, in *Med. Chir. Trans.* vol. iii. and viii.)

Mr. Travers states that he has never known an instance where the disease has not recurred after castration. (See *Med. Chir. Trans.* vol. xvii. p. 335.) This is the experience of most surgeons.

Sir Astley Cooper observes, that of all the operations of surgery, there is scarcely any which is so generally unsuccessful as that of cas-

tration for this disease; and there is no hope of the patient's life being saved, unless the operation be performed as soon as the nature of the complaint is ascertained. (*Op. cit.* p. 131.) In his valuable work on the *Structure and Diseases of the Testis*, there is an interesting plate (viii.) representing the appearances presented in an instance where excision had been performed, but a relapse occurred. There the end of the spermatic cord is seen forming a considerable tumour; a large swelling may be noticed in the groin; and a very considerable mass between the left kidney, ureter, and sigmoid flexure of the colon.

Notwithstanding the deceitful feel of fluctuation, dependent on the elasticity of the swelling, a well-informed surgeon will generally arrive at a correct diagnosis; but if there be doubt, puncture of the tumour with a very small trocar may be practised. "If it be a hydrocele, the serum escapes, and the tumour disappears; but if it be fungus hæmatodes, there comes out a little blood, and that is all. No harm is done by the puncture." The bleeding soon stops, and the wound heals. (*Sir B. Brodie*, in *Lond. Med. Gaz.* vol. xiii. p. 407.)

[A few instances are recorded in which cancerous disease has primarily shown itself in the tunica vaginalis, the testicle remaining unaffected for a length of time. Mr. Curling has directed attention to this variety, and described it under the name of *Carcinoma of the Tunica Vaginalis*. (*Op. cit.* p. 355.) Sir Everard Home relates a case which occurred in his practice. (*Observations on Cancer*, p. 125.)]

Sir Benjamin Brodie also refers to a specimen, which was seen and described by Sir A. Cooper (*op. cit.* p. 207), where the glandular structure continued sound, while there was a large medullary tumour completely occupying the cavity of the tunica vaginalis. "However distinct the testicle may have been in the first instance, it becomes at last confounded with the disease; and there is then a tumour of an oval shape, and in this respect different from hydrocele. It is also heavier than a hydrocele, opaque instead of being transparent, harder at some parts than others, and without the smooth regular surface of hydrocele. The softness and elasticity of the tumour, however, have often caused it to be mistaken for hydrocele, and punctured." (See *Wardrop on Fungus Hæmatodes*; *Earle*, in *Med. Chir. Trans.* vol. iii. p. 60.)

[*Scirrhus of the Testicle*. Under this heading it was formerly the practice to comprise the several diseases of the testis which are accompanied by induration. (*Pott's Chir. Works*, vol. ii. edit. 1808.) Dr. Baillie mentions its frequency, and describes the condition of parts met with in the so-called *scirrhus testicle*. (*Morbid Anatomy*, p. 352, ed. 2.)

Mr. Travers, however, declares himself "incredulous as to the fact of the scirrhus cancer affecting the testis" (*Med. Chir. Trans.* vol. xvii. p. 327); and Sir A. Cooper remarks, "I much doubt the existence of this disease in the same form and appearance as it assumes in the breast." (*Op. cit.* p. 150.) Although this variety of cancer is exceedingly rare in the testicle, yet undoubted specimens have been met with. The disease is distinguished by its slow growth, irregular shape, and the excessive hardness of the organ, accompanied by occasional severe pain darting up towards the loins. The spermatic cord becomes enlarged and hardened, and the glands when involved ac-

quire an extreme degree of density. The tumour seldom attains a great size, nor does it become soft or ulcerate. The cancerous cachexia is commonly well marked, and the patient slowly succumbs, generally without other organs being affected, or much local suffering.

Excision is the only treatment applicable, but it should be practised before the cord or lymphatic glands are implicated.

On examination scirrhus of the testis differs in no respect from the same disease in other parts, except that the "stony hardness," so characteristic of this affection in the mamma, is not so marked. Small portions of bone have sometimes been found studding it in very old cases.

*Melanosis, and Colloid Disease, of the Testicle* have been met with, but they require no special description. (Vide article CANCER.) Cruveilhier in his *Anatomie Pathologique*, liv. xix., has figured melanotic deposits in the testes, from a man who died of this disease in other organs. Early removal of the diseased organ presents the only chance of recovery.

*Epithelioma* has been known to involve the testicle by extension of the disease from the scrotum, but never to commence in the gland as a primary affection. (Vide Article, CANCER.)]

[*Nervous Affections of the Testicle* are met with under two forms—a true *Neuralgia* of the spermatic nerves, possessing all the characters of tic douloureux in other parts; and a more common affection known as *Irritable Testis*, which consists in an abnormal sensibility of the testes, increased to severe pain by the slightest touch. M. Sarrau proposes to call this latter affection *Chronic Neuralgia* (*Thèse sur la Névralgie du Testicule*, 1841); but it differs from true neuralgia in the frequent existence of this morbid condition on both sides of the body, in the absence of sudden remissions and paroxysms of pain, and in the comparative freedom from suffering so long as the patient is at rest, although it returns with the slightest movement or contact.

These nervous affections of the testicle are met with in weakly irritable persons, and are usually associated with deranged health or a disordered state of the digestive organs. They commonly arise from some affection of the genito-urinary system, and most frequently from abuse of the sexual organs. Thus they will occur from great venereal excitement or excess, repeated masturbation, frequent nocturnal emissions, and from enforced and protracted continence; they may follow an attack of orchitis or epididymitis, especially when the seminal flow is obstructed or retarded by closure of any part of the duct; they are present somewhat often in persons affected with varicocele; a stone in the urethra, kidney, or ureter may occasion them. Sometimes, like neuralgic diseases in general, they appear to depend upon that depressed state of health which results from malaria, and the paroxysms have then been known to occur at regular intervals.]

*Neuralgia of the Testicle* is an exceedingly painful affection of the part, generally unaccompanied by any swelling or other obvious change in it. The suffering is frequently of the most excruciating kind, and of long duration, though subject to occasional remissions, like neuralgic pains in other parts of the body.

[It may occur at any age, but is most frequent after puberty. The pain commences suddenly in

one testicle, and shoots up into the abdomen or thigh, resembling by its intensity an attack of colic; the scrotum is corrugated, and the testis drawn forcibly against the external abdominal ring by spasm of the cremaster muscle. The patient is bent double with pain, is constantly shifting his position, or rolls in agony on the floor, nausea and even vomiting are frequently induced. Between the paroxysms the gland may often be handled without exciting pain, unless the affection has been of long duration, when the testicle becomes swollen and perhaps a little inflamed. It occurs in weak, nervous, dyspeptic persons, and is nearly always accompanied by derangement of the digestive organs.]

The patient frequently complains of pain in the testicle when there is no disease in it. There is a state of the nerves of the part which makes him feel pain in it, although there is no inflammation nor any other actual disease; and this is all that we mean when we talk of a neuralgic affection in this or any other part of the body. You will find an example of it in persons in whom a large calculus passes from the kidney to the bladder. As soon as the calculus has passed a little way down the ureter, the patient complains of pain in the testicle, which is at the same time frequently drawn up, by the spasmodic action of the cremaster muscle, into the groin. When you examine it, you find it of its natural size and natural shape, at first not even tender, although excessively painful; in short, there is a painful affection of the testicle, depending not on any disease of the organ itself, but on the influence which the calculus, in passing down the ureter, exercises on the spermatic plexus of nerves. Disease in the kidney will sometimes produce pain in the testicle, although there is no reason to believe that a calculus, or other substance, has escaped from the kidney into the ureter." (*Sir Benjamin Brodie, Lond. Med. Gaz.*, vol. xiii. p. 620.)

In the dissection of a testicle that has been the seat of neuralgia, no change of structure can be found. In one instance, which I attended, there was occasionally a little enlargement of the organ, though for the most part it remained free from all swelling, or other manifest alteration. If the complaint be connected with functional disturbance of the liver or stomach, the chance of relief must depend upon the possibility of curing this primary affection. In many cases, which appear to be entirely nervous, or not associated with any other perceptible fault in the system, large doses of the sulphate of quinine, or of the carbonate of iron, may be prescribed; or, if the disease assume an intermittent type and come on periodically, the liquor arsenicalis. In some cases, the muriate of morphia, opium, or hyoscyamus, joined with small doses of calomel, will answer best.

As local applications, leeches are of little value unless the testicle be swollen, but a plaster consisting of one third of extract of belladonna and two thirds of soap cerate, or the veratria ointment, deserves to be particularly specified.

[The tincture of aconite applied as a lotion will deaden the sensibility for a time. Blisters to the scrotum followed by some anodyne ointment have been found of service; or the hypodermic injection of morphia may be tried. Warm baths and hot fomentations will often give temporary relief. On no account should the gland be excised, as the



affection sooner or later disappears under treatment and rest, although the patient will sometimes beg that castration be practised as a means of getting rid of his suffering. In some cases sea-bathing or travelling have been found of great service, and instances are recorded where marriage has effected a cure.

*Irritable Testis* is a more common affection than neuralgia, and is not unfrequently met with, to a slight extent, about the period of puberty, when the testes, like the mammary glands, often become abnormally sensitive. It sometimes comes on after inflammation of the testicle or of the epididymis, but its most frequent cause is excessive sexual indulgence in weakly irritable persons, and particularly so if from thickening about the duct, or from any other cause, the passage of the semen be hindered. The testis in this affection becomes extremely sensitive, so that manipulation is impossible, and even the contact of the dress cannot be borne: the pain extends sometimes along the course of the cord, and is much increased by the erect posture, by exercise, or by want of support to the scrotum, which is generally much relaxed. Occasionally both organs will be affected: one usually being more sensitive than the other. Commonly no alteration in the gland can be detected, although one spot may be more painful than the rest: if this morbid condition have existed for some time a slight fulness of the organ may perhaps be felt, and the spermatic veins may be enlarged. So long as the patient remains at rest in the recumbent posture with the testicles supported, he is free from pain, but it recurs with movement. The complaint is often very tedious and long resists treatment, the patient becoming very depressed and anxious as to the result, so that he demands removal of the organ. In those cases where castration has been performed nothing abnormal was found in the gland except a little congestion of its vessels: and the pain has been known to return in the cord. Operation therefore should never be practised. The treatment should be directed to remove, if possible, the cause of the affection, and to improve the general health. Leeches will afford relief more frequently than in neuralgia of the testis, especially if the organ be swollen. Lotions or ointments containing belladonna, opium, or aconite, will be found useful: and the local application of cold has sometimes proved of great service. Change of scene, amusement, and occupation, so as to divert the mind of the patient from his malady, are also necessary.]

[*Atrophy of the Testicle* may occur from a great number of causes. The organ gradually diminishes in size but retains its flat oval shape: it loses its firmness and becomes soft and flabby, the scrotum also is relaxed; the peculiar sensation normally experienced on pressure ceases to be felt, and there is a gradual loss of sexual power, often even of desire, which is persistent: sometimes the wasting is extreme, and a small nodule attached to the cord will alone represent the body of the gland.

On examining an atrophied testicle, its substance is pale and anæmic: the secreting structure has more or less completely disappeared, and the shrunken organ is made up chiefly of the septa between the lobules, with perhaps a little fibrous structure. The epididymis is seldom involved even when the rest of the organ is quite wasted.

This condition comes on slowly with age, and occurs also in lingering exhausting diseases, such as phthisis, but it is rarely so complete as when it results from injury or disease of the organ.

A violent blow on the testicle will cause it to waste and destroy its function: an injury to the head and brain will produce the same effect. Larrey, Hennen, and others relate many instances of this: it has been observed also to follow an injury to the spine, although more rarely. (*Curling, op. cit.*, p. 105.)]

Atrophy of the testicle was remarked by Baron Larrey to occur with remarkable frequency after the deep sabre-cuts of the back of the neck, received by the French soldiers in Egypt, in their contests with the Turks.

[Disease of the brain, apoplexy, paralysis, have all been followed by a loss of power and withering of the gland. Compression of the organ, or of the cord, by a tumour, a hydrocele, or a truss, has also been attended by the same result. A remarkable case is related by M. Jobert de Lamballe, which occurred in the practice of M. Roux, where contraction of the cicatrix after sloughing of the scrotum, from a gun-shot wound, caused atrophy of the testicles.]

The pressure of a large hernial swelling has often been known to occasion atrophy of the testicle; and the strong compression of the spermatic cord by a truss would appear to be capable of producing the same consequence.

Varicocele occasionally leads to wasting of the testis; and sometimes the obliteration of the principal spermatic veins with a ligature, or forceps, adopted for the cure of a varicocele, has been followed by this change in the testicle.

[Occlusion of the spermatic artery produces a similar effect upon the gland, and this circumstance has induced M. Manoir, of Geneva, to adopt a method of treatment for chronic enlargement of the testicle, and even for cancer of the organ, by tying the spermatic artery through an incision made parallel with the cord. Wardrop relates a case where there was wasting of both testes, and after death both spermatic arteries were found to be obliterated by an abdominal aneurism.]

Acute inflammation of the testicle from gonorrhœa; chronic enlargement of it from other causes; and especially scrofulous disease of the organ, may, in the end, lead to atrophy of it: in the first case, possibly in consequence of the vas deferens becoming sometimes permanently obstructed; but in the other two examples, no doubt, from disorganisation of the testicle itself. Obliteration of the vas deferens has been observed to be attended with a dwindling away of the testicle; a circumstance which would be expected from the recollection of the functions of the organ being necessarily destroyed by such obliteration.

[It is very seldom that the epididymis is closed sufficiently to prevent the flow of semen, but when this occurs the testicle becomes useless, and loss of function and atrophy follow.

Inflammation is by far the most frequent cause of wasting of the testicle, and when this occurs the normal shape of the gland is generally altered; its outline becomes irregular and uneven, but its bulk and consistence are not so much reduced as when shrinking occurs from other causes. In these cases the glandular tissue will have disappeared or a mere trace of it only be left, whilst

a fibrous material, of some density, occupies the body of the organ. If atrophy result from scrofulous disease, the gland will be converted into a mass of cheesy deposit, or dry calcareous matter.

Wasting of the testicles has been stated to follow the inflammation arising from the mumps (*Hamilton, Trans. Roy. Soc. Edin.*, vol. ii.); but it is very doubtful if such be the case. Long-continued abstinence has been known to occasion the loss of desire, and ultimately of the testicular function, so that partial atrophy has ensued: mental impressions will sometimes produce the same result and in the same manner.

Masturbation and excessive venery may be followed by wasting of the organ, and if both testicles become affected, impotency is the result: according to Mr. Curling the repeated local congestion thus caused induces an attack of inflammation and atrophy ensues. (*Op. cit.* p. 106.) Larrey refers to cases where constant indulgence in alcoholic stimulants has produced a like effect. Narcotics have been similarly charged, as also the continued use of iodide of potassium, but this is not yet satisfactorily proved, and certainly the cases in which it occurs must be very rare. Atrophy of the testicles has been observed in the disease known as Elephantiasis Græcorum; Lawrence (*Med. Chir. Trans.* vol. vi.) and Curling (*Med. Gaz.* vol. vii.) have each met with an example of this, and other instances have been recorded.

When the testicles have been arrested in their descent, and have not reached the scrotum, they are often soft and very small. This, however, is due to their non-development, and not to a wasting of the gland; the same may be said of those cases of deficient growth of the testes, which is not uncommon in idiots and others whose brains are imperfectly developed.

The treatment of these cases is most unsatisfactory, and must be guided in each instance by the cause of the affection. Restoration of the organs to their normal size is hardly to be expected.]

The induration and swelling of the testicles resulting from effusion of urine into the scrotum, and often accompanying fistulæ in perinæo, will subside after the disease of the urethra has been cured. (See *J. Cloquet, Pathologie Chir.*, p. 44.) Every surgeon of experience must have witnessed this fact.

The late Mr. Ramsden thought, that some sarcocæles might be relieved by removing with bougies a supposed morbid irritability of the urethra, with which his theories led him to connect the origin of the complaint. (See *Pract. Obs. on Sclerocæle*, &c.) No doubt many chronic enlargements of the testicle have subsided during this treatment, especially when aided by calomel and other means; but a doubt may be entertained, whether the bougie had any essential share in producing the benefit obtained. The practice, at all events, is not much adopted, though on the first suggestion of it many trials were made.

G. G. Gascoyen.

See *Pott's Chirurgical Works*, vol. ii. ed. 1808. *Abernethy, On Tumours. James Wardrop, On Fungus Hematodes. Baillie's Morbid Anatomy*, p. 352, ed. 2. *Delpech, Précis. Élém. des Maladies Chir.*, t. iii. p. 564. *Richerand, Nosogr. Chir.*, t. iv. p. 300, &c. ed. 4. *Baron Dupuytren, Leçons Orales de Clinique Chir.*, t. i. art. iv. and vi. 8vo. Paris, 1832. *Sir Astley Cooper, On the Structure and Diseases of the Testis*, 4to. Lond. 1830. *Cusack, in Dublin Journal of Med. Science*, No. 23. *Benj. Travers, in Med. Chir. Trans.* vol. xvii. *Sir Benjamin Brodie, in Lond.*

*Med. Gaz.*, vol. xiii. 8vo. London, 1834. *J. Cloquet, Pathol. Chir.* p. 99, &c. *Crucveilhier, Anatomie Pathol. du Corps humain*, fol. Paris, 1829-35. *Mayo's Outlines of Pathology*, chap. iii. 8vo. Lond.

[*Dr. Robert Hamilton, Trans. Roy. Soc. Edin.* vol. ii. 1790. *Sir Everard Home, Observations on Cancer*, 1805. *Lawrence, Edin. Med. and Surg. Journal*, vol. iv. 1808. *Med. Chir. Trans.*, vol. vi. *Baron Larrey, Clinique Chirurgicale*, 1829. *Hennen, Principles of Military Surgery*, 1829. *Rouchoux, Arch. Gén. de Méd.* 1833. *Ricord, Traité de Maladies Vénériennes*, 1838. *Sarrau, Thèse sur la Névralgie du Testicule*, 1841. *Curling, A Practical Treatise on Diseases of the Testis*, 1843. *Velpéau, Dict. de Médecine*, vol. xxix. 1844. *Syme, Lond. and Edin. Journ.* 1845. *Arnott, Med. Chir. Trans.* 1847. *Gosselin, Arch. Gén. de Méd.* t. xvi. 1848. *Ollivier, Arch. Gén. de Méd.* t. xv. 1848. *Jobert (de Lamballe), Plaies d'Armes à Feu. Communications à l'Académie de Médecine*, 1849. *Jarjavay, Arch. Gén. de Méd.*, t. xx. 1849. *Vidal (de Cassis), Treatise on Venereal Diseases. Translation by Blackman, Amer. edit.* 1854. *Nélaton, Pathologie Chirurgicale*, vol. v. 1858. *Dr. George Johnson, Med. Chir. Trans.* vol. xlii. 1859. *Gross, System of Surgery*, vol. ii. 3rd. edit. 1864. *Cullerier, Des Affections Blennorrhagiques*, 1864.]

TETANUS. (From *τείνω*, to stretch. Tetanus is defined by all authors to be a more or less violent and extensive contraction of the muscles of voluntary motion, attended with tension and rigidity of the parts affected, [which is long continued and uncontrollable.]

The excessive contraction of the muscles is generally kept up, without any intervals of complete relaxation; in which respect the disorder differs from ordinary spasms and convulsions, where the contractions and relaxations alternate in rapid succession. In tetanus, the powers of sensation and intellect also remain unimpaired, in which particular it forms a contrast to epilepsy. (*Rees's Cyclopædia*, art. *Tetanus*.)

When its effects are confined to the muscles of the jaw or throat, it is called *trismus* or *locked-jaw*; when a greater number of muscles are involved, but the trunk retains its ordinary straightness, the case is named *tetanus*. When the body is bent forwards, the disease is termed *emprosthotonos*; and *opisthotonos*, when the muscles of the back are principally affected. To these four forms, some writers add a fifth, which is denominated *pleurosthotonos*, and characterised by the body being drawn to one side. It is the *tetanus lateralis* of Sauvages. The different terms applied to tetanic affections do not then imply so many particular diseases, but only the seat and various degrees of one and the same complaint. Trismus is invariably a part of each of the other varieties.

A still more important division of tetanus is into *acute* and *chronic*, according to its greater or lesser intensity. The first is exceedingly dangerous, and usually fatal; while the latter, on account of the more gradual progress of the symptoms, affords more opportunity of being successfully treated. (*Larrey, in Mém. de Chirurgie Militaire*, t. i. p. 235, 236.)

Tetanus is also divided into *traumatic*, or that arising from wounds, being the case with which surgeons have principally to deal, and occasionally termed *symptomatic*; and into *idiopathic*, or that proceeding from other causes.

Traumatic tetanus sometimes comes on in a surprisingly sudden manner, and quickly attains its most violent degree. The most rapidly fatal case that has ever been recorded is one that we have on the authority of the late Professor Robison of



Edinburgh. It occurred in a negro, who scratched his thumb with a broken china plate, and died of tetanus a quarter of an hour after this slight injury. (See *Rees's Cyclopædia*, art. *Tetanus*.) But, commonly, the approaches of the disorder are more gradual, and it slowly advances to its worst stage. In this sort of case, the commencement of the disorder is announced by a sensation of stiffness about the neck; a symptom which, increasing by degrees, renders the motion of the head difficult and painful. [The patient's first complaint will often be "that he has taken a cold, or is suffering from a sore throat, or stiff neck."] In proportion as the rigidity of the neck becomes greater, the patient experiences in the throat a sort of dryness and soreness, and about the root of the tongue an uneasiness, soon changing into a difficulty of mastication and swallowing, which after a time become totally impossible. The attempt at deglutition is attended with convulsive efforts, especially when an endeavour is made to swallow liquids; and so great is the distress which accompanies these convulsions, that the patient becomes very reluctant to renew the trials, and occasionally refuses all nourishment. Sometimes it even inspires him with a dread of the sight of water, and a great resemblance to hydrophobia is produced.

One of the next remarkable symptoms is a severe pain at the bottom of the sternum [pit of the stomach], darting from this point backward to the spine, in the direction of the diaphragm. As soon as this pain commences, the spasms of all the muscles about the neck become exceedingly violent, and the head is drawn backwards, or forwards, according as the contraction of the extensor or flexor muscles happens to be strongest; but in the majority of cases the head and trunk are pulled backwards, and the contractions increasing in force, the body is frequently raised in the form of a bow, resting upon the head and feet alone; a state which is more particularly denominated *opisthotonos*. At the same time the muscles which close the lower jaw, and which were affected with spasm and rigidity in the very beginning of the disorder, now contract with great power, so as to maintain the lower jaw-bone inseparably applied to the upper. The last state, which has been considered as a particular affection under the name of *trismus*, or *locked-jaw*, Boyer conceives, may be regarded as the pathognomonic symptom of tetanus, which in many instances is limited to such an affection of the jaw. (*Mal. Chir.* t. i. p. 288.)

Although the contraction of the muscles rarely ceases so completely as to form an intermission there are occasional remissions; and, in two cases under Dr. Parry, there were marked intervals. (*Dr. Symonds*, in *Cyclop. of Practical Med.*, art. *Tetanus*.)

[Four cases are related in the *Guy's Hospital Reports*, series iii. vol. iii. p. 75. In two there was relief of the symptoms for thirteen days, but exhaustion ensued, and death resulted. In a third, the symptoms were relieved for many days, and in the fourth, the remission was for two days only, but both these cases were fatal.]

The continuance of the disease leads to increasing spasm of the diaphragm, which now returns every ten or fifteen minutes, and is instantly succeeded by a stronger retraction of the head and rigidity of the muscles of the back, and even of those of the lower extremities. A violent stabbing

pain is felt in the situation of the diaphragm; and, if the disorder increases, comes on at shorter and shorter intervals. The abdominal muscles are also strongly contracted, so that the belly feels as hard and tense as a board. By the violence of the contractions, indeed, the recti muscles have been known to be lacerated, as I shall relate an example of hereafter. Sometimes the spasm and tension extend only to the muscles on one particular side of the body: the *tetanus lateralis* of Sauvages, and the *pleurosthotonos* of other nosologists.

When the disease reaches its most violent stage, the flexor muscles of the head and trunk contract so powerfully that they counterbalance the force of the extensors, and hold those parts in a straight, fixed, immoveable position. This is the condition to which the appellation of *tetanus* more particularly belongs. The muscles of the lower extremities become rigid; and even the arms, which till now were little affected, also partake of the general spasm and stiffness, with the exception of the fingers, which often retain their moveableness to the last. The tongue likewise continues a long while endued with the power of voluntary motion; but, at length, the violent spasms do not leave it unaffected, and it is then liable to be forcibly propelled between the teeth, where it is occasionally dreadfully lacerated. [This is, however, rare.] Sometimes the teeth are broken by the violence of the spasm. The sphincters are variously affected; thus the urine is sometimes discharged with great and sudden impetus during the violent spasm of the abdominal muscles; at other times it is retained. The anus is in general obstinately closed, though cases have occurred in which the contents of the rectum have escaped involuntarily. (*Symonds*.)

In the extreme period of the disorder all the muscles destined for voluntary motion are affected; among others those of the face: the forehead is drawn up into furrows; the eyes, sometimes distorted, are generally fixed and motionless in their sockets; the nose is drawn up; and the cheeks are retracted towards the ears; so that the features undergo a most extraordinary change; [the tetanic grin, or risus sardonicus.] When tetanus arrives at this stage, and the spasms are universal, a violent convulsion usually puts an end to the patient's misery.

Wherever the muscular contractions are situated in cases of tetanus, they are always accompanied with the most excruciating pain. They sometimes last, without any manifest remission, to the end of the disorder; but, in almost all cases, their violence, and the sufferings excited by them, undergo periodical diminutions every minute or two. The relaxation, however, is never such as to let the muscles which experience it yield to the action of their antagonists; and it is in nearly all cases followed in ten or twelve minutes by a renewal of the previous contractions and suffering. The recurrence of these aggravated spasms [increased reflex excitability], frequently happens without any evident cause; but it is often determined by efforts which the patient makes to change his posture, swallow, speak, &c.

When the spasms are general and violent, the pulse is contracted, hurried, and irregular; and the respiration is similarly affected; but during the remission, the pulse and respiration may return to

their natural state. There is generally, however, a progressive alteration of the pulse. "At the beginning, it is pretty hard and full, but towards the close it becomes more frequent and feeble, and often is irregular and intermittent. The heat of the skin also appears to depend on the violence of the spasms; it has been found by Dr. Fribo, of Geneva, as high as 110° Fahrenheit. The perspiration is generally profuse over the whole body; but sometimes is confined to the face and chest. It continues during the whole course of the disease, and has a peculiar pungent odour. The urine presents nothing remarkable as to quantity or quality; some describe it as always high-coloured (*Rochoux, Dict. de Med., t. xx.; Fournier Pessay, Dict. des Sc. Med., t. lx.*), while others have observed it to be as often quite unchanged. (Cullen noticed its occasional suppression, or its evacuation with difficulty.) Torpor of the intestines, in a degree that resists the most powerful purgatives, is allowed by all who have witnessed the disease to be a more invariable accompaniment than any other. Such dejections as are obtained are excessively offensive and unnatural." (*Symonds, in Cyclop. of Pract. Med., art. Tetanus.*)

In this disease the head is seldom affected with delirium, or even confusion of thought, till the last stage of it. [There is absence of numbness and tingling; there is loss of sleep, which is exceedingly distressing; sometimes there is an occasional doze during the intervals of the paroxysms, and a sudden startling waking up.]

Vomiting sometimes appear early in the disease; but commonly they are not continued: and it is usual enough for the appetite to remain through the whole course of the disease; and what food happens to be taken down seems to be regularly enough digested. In several instances, a military eruption has appeared upon the skin; but whether this be a symptom of the disease, or the effect of a certain treatment of it, is undetermined. (*Cullen, in First Lines of Physic, vol. iii.*)

[In one case, case 13 (*Guy's Hos. Rep., op. cit. p. 5*), the symptoms continued severe until the ninth day, and on the eleventh military eruption appeared over the whole body, accompanied with successions of spasms and intervals of repose. On the sixteenth day exhaustion and rambling supervened, but on the twenty-second day subsidence of symptoms and protracted recovery. He was treated by large and repeated doses of musk.]

According to Baron Larrey, opisthotonos is not so often observed in Egypt as emprosthotonos; and the experience of this gentleman taught him that the former was the most rapidly fatal. We must not adopt, however, his curious opinion, that the violent extension of the vertebræ of the neck, and the manner in which the head is thrown back, cause strong compression of the spinal marrow, and a permanent contraction of the larynx and pharynx (*Mém. de Chirurgie Militaire, t. i. p. 246*), since this sort of compression, if it did not at once destroy the patient, would at any rate paralyse most of the muscles, and instantly stop their extraordinary contraction.

This experienced writer notices how much the nerves of the neck and throat seem generally to be affected on the invasion of this disease. The consequent contraction of the muscles of these

parts, he says, is soon attended with difficulty of deglutition and respiration. [There is great apprehension of suffocation, and towards the termination much dyspnœa, with fits of comparative apnœa; and often comparative voicelessness owing to spasmodic interference with the action of the chest, and of the tight shutting of the jaws.] The patients then experience, if not a dread of liquids, at least a great aversion to them, which often prevents the administration of internal remedies; and if the wound is out of reach of the interference of art, the patient is doomed to undergo the train of sufferings attendant on this cruel and terrible disorder. Nothing can surmount the obstacles which present themselves in the œsophagus. The introduction of an elastic gum catheter into this canal, through the nostrils, is followed by convulsions and suffocation. "I have tried this means (says Larrey) on the person of M. Navailh, a surgeon of the second class, who died of a locked-jaw, brought on by a wound of the face, accompanied with a comminuted fracture of the bones of the nose, and part of the left orbit.

"In the examination of the bodies of persons dead of tetanus, I have found the pharynx and œsophagus much contracted, and their internal membrane red, inflamed, and covered with a viscid reddish mucus.

"Hydrophobia, hysteria, and several other nervous diseases, likewise produce their chief effects upon these organs, and the result appears to be the same. So, I have just remarked, when tetanus is arrived at its worst degree, the patients have a great aversion to liquids, and, if they are forced to swallow them, immediate convulsions are excited. The circumstance was particularly observed in M. Navailh."—(*Mém. de Chirurgie Militaire, t. i. p. 247, 248.*)

Sometimes tetanic affections deviate from their ordinary course and nature. The most singular of these anomalies is recorded by Sir Gilbert Blane: it is a case in which tetanus prevailed to a very considerable extent, without any degree of pain. The spasms were accompanied with a tingling sensation, which was even rather agreeable than distressing. The case, however, terminated fatally; but, to the last, no pain was experienced. In two examples, mentioned by the same author, the spasms affected only the side of the body in which the wound was situated. [The spasms may attack primarily the muscles of the part injured, instead of the muscles of the jaw (*Morgan, on Tetanus*).]

The dissection of patients who have died of tetanus has thrown no light upon the nature of this fatal disorder. Sometimes slight effusions are found within the cranium; but, in general, no morbid appearance whatever can be detected in the head. There is always more or less of an inflammatory appearance in the œsophagus and in the villous coat of the stomach about the cardia. But those who are conversant with dissections must be well aware that these appearances are common to a great number of diseases, and are uniformly met with in every case of rapid or violent death. Besides the redness and increased vascularity of these parts, Baron Larrey, as I have already stated, found the pharynx and œsophagus much contracted, and covered with a viscid reddish mucus. He also found numerous lumbrici in the bowels of the several patients who



died. (See *Mém. de Chir. Militaire*, t. iii. p. 287.) This, however, could only be an accidental complication, and not a cause. In several cases, Dr. M<sup>r</sup>Arthur found the intestines much inflamed; and in two of them a yellow waxy fluid, of a peculiar offensive smell, covered their internal surface; but, whether the inflammation was primary, or only a consequence of the pressure of the abdominal muscles, which contract so violently in this disease, he is unable to decide. (See *Med. Chir. Trans.*, vol. vii. p. 475, and *Rees's Cyclo-pædia*, art. *Tetanus*.)

[Mr. Lockhart Clarke detected definite structural changes in the spinal cord. Here and there promiscuously, in the white substance as well as in the grey, but more especially in the latter, were irregular streaks and masses of altered tissue, varying from a state of slight softening to one of complete fluidity, the fluid being formed of fine granules and of the débris of the blood-vessels and nerve-tissues once occupying the parts. This condition is not essential to this disease, as it is found in cases of ordinary paralysis. (*Pathology of Tetanus* (*Med. Chir. Trans.* vol. 48).)]

Dr. Lionel Chalmers, of Charleston, South Carolina, states, that when the disease forms very quickly and invades the unfortunate persons with the whole train of its mischievous symptoms, in a few hours, the danger is proportioned to the rapidity of the attack, and that the patients thus seized generally die in 24, 36, or 48 hours, and very rarely survive the third day. But when the disease is less acute, few are lost after the ninth or eleventh. (See *Med. Obs. and Inq.*, vol. i. p. 92, 93.) [See *Statistics of Tetanus*, *Guy's Hosp. Rep.*, series iii. vol. iii. p. 69.] It is the common belief that death takes place from asphyxia.

From the valuable report of Sir James McGrigor, it appears that several hundred cases of tetanus occurred in our army during the campaigns in Spain and Portugal. The disease was observed to come on at uncertain periods after the receipt of the local injury; but it terminated on the second, third, and fourth days, and even as late as the seventeenth and twentieth days; though it was usually not protracted beyond the eighth. (*Med. Chir. Trans.*, vol. vii. p. 353.) I had a patient, however, who lingered in the military hospital at Oudenbosch five weeks, with chronic tetanus, before he died. This happened in the year 1814, soon after the assault on Bergen-op-Zoom, where the patient had been wounded, and suffered amputation of the thigh. [The duration of the disease is generally very short; of 327 cases 183 were fatal within 5 days, 133 within 22 days, and 11 above 22 days. See *Statistics*, *Guy's Hosp. Rep.*, *op. cit.* p. 76.]

Although tetanus is a disease which has been observed in almost all parts of the world, experience proves that its frequency is much the greatest in warm climates, and especially in the hot seasons of those climates. [See statistics on sex, age, constitution, climate, season of the year, atmospheric condition, as influencing the disease, *Guy's Hosp. Rep.*, *op. cit.* p. 25 *et seq.*] It is also more common in marshy situations, and countries bordering upon the sea, than in places which are very dry, elevated, and at a distance from the seacoast. Every class of individuals is exposed to its attacks; but infants a few days after their

birth, and middle-aged persons, are said to be oftener affected than older subjects, or others in the youthful period of life. The male sex more frequently suffer than the female; and the robust and vigorous more frequently than the weak.

According to Dr. Cullen and other medical writers, the causes of tetanus are cold and moisture, applied to the body while it is very warm, and especially the sudden vicissitudes of heat and cold. Or the disease is produced by punctures, lacerations, or other injuries. Cullen admits, however, that there are probably some other causes, which are not distinctly known.

Baron Larrey observes that gunshot wounds in the course of the nerves, and injuries of the joints, often produced tetanus in the climate of Egypt, particularly when the weather or temperature passed from one extreme to the other, in damp situations, and in those which were adjacent to the Nile or the sea. What he terms dry and irritable temperaments were the most subject to the disorder, the event of which was found to be almost always fatal. (*Larrey, Op. et loc. cit.*)

Traumatic tetanus is remarked to proceed oftener from wounds of the extremities, and especially the fingers and toes, than from similar injuries of the trunk, head, and neck. Sometimes it originates at the moment of the accident; as in the instance mentioned by the late Professor Robison of Edinburgh; but, in general, it does not come on till several days afterwards, sometimes not till the wound is nearly or perfectly healed, and free from all pain and uneasiness. It would seem that a wound would sometimes not have the effect of exciting the disorder, if the patient carefully avoided sudden exposure to cold. In 1833 I attended a gentleman who had met with a lacerated wound of the scalp by being thrown from his horse. From this accident he was recovering in the most favourable manner; but, on going out into the cold air, at the end of a fortnight, when the wound was nearly healed, he was attacked with trismus, which soon assumed the form of universal tetanus, and he died in six or seven days after the commencement of the disorder. Dr. Murray relates a case in which a midshipman trod on a rusty nail one evening at nine o'clock, and after exposing himself to the cold night air in keeping watch, had tetanic symptoms the following morning at eight. (See *Lond. Med. Gaz.* for 1832-33, p. 623.) Tetanus occurs in all conditions of wounds; in some of a healthy, and others of an ill-conditioned appearance; sometimes, as I have just given an instance of, when they are almost, or even entirely healed. In one case, mentioned by Dr. Hennen, cicatrization was completed on the same day that life terminated. It occurs too whether the wound be large or small. Dr. Elliotson had a case, as severe as any he ever saw, where there had been merely a contusion of the thumb. An example is given in the *Trans. of the Lond. Med. Society*, in which the disease followed a burn, at a time when there was merely a dry scab on the leg; nay, as Dr. Elliotson observes, the disease has sometimes declined and ceased, while the wound every day grew worse and worse. Larrey, however, lays considerable stress on the condition of the wound, which is generally either dry, or covered with a thin serous exudation. Dr. Rush also speaks of an

absence of inflammation in wounds that cause tetanus. (*Med. Reg.* vol. i.)

Dr. Reid knew of a case in which tetanus followed the mere stroke of a whip-lash under the eye, though the skin was not broken. Andral refers to an instance in which the formation of a seton on the chest occasioned a fatal attack of tetanus. (*Clinique Méd.* t. iv. p. 445.) Mr. Morgan also speaks of one case in which the stroke of a cane across the back of the neck, and of another, in which a blow on the head with the same instrument, produced the disease: in both, the result was fatal. (*Lect. on Tetanus*, 1833.) The extraction of a tooth has produced the disorder.

Wounds, then, of every description may give rise to tetanus, and in warm climates, very trivial injuries produce it. Thus, in Egypt, Larrey had one case which proceeded from the lodgment of a small piece of fish-bone in one of the sinuses of the fauces. (*Mém. de Chir. Militaire*, t. i. p. 254.) In colder regions, traumatic tetanus seldom happens, except from contused, punctured, or lacerated wounds; or wounds of the ginglymoid joints, with lacerations of the tendons and ligaments; compound fractures, or dislocations; deep pricks in the sole of the foot; and especially lacerations or ulcerations of the fingers and toes. A partial division of a nerve has been suspected as a frequent cause; but as some nerves must be imperfectly cut through in almost every wound, and yet tetanus does not arise, this cause is not invariably effectual. Baron Larrey, however, has recorded a fact which favours this doctrine, as I shall presently notice; and a case in which the branch of the median nerve, going to the thumb, was found partly torn through, and its extremity inflamed and thickened, has been related by Mr. Liston. (*Ed. Med. and Surg. Journ.*, No. lxxix. p. 292.) The inclusion of the nerves in ligatures, applied to arteries, is another alleged cause of tetanus; but as this fault is very common, and tetanus rather rare in this country, while it may follow all sorts of wounds, whether from accidents or operations, we must believe that some particular state of the system is required to render this cause efficient. However, there are some cases and observations on this point adduced by Larrey, which will be quoted in the sequel of this article. (See t. iii. of his *Mém. de Chir. Mil.*) At the same time, I do not mean to hint that the nerves are not sometimes tied in tetanic cases, or that the practice is not on every account blameable. Amputation and castration are the only great surgical operations to which I have seen tetanus succeed; though it may follow the employment of the knife on less severe occasions. In St. Bartholomew's Hospital it once followed the operation of removing the breast.

There cannot be a doubt, that difference of climate makes considerable difference in the degree and danger of tetanus. Larrey found that in Egypt the disease was more intense, and bore a greater resemblance to hydrophobia, than in the colder climate of Germany. In both these countries, he remarked that when the wounds causing tetanus injured nerves situate on the forepart of the body, emprosthotonos was occasioned; that if the posterior nerves were hurt, opisthotonos followed; and that when the wound extended quite through a limb, so as to injure equally both descriptions of nerves, complete tetanus ensued. He noticed, also, that the disease commonly arose

from wounds, when the seasons and temperature passed from one extreme to another. Exposure to the cold damp nocturnal air, he found particularly conducive to it. (*See Mém. de Chir. Milit.*, t. iii. p. 286.)

[Although it is not admitted that atmospheric changes have any influence as a real point of causation, yet there are certain facts to be borne in mind which must not be overlooked. Larrey remarked that tetanus was apt to prevail after sudden change from heat to cold, especially the cold moist air of spring nights. After the battle of Moscow, in the midst of great heats, very few of the French troops were affected with tetanus, whereas those who were wounded in the battle of Dresden, where the weather was cold and wet, just after a very hot season, were decimated by that complaint, which did not spare even those who underwent immediate amputation.]

Hennen (*Military Surgery*) remarks "that it is a fact not a little curious that patients under similar circumstances in every respect, of age, diet, nature and period of infliction of wounds, as well as accommodation for their cure, shall become liable to it in one hospital or district of a town and be free from it in another. In almost all the instances that I have seen, the patients have been exposed to a stream of air directly blowing upon them. This has been sometimes cold, and at other times of a high temperature."

Sir G. Blane remarks, "that tetanus affected some ships remarkably more than others, particularly the 'Barfleur' and 'Bedford,' though the wounds had nothing peculiar, nor were in greater proportion than the rest of the fleet. Four died of tetanus in each of the above ships. This disease took a run in some particular ships after the battle of the Chesapeake. I have known it prevail in some particular hospitals more than others."

On board the 'Dreadnought' hospital ship tetanus has been observed to prevail at certain states of the weather, and that it has attacked certain sides of the ward.

Of the 72 cases admitted into Guy's Hospital (*Op. cit.* p. 64), 41 were admitted with tetanus, and of these 14 cases could be distinctly traced and associated with exposure to sudden change of temperature, either as the original cause, and called idiopathic, of which there were four cases; or as the forerunner or direct antecedent of tetanus combined with a previous lesion, and called traumatic. Thirty-one cases had tetanus supervene after admission into the Hospital for injury, and in three of these cases there was direct evidence of exposure to draught and cold previous to the attack.

It is generally agreed that idiopathic tetanus is mainly due to exposure to damp and cold, and sudden vicissitudes of temperature, and that its onset simulates rheumatism very much. All these facts tend to show that the wound of the nerves is not the only cause of the disease. Rheumatism is a blood poison. Is idiopathic tetanus so too? or is it extreme irritation of the cutaneous nerves? Take it for granted that traumatic tetanus is in all cases due to local irritation of a peculiar nerve; why cannot we check the disease at its very onset by local means? Why are we obliged to have recourse to powerful internal remedies for its cure? How is it that quinine has such a beneficial effect, especially in the idiopathic variety? All these



points are worthy of notice and consideration. Is tetanus a blood poison like hydrophobia, and the poisoning by strychnia, to which it is closely allied in its symptoms, and its probable seat, in the medulla oblongata and upper part of the spinal cord?]

In the campaigns in Spain and Portugal, according to the report of Sir James McGrigor, tetanus occurred in every description and in every stage of wounds, from the slightest to the most formidable: it followed the healthy and the sloughing; the incised and the lacerated; the most simple and the most complicated. It occurred at uncertain periods; but it was remarked that if it did not commence in 22 days from the date of the wound the patient was safe. (See *Med. Chir. Trans.*, vol. vi. p. 453.) In Egypt, as we learn from Larrey, the latest period of the commencement of tetanus after a wound was from the fifth to the fifteenth day. (*Mém. de Chir. Militaire*, t. i. p. 263.) [See also statistics on the state and condition of the wound at the time of the occurrence of tetanus in the several recorded cases. (*Guy's Hosp. Rep.*, *op. cit.*, p. 71.)]

It is observed by Dr. Dickson, that as the acute form of tetanus is so uniformly fatal, it is of the greatest consequence to attend to whatever may assist in detecting the disease early, or in warding it off. Richerand states that in wounds threatening convulsions and tetanus, a persevering extension of the limbs during sleep often manifests itself before any affection of the lower jaw; and we should naturally pay more attention to any admonition of this kind in punctured or extensive lacerated wounds, particularly of tendinous or ligamentous parts, and especially in injuries of the feet, hands, knee-joint, back, &c. Some prelusive indications of danger may often be derived from the increase of pain, irritation, restlessness, nervous twitches, pain and difficulty in deglutition, or in turning the head; spasms, or partial rigidity of some of the voluntary muscles; pain at the scrobiculus cordis; a suppressed or vitiated state of the discharge, &c., which mark the slower approaches of the disease. Larrey adduces several instances of tetanus, in which the wound was either dry, or afforded only a scanty serous exudation, and where the symptoms were relieved on suppuration being re-established; and Dr. Reid (*Edinb. Med. and Surgical Journal* for July, 1815,) remarks, that on removing the dressing, the wound was covered with a darkish unhealthy-looking matter, and that he had seen this change the forerunner of tetanus in two other instances. A torpor of the intestines has generally been observed to precede as well as accompany the disease, and Boyer, in particular, enumerates an obstinate constipation amongst the predisposing causes. (*Mal. Chir.*, t. i. p. 287.) Mr. Abernethy informs us that in four cases where he inquired into the state of the bowels, the evacuations were not like feces; and he proposes as a question, in investigating the cause, what is the state of the bowels between the infliction of the injury and the appearance of this dreadful malady? (*Surgical Works*, vol. i. p. 104.) Dr. Parry thinks the velocity of the circulation an useful criterion of the danger of the disease, and observes, that if the pulse be not above 100 or 110 by the fourth or fifth day, the patient almost always recovers; but that, if it be quickened early, the disease mostly proves fatal, and yet there are

a few instances of recovery, where the pulse rose to 120 on the first day. Baron Larrey remarks, that when the perspiration, which so often attends the disease, is symptomatic, it begins upon the head and extremities; but that when it is critical it occurs over the chest and the abdomen. (*Mém. de Chir. Militaire*, t. i. p. 256.) It must be confessed, however, that in many cases perspiration flows very freely without bringing relief. (*Rees's Cyclopædia*, art. *Tetanus*.)

[Puerperal tetanus, and tetanus following lesions of the uterus and abortion, have been for some time noticed by obstetricians; the disease, for the most part, is of an acute character, and is generally fatal.—(*Simpson, Edin. Month. Journ.*, February, 1854.) See also cases in *British Med. Journ.* for June and September, 1865; four cases in *Dublin Quar. Jour.*, 1865, and a case in the *Medical Times and Gazette*, 1866.

*Trismus nascentium*.—Tetanus attacking newborn children offers the same symptoms as in the adult. For details see works on diseases of children.]

[*Diagnosis*.—As regards diagnosis, the practical surgeon has no difficulty in discovering the presence of the disease—the powerful and painful spasms of the voluntary muscles; the constancy and non-intermitting character of these spasms; the extreme rigidity and fixed closure of the jaws; the peculiar cast of countenance known as the “tetanic grin;” the great pain at the scrobiculus cordis from spasm of the diaphragm; the arched and bowed condition of the body; the supervention of the disease after a wound, as in the traumatic form; and its occurrence after exposure to cold and moisture, as in the idiopathic variety; the affection of the laryngeal and pharyngeal muscles in the advanced stage;—all these symptoms taken together, at once stamp the disease as one of tetanus. However, taking any of the symptoms singly and individually, some error may be arrived at in the diagnosis: thus it has been mistaken for hydrophobia from the severity and intensity of the spasm of the muscles of the larynx and pharynx, which is the almost pathognomonic sign of hydrophobia, but in this latter disease there is no continued spasm of the voluntary muscles; there is no tetanic grin, but a wild maniacal kind of expression of countenance, never to be forgotten when once seen; there is no locked jaw; the disease has followed the bite of a rabid animal; there is extreme and intolerant sensibility of the surface and organs of sense, and the characteristic thirst and aversion to fluids, so that the sight or noise of fluids induces the paroxysms. Again, tetanus has been mistaken for rheumatism, and, in fact, two cases, prior to admission to Guy's Hospital, were treated for that disease; but it was only in the very early stage, before the symptoms peculiar to tetanus were fully developed.

Epilepsy cannot be mistaken for tetanus, although in an epileptic case (*G. H. R.*, *op. cit.* p. 74) tetanus supervened a few days previous to the expected attack, and was complicated with screaming and convulsions, resembling those of periodicepileptic seizures. Poisoning by strychnia is the only disease which might probably lead us into error respecting the diagnosis, and in the trial of Palmer for the murder of Cook it was endeavoured to be proved that the symptoms in his case were more those of tetanus than those of strychnia; it is true they are alike in

some of the conditions: thus in both there are tetanic convulsions of the voluntary muscles, there is an arching back of the head and neck, violent stretching of the legs, and spasms brought on by the slightest touch; there is spasm of the respiratory muscles, and consciousness retained to the last. But in strychnia poison there is no locked jaw; although the jaws may be closed, the muscles relax and allow of the opening of the mouth; the spasms intermit in a most marked manner; there is a distinct interval of subsidence and recurrence of the fearful spasms; there is early marked spasm of the laryngeal muscles, and terror of suffocation, as in Cook's case, when he cried out, "Raise me up, I shall be suffocated." (*Taylor on Poisoning by Strychnia, Guy's Hos. Rep.*, series iii. vol. ii. p. 293.)

A most interesting and well-marked case occurred in Guy's Hospital in June, 1868. A boy, aged 12, was brought from a chemist's shop, where he was employed, in a state of the most frightful spasm; there were well-marked convulsions, the body was most rigidly bowed by powerful contraction of the spinal muscles; spasm of the laryngeal muscles, so much so that the face was livid, and impending suffocation expected every moment. The boy was perfectly sensible, and there was no locked jaw; the muscles of the jaw were not in the least affected by the spasms. These truly frightful convulsions were not continuous, but suddenly ceased and as quickly returned, the boy anticipating them during the relaxation, and on the return of the convulsions saying, "It's coming on, I am dying; good bye, &c." Ice was applied along the spine, which had the effect of diminishing the spasms; the boy vomited freely, and the whole symptoms gradually subsided and left him quite well at the end of a week. This case was at first thought by some to be tetanus; the boy's agony was so great that no clear account could be obtained, so that one had to rely upon the symptoms as they presented themselves. It was remarked that this boy's case exactly corresponded with the symptoms in Cook's case, but of a more marked degree, and death was expected every moment after each attack of spasmodic convulsions, and withal the jaw could be freely opened and shut, and swallowing was not difficult. It was regarded as a pure case of poisoning by strychnia, although at the time there was no evidence that he had taken any. The remarkable action of the ice to the spine in the vomiting which took place, together with the gradual subsidence of the symptoms and speedy recovery, render the case perfect. It appears that the boy picked up a piece of black stuff from the floor, the size of the tip of the finger, and chewed it, but finding it bitter he spat it out; soon after his legs became stiff, and he remembered nothing more. He was found rigid on the floor, and it is stated that he was not brought to the hospital until an hour after the occurrence. The substance proved to be some extract of *nux vomica*, and that there was about 8 grs. in the piece he took, some of which he spat out.

The diagnosis of poisoning by strychnia from tetanus and hysteria, is elaborately and ably treated by Dr. S. Taylor (*Guy's Hos. Rep.*, series iii. vol. ii. p. 296 *et seq.*.)

*Treatment.*—I next proceed to consider the treatment of tetanus, a subject of infinite difficulty,

because the disease frequently baffles every mode of practice, and, in certain instances, gets well under the employment of the very same remedies which decidedly fail in other similar cases of the disorder. Every plan has occasionally succeeded, and every plan has still more frequently miscarried. The great difficulty, therefore, is to ascertain, amongst numerous discordant accounts, what practice is found on the whole to be attended with the least ill success. For, in the present state of our knowledge, the most credulous practitioner will not flatter himself with the supposition, that any effectual remedy for tetanus has yet been discovered. As, however, acute tetanus was regarded by Hippocrates and the ancients as certainly mortal, and it does not always prove so in modern times, it seems allowable to conclude, that the recoveries which now happen must be ascribed to improvements in practice. This reflection should lead us not to give up the subject as hopeless; but to redouble our exertions for the discovery of a more successful method of treatment, and, if possible, of some new medicine, possessing more specific power over the disorder.

As is justly observed by a well-informed writer, when we reflect upon the obscurity which involves both the *ratio symptomatum* and the proximate cause of tetanic affections, we need not wonder that the practice in these disorders should still be entirely empirical. The indication of cure, which is generally applicable to all diseases, namely, the removal of the exciting causes, is scarcely admissible in a disorder which is the consequence of causes which, in general, have ceased to act, or which it is not in our power either to remove or control. In some cases, where local irritation might be suspected to be still operating, the most effectual method of counteracting its effects on the system would obviously be to intercept all communication between the seat of the irritation and the sensorium. If, however, the disease has already established itself, and severe symptoms have come on, it does not appear that this would commonly succeed in arresting the course of the disorder. Experience too fully proves, that amputation of the limb, from the injury of which the tetanus has arisen, will seldom procure even a mitigation of the symptoms, if performed after a certain period from their first appearance. (*Rees's Cyclopædia*, art. *Tetanus*.) Baron Larrey is the greatest modern advocate for amputation where tetanus depends upon a wound of the extremities; but the facts which he adduces in its favour are not numerous, and he limits his recommendation of the measure chiefly to chronic cases, and extends it to no others, except on the very first accession of the symptoms.

"The equally unexpected and entire success (observes Larrey) obtained by the amputation of the injured limb, in the person of an officer attacked with chronic tetanus, leads me to propose the question, whether, in this disorder, occasioned by a wound of some part of the extremities, it would not be better to amputate the injured limb immediately the symptoms of tetanus commence, rather than expect from the resources of nature, and from very uncertain remedies, a cure which so seldom happens?"

"If tetanus is chronic, as is sometimes observed, amputation may be done at every period of the disorder, provided a choice be made of the time when there is an intermission of the symptoms.



The operation would not answer so well in acute tetanus, if the disease were advanced, and the muscles to be divided were strongly contracted and rigid, as I observed at the siege of Acre, in a soldier, who was seized with tetanus, in consequence of a gunshot wound of the left elbow." (*Mém. de Chir. Militaire*, t. i. p. 262.)

Larrey did, indeed, try amputation in a few instances of acute tetanus. In the case last cited, the symptoms were already considerably advanced when the experiment of amputating the arm was made; yet, says he, the operation was followed by considerable ease. The symptoms recurred, however, a few hours afterwards, and proved fatal on the third day. In another example, this gentleman repeated the experiment, though acute tetanus had begun. The operation is described as having stopped all the symptoms, as it were by enchantment; the patient even passed twelve hours in perfect ease; but, being exposed to the damp cold air, the disorder returned, and carried him off. (See *Mém. de Chir. Militaire*, t. i. p. 263—269.) In a case of acute tetanus, where Mr. Liston amputated the wounded hand, the opisthotonos subsided the following day; yet the case ended fatally, and it is a question whether the degree of temporary benefit which was obtained, did not proceed from other remedies, tried in conjunction with the operation. (See *Ed. Med. and Surg. Journ.*, No. lxxix. p. 293.)

Larrey records some cases in favour of amputation at the commencement of tetanus from wounds, and especially for the relief of the disease in the chronic form. He has likewise adduced an interesting example, in which speedy relief and a cure followed, cutting off all communication between the nerves of the wounded part and the sensorium by a suitable incision.

In this place it may be right to remind the reader that although Baron Larrey once or twice amputated when acute tetanus had somewhat advanced, he does not advise the practice; and he expressly restricts his sanction of amputation to chronic or quite incipient cases of tetanus, and to a few instances in which the ginglymoid joints are fractured, accidents which, independently of tetanus, would generally require the operation. (See *Mém. de Chir. Mil.*, t. iii.) The report of Sir James McGrigor fully confirms the statement of Larrey; namely, that free incisions are of little avail in the acute and fully formed disease, and that amputation fails in the same kind of case. After the battle of Toulouse, this operation was extensively tried, but without success. The French are also said to have lost an immense number of soldiers from tetanus after the battle of Dresden, when Sir James infers, that the practice of amputation must have been fairly tried. (See *Med. Chir. Trans.*, vol. vi. p. 456.) We have seen, however, that according to the precepts of Larrey, the French surgeons would only have performed the operation in chronic cases, which are not the most frequent, or if in other instances, only on the very first accession of the symptoms. But, upon the whole, notwithstanding the partial degree of success attending Larrey's experiments, I have no hesitation in declaring my belief, that amputation of the injured part in chronic tetanus will never be extensively adopted. The uncertain efficacy of this severe measure, and the frequent possibility of curing this form of the complaint by milder

plans, will for ever constitute insuperable arguments against the practice.

Sir Astley Cooper's statements tend to confirm the opinion which I have always given upon the subject. In one case of tetanus, from a compound fracture just above the ankle, the operation seemed to precipitate the fatal event. In another case, the finger was amputated without any good; and a third case is referred to, in which the operation also failed in saving the patient's life. In chronic tetanus, amputation is regarded by Sir A. Cooper as unjustifiable, as the patient often recovers without this proceeding. The medicine which has appeared to this gentleman most useful in such cases is calomel, joined with opium. (*Surgical Essays*, part ii. p. 190.)

Mr. Abernethy also disapproves of amputating any material part of the body, with the view of relieving tetanus, unless the injury require the operation on other grounds: he acknowledges, however, that he has seen tetanus mitigated by the practice, though the patients ultimately fell victims to the disease.

On the subject of making incisions for the purpose of separating the nerves of the wounded part from the sensorium, Larrey states, that they should be practised before inflammation has come on; for if this has made progress, they would be useless and even dangerous. They should comprehend, as much as possible, all the nervous filaments and membranous parts; but he condemns all incisions into joints, as exasperating the symptoms of tetanus, instances of which he has witnessed. The practice of nearly surrounding the wound by a deep incision has been practised in University College Hospital, and most of the cases have been in favour of the plan. Baron Larrey has recorded some convincing proofs of the benefit sometimes arising from completely dividing the trunk of the injured nerve. In one instance, tetanic symptoms followed an injury of the supra-orbital nerve, but were immediately stopped by dividing some of the fibres of the occipito-frontalis, and the nerves and vessels, down to the bone.

The case of the midshipman who trod upon a rusty nail, which penetrated the left foot, between the metatarsal bones of the great toe and the adjoining one, is strongly in favour of this practice. As I have already mentioned, the patient kept watch on deck after the accident, and was exposed to the cold damp nocturnal air. At eight o'clock on the following morning locked jaw had commenced. Under the administration of opium, the disease gained ground. Dr. Murray, therefore, cut down to and divided the posterior tibial nerve, about an inch behind the malleolus internus. Although the patient had not been able to speak before the operation, he immediately opened his mouth with an exclamation, and expressed himself already much relieved. The original wound was then dilated, and covered with a poultice containing laudanum. The case terminated in the patient's recovery. (See *London Med. Gaz.*, 1832-33, p. 623.) Another case, in which the division of the neighbouring nerve was beneficial, may be found in the *Dubl. Journal of Medical Science*, vol. v. p. 311, extracted from the *Calcutta Med. and Physical Trans.*

On the principle of destroying the parts which are the seat of the local irritation, Larrey also frequently applied the actual and potential cautery

to the wound. The application of caustics, says he, may be practised with advantage on the first attack of the symptoms, the same precept being observed as in making the incisions. Bleeding, if necessary, and the use of topical emollients and anodynes, may follow these operations; though in general they have little effect. (*Mém. de Chir. Militaire*, t. i. p. 249.) In the third volume of this interesting work, p. 297, &c. are several cases, in which the cautery was employed with success. We must not conclude, however, that much dependence ought to be placed upon the use of the cautery, since Larrey observes in another place: "The moxa and actual cautery, recommended by the Father of Medicine, have been equally unavailing. The moxa was employed at Jaffa upon three wounded men; yet the disease followed its usual course, and terminated fatally."

"I have cited a striking instance of the inefficacy of the second method, in a case of opisthotonos." (T. i. p. 258.) This author adduces some cases which tend to support the opinion that tetanus occasionally proceeds from the inclusion of a large nerve in the ligature applied to an artery. The son of General Darmagnac died of tetanus consequent to amputation, and, upon examining the stump, the median nerve was found included in the ligature with the artery, and its extremity reddish and swollen. (*Mém. de Chir. Mil.* t. iii. p. 287.) In another case, Larrey suspected the tetanic disorder to proceed from a principal branch of the crural nerve being tied together with the femoral artery, and he cut the ligature; but the relief was only partial and temporary. The cautery was therefore applied deeply to the whole surface of the stump. A marked amendment took place a few hours afterwards, and the patient recovered. A diaphoretic mixture, with camphor and opium, was also exhibited. (T. iii. p. 297.)

Amongst other local means for the relief of tetanus, I may notice the employment of blisters as near as possible to the wound, or their application, or that of the ointment of cantharides, to the wound itself. Almost all modern writers have observed, that tetanus is accompanied at its commencement and in its progress with an interruption or total cessation of suppuration in the wound. Hence the indication to excite this process again, by the means which I have specified. Larrey seems to have adopted both plans; but he particularly applied the ointment of cantharides to the wound itself in an early stage of the symptoms, and in cases where there not only was a suppression of the discharge, but where he suspected the nerves of the wounded part had suffered from exposure to the cold damp air on the detachment of the sloughs. For facts in favour of these local means, the reader must refer to the first and second volumes of the *Mémoires de Chirurgie Militaire*.

It appears also from Larrey's experience in Egypt, that poultices, made of the leaves of tobacco, and applied to the wounds of persons labouring under tetanus, were followed by no advantageous effect. The alkalies also proved of no service. (T. i. p. 257.)

Dr. Rush recommended the wound to be dilated and dressed with oil of turpentine (see *Trans. of the American Philos. Society*, vol. ii.) ; and, for this purpose, some of our naval surgeons have used tincture of opium.

A great degree of obscurity prevails respecting the most eligible *general* or *constitutional* plans of treating tetanus, and I am afraid it must be confessed that our internal remedies cannot be more depended upon than the local means already described. This opinion is fully confirmed by advertising to the discouraging fact, recorded by Sir James McGrigor, viz. that out of several hundreds of cases which occurred in the British army during the late campaigns in Spain and Portugal, there were very few which terminated successfully, or in which the remedies, however varied, seemed to have any beneficial influence, after the disease had made progress. (*Med. Chir. Trans.* vol. vi. p. 449.) In the same countries, Dr. O'Beirne witnessed two hundred cases, not one of which recovered. (*Dubl. Hospital Reports*, vol. iii.) Hennen acknowledges that he never saw a case of "acute symptomatic tetanus" recover; and, with respect to the same form of disease, Dr. Dickson states, that he found all plans of treatment followed by unqualified disappointment.

The possibility of doing good by internal medicines is sometimes totally prevented by the inability of swallowing. In short, the present state of our knowledge respecting tetanus will not allow us to indulge much hope of cure from any means yet discovered, except in the chronic form of the complaint; the instances of success in the treatment of acute tetanus being by no means numerous, and not the result of any determinate plan of treatment.

Of all medicines, opium is that which has raised the greatest expectation, and been the most extensively tried. Indeed, there cannot be a doubt, that, in many chronic, mild cases, it is competent to effect a cure. But, for this purpose, it is absolutely necessary that its use be begun from the earliest appearance of the symptoms; that it be given in very large doses; and that the doses be repeated at short intervals, so that the system be kept constantly under the influence of the remedy. It is, indeed, astonishing how the system, when labouring under a tetanic disease, will resist the operation of this and other remedies, which, in its ordinary state, would have been more than sufficient to overpower and destroy it. Patients with tetanus will bear with impunity quantities of opium which at any other time would be certainly fatal. Instances are upon record of five, ten, and even twenty grains, being taken every two or three hours, for many days, without any extraordinary narcotic effects being produced upon the sensorium. It is always advisable, however, to begin with comparatively moderate doses, such as forty or sixty drops of the tincture of opium, which may be repeated at intervals of three or four hours, and increased at each repetition, until some sensible effect is produced on the spasms. It seems requisite to augment the dose rapidly, as the disease presses upon us every hour, and no time must be lost while there is yet a chance of controlling its fury. The approaching closure of the jaw, and difficulty of deglutition, which may increase so as to render it hardly possible to introduce medicines into the stomach, are additional motives for pushing our remedies before such obstacles arise. (*Rees's Cyclopædia*, art. *Tetanus*.) I once supposed it possible to overcome this impediment by introducing a flexible catheter down the œsophagus from one of the nostrils; but the



attempt to do this always brings on a violent paroxysm of spasms, attended with such a sense of suffocation that it cannot be endured. The experience of the late Mr. Cruttwell, of Bath, and that of Baron Larrey, fully prove that no assistance can be derived from the use of flexible tubes. (See *Mém. de Chir. Militaire*, t. i. p. 247.) Sometimes, however, the obstacle to the administration of medicines, arising from the closure of the jaw, is prevented by loss of some of the incisor teeth, and, in a few instances, Baron Larrey adopted the plan of extracting two of them. This would be useless, however, when deglutition is totally hindered, as happened in one instance recorded by the latter eminent surgeon. (*Op. cil.*, t. iii. p. 301.) Clysters are the only resource, when the spasm of the fauces cannot be overcome. In this way, as much as a drachm of the extract of opium has been introduced into the bowels at one dose. Opiate frictions upon the jaws, throat, and other parts of the body, have been practised. Opiate plasters have also been applied to the masseter muscles, and behind the ears. This external use of opium, however, can only be regarded as a feeble and probably useless means.

A curious fact, noticed by Abernethy, seems to offer some explanation of the little effect of some of the most powerful medicines in tetanus: on opening the stomach of a patient who had died of tetanus after taking large doses of opium, thirty drachms of this substance were found undissolved in the stomach.

I believe it to be now generally admitted, that opium answers only in the milder or idiopathic form of the disease. The testimony of Rush, McGrigor, and Fournier-Pescay, is decidedly against the efficacy of this medicine in other examples of tetanus.

As the costiveness always produced by tetanus is rendered still more obstinate by opium, laxative medicines and clysters should constantly accompany its employment. It is on this ground that opium is frequently objected to as rather injurious. The testimony of the army physicians, as we learn from the report of Sir James McGrigor, is highly in favour of a rigid perseverance in the use of purgatives, given in adequate doses to produce daily a full effect. Dr. Forbes states, that a solution of sulphate of magnesia, in infusion of senna, was found to answer better than any other purgative; and it was daily given in a sufficient quantity to procure a copious evacuation, which was always dark-coloured and highly offensive; and to this practice he chiefly attributes, in one severe case, the removal of the disease. (*Med. Chir. Trans.* vol. vi. p. 452.) Dr. Good condemns drastic purgatives, seemingly in forgetfulness that mild ones have no effect. Strong cathartics have, indeed, frequently proved of great service, and none has higher repute than croton oil. Thus, in a case recorded by Dr. Briggs, half a drachm of colomel, as much scammony, and fifteen grains of gamboge, were given in one dose, followed by a clyster of half an ounce of turpentine, and two drachms of aloes. As these powerful means produced no effect, two drops of the oil of croton were given in the evening, and a clyster of four ounces of sulphate of magnesia in a pint of infusion of senna. In less than an hour, a black stool was voided, and relief immediately experienced. (See *Edinb. Med. Journ.* No. 85, p. 277.)

A spasmodic rigidity of the muscles being the most prominent symptom of tetanus, it was natural for practitioners to try the efficacy of some other antispasmodic medicines besides opium; and those which have been principally the subject of experiment, are castoreum, æther, conium maculatum, musk, camphor, and latterly digitalis. In many cases, opium and camphor have been exhibited together. Indeed, Larrey asserts that, of all the medicines hitherto proposed by skilful practitioners, the extract of opium combined with camphor, and the nitrate of potash, dissolved in a small quantity of the almond emulsion, and given in doses more or less strong, produces the most favourable effects, since patients, who have an aversion to other fluids, take with pleasure this mixture, the action of which must be promoted by bleeding, if necessary, and blisters, under the circumstances which have been specified. (See *Mém. de Chir. Militaire*, t. i. p. 271.) In the same work several cases are detailed which were benefited by such treatment.

Although some practitioners have fancied that they saw good effects result from musk, yet the majority, who have made trial of both this and camphor, in cases of tetanus, have found no reason to recommend these medicines. One hundred and fifty grains of musk were given, in the space of twelve hours, to a girl thirteen years old, affected with incipient tetanus; but no salutary effect was produced.

We learn also from Sir James McGrigor, that æther, camphor, musk, and other antispasmodics, as likewise the alkalies, were tried by our military surgeons in Spain, and found unsuccessful. (*Medico-Chir. Trans.* vol. vi. p. 458.)

From the same authority we find that digitalis, in large doses, was tried in several cases in the Peninsula; and that it, with several other medicines enumerated, failed in almost every case of acute tetanus which occurred. (P. 454.) In one case, the jaw remained fixed to the last, and the patient was never entirely free from spasms. (P. 458.) Prussic acid and belladonna have been tried, but do not retain at present many advocates in this country. Prussic acid was tried, however, by Dr. Rees, in America, in combination with the application of caustic along the spine, and the patient recovered.

Analogy has led to the employment of the warm bath, as a plan which seemed to promise great benefit, by producing a relaxation of the contracted muscles. But, notwithstanding this means has appeared, in a few instances, to occasion some little relief, particularly when the practitioner has been content with mere fomentations, it generally fails, and often has even done mischief. This may perhaps be, in some measure, ascribable to the disturbance and motion which the patient must necessarily undergo in order to get into the bath; for it is very well known, that every exertion on the part of the patient is apt to excite most violent paroxysms of spasms. The author of the article *Tetanus*, in the *Encyclopédie Méthodique*, had seen the warm bath do harm in two or three cases, in which it was expected to have done good. Though numerous writers have recommended the trial of the plan, it would be difficult to trace, in their accounts, any facts which decidedly show that its adoption was ever followed by unequivocal benefit. The warm bath

was tried in Spain, and found to produce only momentary relief. (*Medico-Chir. Trans.* vol. vi. p. 457.) Dr. Hillary, who practised a long while in the warm climate of America, where tetanus is very common, disapproves of this method of treatment. He observes that, although the use of the warm bath may appear to be very rational, and promise to be useful, he always found it much less serviceable than emollient and antispasmodic fomentations; and he also mentions, that he had sometimes seen patients die the very moment when they came out of the bath, notwithstanding they had not been in it more than twenty minutes, the temperature of the water being likewise not higher than 29 or 30 of Reaumur's thermometer. (See *Hillary on the Air and Diseases of Barbadoes*.) De Haen also relates a similar fact of a patient dying the instant he was taken out of the warm bath.

Hippocrates was an advocate for the application of cold water. The advantages of the cold bath were first particularly explained by Dr. Cochrane, in the *Edinb. Medical Commentaries*; and the plan subsequently received the praises of Dr. Wright, Dr. Currie of Liverpool, and others. Of all the remedies which have been employed in cases of tetanus, the cold bath is represented by some authors as that which has been attended with the greatest success. Dr. Wright published, in the *Med. Obs. and Inq.* vol. vi. a paper, containing a narrative of the first trials of this method, which were all successful. The plan is said to be preferred throughout the West Indies. It consists in plunging the patient in cold water, and in that of the sea, when at hand, in preference to any other, or else in throwing from a certain height several pails of cold water over his body. After this has been done, he is to be very carefully dried with a towel, and put to bed, where he should only be lightly covered with clothes, and take twenty or thirty drops of laudanum. The symptoms usually seem to give way, in a certain degree, but the relief which the patient experiences is not of long duration, and it is necessary to repeat the same measures at the end of three or four hours. They are to be repeated in this manner until the intervals of freedom from the attacks of the disorder increase in length. This desirable event, it is said, generally soon follows, and ends in a perfect cure. Wine and bark were sometimes conjoined with the foregoing means, and seemed to co-operate in the production of the good effects. Dr. Wright concludes the account with the following remark, sent to him with a case, by Mr. Drummond, of Jamaica:—"I am of opinion, that opiates and the cold bath will answer every intention in tetanus and such like diseases; for whilst the opium diminishes the irritability, and gives a truce from the violent symptoms, the cold bath produces that wonderful tonic effect, so observable in this and some other cases. Perhaps the bark, joined with these, would render the cure more certain. May we not then have failed in many cases, by using opiates alone in large doses, or, what probably is worse, with the warm bath instead of the cold bath? And have we not reason to suspect, that the increased doses of opium, which seemed requisite when the warm bath was used, may have proved pernicious?" (*Vol. vi. p. 161.*)

Our army surgeons, however, who were in Spain, found the cold bath worse than useless.

(*Med. Chir. Trans.* vol. vi. p. 254.) Dr. Parry's testimony is almost as condemnatory of it. Mr. Morgan relates an instance that occurred in St. Thomas's Hospital, in which a tetanic patient was plunged into a cold bath at his own request; all the symptoms disappeared in a moment, and he was almost immediately taken out of the bath; but he was taken out lifeless." (*Lectures on Tetanus, &c.*) Dr. Elliotson also relates a case, in which, after a pail or two of water had been dashed upon the body, the patient fell down dead, as if shot. Here I beg to remark particularly, that the plan seems to present no hope of benefit in cases of tetanus from wounds, however strong the evidence may be of its utility in other examples of the disease. This was the opinion of Hippocrates, and, in modern times, that of Dr. Cullen, Callisen, &c. "Immersio subita iterata totius corporis in aquam frigidam in tetano a causa interna mire prodest, in tetano a causa externa minorem effectum præstat." (*Systema Chirurgiæ Hodiernæ*, pars i. pp. 169, 170, edit. 1798.) On the subject of cold effusion and bathing, there are on record two cases which are curious. One is related by Baron Larrey. It was an instance of tetanus from a gunshot wound. The cold bath was used. The two first trials gave the patient extreme pain, and no amendment followed. The sight of the bath the next time filled him with an invincible dread of the water, into which he refused to be put. He was covered, however, with a blanket, and immersed. The tetanic stiffness was immediately increased, and dreadful convulsions excited. It became necessary to remove him directly from the bath, and put him to bed. Deglutition was from this moment utterly impeded, and the contraction of the muscles carried to the most violent degree. A tumour, about as large as an egg, suddenly made its appearance near the linea alba, below the navel. After death this was found to be caused by a rupture of one of the recti muscles, and a consequent extravasation of blood. (See *Mém. de Chir. Mil.* t. iii. pp. 287—289.) This case is decidedly in support of the truth of the sentiment expressed on this subject by Hippocrates, Cullen, and Callisen. The next is not so: it is mentioned by Sir James McGrigor, that, in the march of the Guards through Galicia, one of them was attacked with tetanus, in consequence of a slight wound of the finger. As it was impossible to think of leaving the man in the wretched village where he was taken ill, he was carried on a bullock car, in the rear of the battalion. During the first part of the day he was drenched with rain, the thermometer standing at 52°; but, after ascending one of the highest mountains in Galicia, the patient was in a cold of 36°; to which he was exposed from six in the morning till ten at night, when he was found half starved to death, but free from every symptom of tetanus. (See *Méd. Chir. Trans.* vol. vi. p. 450.)

Mr. Abernethy, in his lectures, expresses his conviction, that in tetanus, and all nervous affections, it is a most material point to operate on the brain, through the medium of the digestive organs, and that the production of secretions from the alimentary canal has a more beneficial effect than any other means. He particularly commends the exhibition of calomel and jalap, mixed with treacle, as answering better than salts. Where much difficulty occurs in making the patient swallow



common purgative medicines, I would strongly recommend to the recollection of practitioners the oleum tiglii, a drop of which, blended with a little mucilage, and put on the root of the tongue, will operate powerfully on the bowels.

Another remedy, said to have frequently effected a cure in tetanus, is mercury. (See *Journ. de Méd.* p. 45.) Mercurial frictions, practised so as to bring on a quick affection of the mouth, and in an early stage of the disorder, are preferred. Others contend, that it matters not whether mercury be rubbed into the body or given internally. It is generally allowed, that opium may be advantageously exhibited at the same time. This practice was first adopted in the West Indies (see *Edinb. Physical and Literary Essays*, vol. iii.), where it succeeded in many cases. Whatever benefit, however, may have been experienced from this plan in mild cases, it completely fails in the acute form of the disease. In Egypt mercurial frictions appeared to Baron Larrey to aggravate the symptoms. (*Mém. de Chir. Mil.* t. i. p. 257); and Dr. Emery, Mr. Guthrie, and other medical officers attached to our army in the Peninsula, tried inunction of the whole body, three times a day, with strong mercurial ointment, in unlimited quantity, with no degree of success. After the battle of Toulouse, a fatal case even occurred in a man strongly under the influence of mercury, which he had been previously using for the cure of the itch. (*Sir J. McGrigor, in Méd. Chir. Trans.* vol. vi. p. 454.) I have repeatedly seen mercury tried, and almost invariably without success. Calomel, combined with ipecacuanha, is also generally inefficacious in acute cases; but in chronic ones it proves serviceable by keeping open the bowels.

Another method of treating tetanus is that of administering the most powerful tonics and stimulants, such as wine, brandy æther, preparations of ammonia, bark, cordials, &c. The introduction of this plan was chiefly owing to the eminent Dr. Rush, Professor of Medicine in Philadelphia, who published, in the *Trans. of the American Philos. Society*, vol. ii., a paper entitled, "*Obs. on the Cause and Cure of Tetanus*." Dr. Rush considers tetanus as a disease essentially connected with debility, and he recommends for it the exhibition of the preceding class of remedies. He particularly advises the liberal use of wine and Peruvian bark; and, as we have already stated, when tetanus arises from a wound, he directs the dilatation of it, and dressing with oil of turpentine. Considerable success is represented as having attended the practice. Several other instances of success are also recorded by Dr. Hosack. (*American Medical Repository*, vol. iii.)

[Large doses of whisky and morphia have been advised and adopted. (*American Medical Times*, 1864, ii. p. 29.)]

Dr. Elliotson, considering neuralgia, paralysis agitans, chorea, and tetanus to be "affections of the nerves, or of those parts of the brain and spinal marrow which are immediately connected with them," was induced to try the effect of sub-carbonate of iron in three examples of traumatic tetanus, in consequence of the success with which it had been exhibited in the other complaints above specified. Costiveness was obviated by giving ʒij of the ol. terebinthinæ, followed, when requisite, by the ol. ricini. The subcarbonate of iron was

given in doses of ʒij. and even half an ounce, every two hours. It was mixed with twice its quantity of treacle, and blended with strong beef-tea. Two of the cases recovered; the third, which was one where the spasms were excessively violent, and the pulse 140, and was too rapid in its progress for an effectual trial of the remedy, the patient dying the day after commencement of the plan. (See *Med. Chir. Trans.* vol. xv. p. 161, &c.) I tried the subcarbonate in one case of traumatic tetanus, but it was in an advanced stage, and the patient died on the following day. According to Dr. Elliotson, it has been given in the West Indies with considerable success.

Nothing is a more certain proof of our not being acquainted with any very effectual method of treating a disease, than the multiplicity of remedies, which are as opposite as possible in their effects. We have seen that Dr. Rush conceived that tetanus was a disease connected with debility; and he has recorded examples in which it was successfully treated with tonics and stimulants. Dr. Bright has lately published a case, in which the free exhibition of sulphate of quinine, with bark and stimulants, was followed by the patient's recovery. (See *Guy's Hospital Reports*, series i. vol. i.) [Several cases have recently been recorded in the several journals of success following frequent and large doses of quinine. It was given in twenty-five cases at Guy's Hospital, and of these seven recovered. (See *Guy's Hospital Reports*, series iii. *op. cit.*)] We learn from Dr. Rees, that there are in America very many surgeons who pursue the stimulating plan of Dr. Rush: "among these is Professor Hosack, who relies upon Madeira wine; while there are many others who adopt the opposite theory, and not only bleed unsparingly, but combine the whole antiphlogistic battery; and instances of their success are reported, quite as numerous as those of the opposite theory and practice." (See American ed. of this *Dictionary*, part ii. p. 346.) Many practitioners are advocates for venesection, especially in the early stage of tetanus. Dr. Dickson thinks that in a full habit, where the wound is swelled, inflamed, and painful, venesection, with free purging, and such other means as are calculated to allay the general and local irritation, affords the fairest chance of averting the danger. (See *Med. Chir. Trans.* vol. vii. part 2.) Larrey has also published several cases in which bleeding had a good effect. We are informed by Sir James McGrigor, that in our military hospitals in Spain venesection had a fair trial. In three cases at St. Andero, detailed by Mr. Guthrie, this was the principal remedy. One patient with tetanus, from a wound in the back part of the hand, was bled nearly *ad deliquium* several times with good effect, calomel and diaphoretics being also given, and he recovered. Another patient was bled in the same manner with such amendment, that he suffered but little from spasm, and could open his mouth very well, when he was seized with diarrhoea, which, in his debilitated state, carried him off. In the third case, which was one of acute tetanus, venesection, pushed to the utmost, totally failed. (*Op. cit.* vol. vi. p. 455, 456.)

Sir Astley Cooper represents bleeding as hurtful in tetanus, and I have seen cases in which it seemed to me to shorten the patient's life. Dr. Elliotson pronounces bleeding not to be of any service, unless

the wound be inflamed, or there be some decided internal inflammation present, or the patient is in a state of plethora.

The powerfully relaxing effect of tobacco clysters, in hernia and enteritis, suggested a trial of them in tetanus. This plan is strongly recommended by Dr. O'Beirne (see *Dublin Hospital Reports*, vol. iii.) and Dr. Anderson, of Port Spain, Trinidad. (See *Edinb. Med. Chir. Trans.* vol. i. p. 187.) In one very acute case the plan was tried by Mr. Earle, but it only afforded a temporary alleviation of the spasms, and, as it caused severe agitation, it was discontinued. According to Sir James Macgregor, tobacco clysters, tried in the advanced stage of the disease, seemed to have no effect. He considers tobacco fume, however, as deserving further trial.

A remarkable case is recorded by Dr. Philips, in which the jaw suddenly fell, upon the exhibition of an enema with oil of turpentine. (See *Med. Chir. Trans.* vol. vi. p. 65.)

According to Baron Larrey, frictions, with oily liniments, as recommended by some authors, were tried by the French surgeons at Cairo, but they produced no change in the state of the disease. We learn, from the same authority, that the application of blisters to the throat also failed in checking the symptoms.

The Barbadoes tar, mentioned by Cullen, electricity, the colchicum autumnale, recommended by Dufresnoy, and several other means formerly in repute for tetanus, have now been fully proved by experience to possess little or no claim to this character.

In consequence of the general failure of all remedies hitherto tried in acute tetanus, Mr. Morgan proposes to introduce into the system a substance which has the property of producing on the nervous system a condition directly opposite to that which is developed in tetanus, viz. paralysis. In support of the plausibility of this scheme, he adduces some experiments, in which the artificial tetanus, induced by inserting into the wound a poison called "chatic," and obtained from Java, was removed or abated by the counteraction of ticunas, a North American poison.

[The Woorara or Curara is formed of the juice of the *Strychnia toxifera*, and said to be mixed with the poison of the serpent. It is a very violent poison, and speedily fatal when inoculated; Dr. Harley considers that its value consists in its peculiar power of paralysing the motory much sooner than the sensory nerves. Its action in tetanus is to allay the spasm; you try to keep the spasms from killing the patient by their violence, until the morbid state calling them into play has exhausted itself. Demme (*Schweiz. Zeitschrift für Heilk.* ii. S. 356, 1864) has collected twenty-two cases treated by this means, and of these eight recovered; some of the latter were chronic and subacute cases. It is generally employed in solution over a raw surface made by a blister, or injected subcutaneously. Broca recommends its exhibition by mouth, although it is stated that when administered internally its effects are scarcely sensible. (See also article "Curare," in the *Nouv. Dict. de Méd. et Chir.* vol. x. p. 548; 1869.)

The Calabar bean in its action in sufficient doses paralyses the voluntary muscles, the very muscles which are spasmodically contracted in

tetanus. Hence the prospect of counteracting the influence of the disease by that of the poison. Dr. Watson (*Lancet*, March 2, 1867) has given a full detail of two cases of traumatic tetanus successfully treated in this way; and in the *Lancet* for April, 1868, other cases with remarks are offered.

The Cannabis indica in the form of tincture has been found serviceable, as a hypnotic anodyne, antispasmodic and anæsthetic. Professor Miller has recorded three cases of cure, but in the majority of instances it has failed.

The tincture of aconite in doses from five to eight minims every two hours has been attended with success (*British and Foreign Med. Chir. Rev.* 1859).

Nicotine has been used with success (*Lancet*, November, 1867.)

From the share which the state of the medulla spinalis is conceived to have in the production of the disease, the practice of applying a blister the whole length of the spine has been derived. Dr. Reid is an advocate for this practice, combined with the employment of powerful cathartics. (See *Trans. of King's and Queen's College of Physicians*, vol. i. p. 122.) The same plan, dressing the part with tartar emetic ointment, and purging, are the chief remedies advised by some others. (See *Syme's Paper in Glasgow Med. Journ.* vol. iii.)

After adverting to the opposite modes of stimulant and antiphlogistic treatment, sometimes followed in America, Dr. Rees informs us that of late the practice in that country has very much changed, extensive vesication, especially on the region of the spine, being very generally relied upon, and with singular success. "One of the most severe cases of tetanus (says he) I ever witnessed, arose from a gunshot wound, a load of shot having entered the back and penetrated into the dorsal and lumbar vertebræ. The disease speedily assumed the form of opisthotonos, and was treated by the application of caustic potash to the spine, from the cervical vertebræ to the sacrum. About an inch in width of the skin was destroyed all the way down, and the only internal medicines relied on were prussic acid, in large doses, and elaterium as a cathartic. The case had a successful termination. (See *Amer. Med. Recorder* for 1825, and Rees's ed. of this *Dictionary*, part ii. p. 346.)

Cupping and leeching the spine have also been resorted to, and occasionally found useful.

I have known one or two cases of chronic tetanus get well during the free exhibition of tartarised antimony, but I have more frequently seen it fail.

[*Subcutaneous injections* of sulphate of atropia have been used and followed by success. (*Gaz. Méd. de Lyon*, May, 1860.)

Chloroform administered by inhalation and internally has been very extensively tried. It allays the intensity of the spasms, and has been followed in some instances with success, but in general it cannot be depended upon.

Applications of aconitine, belladonna, conium, veratria, &c., have been tried, so also Galvanism and electricity with doubtful benefit.]

Alfred Poland.

Consult Hippocrates de Morbis Popularibus, lib. v. et. vii. *Cælius Aurelianus*, De Morbis acutis, Med. Obs. and Inq. vol. i. p. 1, 87; vol. vi. p. 143. *Hillary*,



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THORAX, INJURIES OF THE. [Injuries of the thorax derive their chief interest from the importance of the contained organs, and their liability to be implicated. The parietes are not unfrequently contused by falls, blows, and violent compression, as when a wheel passes over the body—an accident which is often attended with the most serious lesions to the viscera. As a result of a contusion, the soft parts alone may suffer, and that in a slight or serious manner. There may be only (a) a trifling bruise followed by temporary pain, or (b) there may be an extensive effusion of blood from the giving way of blood-vessels; or (c) the muscular fibres may be torn, and a very troublesome injury be produced. Again, as a result of contusion, and without any wound (d), the ribs or sternum may be broken more or less violently, or they may be displaced; and the (e) lungs and heart may be ruptured.

(a) A mere bruise, though slight, is not unfre-

quently followed by uneasiness for a very considerable time. The difficulty of keeping the part at rest has much to do in maintaining the pain, but its continuance is also to be ascribed to the injury which the nerves of the part sustained from the original violence. The treatment consists in obtaining rest by the use of straps of adhesive plaster, applied from the spine to the sternum, and from over the shoulder down in front, so as to cover and completely fix the side; or by the use of a sufficient bandage; but all bandages are difficult to keep in place, and have the great disadvantage of fixing the sound side of the chest as well as the injured, and so augmenting the restraint and uneasiness. Sedative embrocations and opium or belladonna plasters may also prove useful; but time and fixture are the main remedies.

(b) When much blood is effused, it may be very extensive, and form a prominent fluctuating swelling on the side of the chest. Rest, quiet, and cold applications in the first instance, with slightly stimulating embrocations, gentle friction and the support of a bandage afterwards, will limit the effusion and bring about absorption without the formation of pus, which is very apt to be generated if motion is permitted, and violent friction or warm poultices are employed.

(c) When the muscles are torn, they will be more or less paralysed, and blood will be freely poured out from their vessels. The breach of continuity in the fibres may, if extensive, be recognised, and the treatment consists in the use of those measures alluded to above for commanding the bleeding; and further by position and mechanical appliances to approximate the divided fibres, so as to allow of their uniting.

(d) The ribs and sternum, if broken or dislocated, may cause serious injury to the viscera, but the treatment of such an accident is considered at length elsewhere.

(e) *Gosselin* has, in the 1st vol. of the *Mémoires de la Société de Chirurgie de Paris*, ably discussed the curious and previously only imperfectly-known lesion of the rupture of the pulmonary tissue without any wound of the parietes of the chest, and he has shown how this may occur either directly at the point corresponding to the contusion, or indirectly at some other portion of the lung. This most grave accident, and also rupture of the heart, which has not unfrequently occurred (see *Gamgee's Researches in Pathol. Anat. and Clinical Surgery*), without any wound of the thoracic walls, have usually followed a very severe contusion, as when a heavy wheel passes over the chest; and such injury is generally (though not always) quickly fatal. *Gosselin* supposes that the giving way of the lung is due to its being violently compressed when full of air, and the larynx closed. The excessive constitutional symptoms which follow; the evidence of internal bleeding; the peculiar sounds heard on auscultation; the dyspnoea, pain and distress; the escape of blood by the mouth, or blood and air into the pleural cavity if the pleura pulmonalis is torn, giving rise to the usual evidences of hæmo-pneumo-thorax; will abundantly testify to the lesion which has been sustained. Again, when the heart gives way, death is usually rapid, but survival for some hours has, in exceptional instances, been recorded. It is remarkable that in fully half of the cases collected by Mr.

Gamgee the pericardium was not torn. There is also reason to believe that the heart may be ruptured as a result of severe falls, even when the chest has not sustained the force of the blow.

Contusions of the chest may be followed by inflammation and suppuration below the muscles, and the formation of deep collections of pus, which before they come to the surface will cause much pain and constitutional disturbance. An obscure fluctuation may occasionally be found, but from the depth at which the pus lies it is not easily made out. A prominence, however, of the part, heat, redness perhaps, and pain, with the history of the case, will clear up the diagnosis. The pus should be evacuated early. Sometimes the abscess makes its way into the axilla. After evacuation, pressure on the part, the retained patency of the orifice, and the fixture of the arm on the affected side will fulfil the requirements of the case.

Wounds of the chest may be penetrating, *i.e.* may open the pleura, or not, and they may either be incised, punctured, lacerated, or contused. It is generally not difficult, after a time, to decide that a wound has penetrated the pleural cavity, but it is far from easy, in many cases, to determine positively that it has not. The probe is not employed in such cases, for fear of the harm it may occasion; but the finger may, in many instances, be used with advantage if great gentleness is employed. It is chiefly by a consideration of the direction of the wound, the nature of the wounding agent, and the extent of the blood-mark on it—if it is a knife or such weapon—and the effects which follow, that we decide this important point.

Simple non-penetrating wounds are of frequent occurrence, and require simple treatment like similar wounds of other parts. It is always important to fix the chest so as to obtain rest during cicatrization, and prevent the formation of sinuses, which otherwise are apt to occur. The wound itself will require such dressing as its features demand, but in general "water dressing" will suffice.

The complications which may attend wounds of the parietes are (*a*) violent hæmorrhage from a wounded vessel, such as an intercostal, the internal mammary, &c. Wounds near the clavicle or axilla are very dangerous, on account of the risk of serious bleeding; (*b*) fracture or injury of bone or cartilage; (*c*) the presence of foreign bodies; (*d*) injury to the mammary gland in the female; (*e*) emphysema.

(*a*) When an intercostal artery is wounded, and cannot be commanded by pressure on the bleeding point or tied (to effect which it may be requisite to enlarge the original wound), then a double ligature must be carefully passed round the rib, and tied, so as to close the vessel on both sides of the orifice. The most efficient method of applying pressure is by the finger, the wound being in the first instance enlarged so as to admit of its exact application. In this way efficiency is usually secured, and the escape of pus is unobstructed, while no risk of irritation and sloughing is run, as when a large and especially an absorbing foreign body, like a sponge or mass of lint, is introduced. If the wound penetrates the pleura, and is a narrow one, the bleeding from such a vessel may be long concealed, as little may escape externally till the wound is enlarged. Of the many suggestions which have been, at va-

rious times, made for commanding this most troublesome, though by no means common, complication of wounds of the chest, few are of any real practical value. Well applied and continued pressure should be first tried (if the orifice in the vessel cannot be seen and closed with a thread), and if that fails, or is inefficient, or is unprocurable from the relay of assistants required, then the double ligature should be applied as above described.

It has been suggested that if any doubt exists as to whether the blood comes from an intercostal artery or the interior of the chest, to introduce a piece of card, bent so as to form a gutter, and then observe whether the blood flows along it (as it would do from an intercostal lying under the border of the upper rib), or trickles out below the card (as it would if coming from the interior). By eye and finger, however, there is usually abundant evidence obtained of the source of the bleeding.

The internal mammary is very rarely reached in wounds, but when it is opened it is a serious complication, as great hæmorrhage may take place into the pleural cavity or the mediastinum, and yet little escape externally. The pericardium, too, may be opened, and the bleeding take place into it. The danger is great in cases in which this vessel is wounded, both on its own account and its usual association with lesion of other important parts. The symptoms are those of external or internal hæmorrhage with those due to any further accompanying complication such as wounds of lung, heart, &c., superadded. Pressure may be got to command the bleeding, and the finger, or the limb of a pair of forceps, covered with lint, will serve best for applying it; but it is better to enlarge the wound and tie the vessel, if at all practicable, the cartilaginous portion of a rib being removed, if necessary, to enable us to effect this. It is not infrequent for the cartilage of one or more ribs to be divided in the original wound, so that we have less scruple in having recourse to this proceeding. The lower down the vessel is wounded, the more difficult it is to secure. Goyrand's method of ligaturing the internal mammary, as described by him in the number of the *Lancette française* for Sep. 30, 1834, is probably the best, yet it is but *une opération d'amphithéâtre*—the only reliable method being to get at the vessel by the wound.

(*b*) When the ribs or sternum are fractured, they may cause tearing of the pleura, lungs, heart, or great blood-vessels. Any loose fragment must be removed with caution, and the fracture treated as is elsewhere described.

(*c*) Foreign bodies must be early removed. If the wound be a penetrating one, the presence of such agents may prove most dangerous and destructive. They may be found sticking in the external wound, or they may have passed into the lungs or heart, or they may have fallen into the cavity of the chest, and be lost. Small metallic bodies occasionally become encysted in the walls or cavity of the thorax, but as a rule their presence is extremely hurtful, and no effort short of doing more harm than can follow their being abandoned should be wanting to remove them. It is most remarkable how broken blades may be overlooked when concealed by the soft parts, as cases are not wanting in which portions of knives, stilettos, &c. have been impacted in the walls of the chest for long periods till the irritation, pain, and inflammation



they occasioned has caused a careful examination to be made, which has led to their discovery. Occasionally they have not been found till after death. When a foreign body falls into the pleural cavity it usually sets up violent inflammation, followed by the establishment of empyœma and hectic fever. Such cases are extremely dangerous and commonly fatal from the difficulty which attends the removal of the body. The absence of any indication of wound of the lung will usually enable us, along with the positive evidence of penetration, and the irritation and inflammation set up, to determine what the nature of the accident is. The passage of balls round the chest, either externally or within, is not seen, or at least only to a very limited extent, in modern warfare, where conical balls and powerful firearms are used. If sinuses are formed in this way in the thoracic walls they should be laid open and the wound allowed to granulate. It is an old observation how violent a trepidation frequently seizes on those who in battle, and more especially in duels, receive wounds in the chest; and it is well to remember that this is seen, not alone when the thorax has been penetrated, or a severe injury inflicted, but also when even trivial lesions of the parietes have been sustained.

(d) Injuries to the mammary gland demand no special notice, and (e) emphysema will be afterwards treated of.

*Penetrating* wounds of the chest are chiefly important on account of the complications which may attend them. Several of these complications have been already sufficiently considered. It is possible for the parietes to be perforated and none of the viscera to suffer, but there is always the greatest risk that in penetrating wounds the lungs, pericardium, or heart will sustain grave injury. The anterior mediastinum has been traversed from side to side behind the sternum, and no immediate evil has followed, but the inflammation, diffuse suppuration, and risk of purulent infection afterwards, renders all such accidents most dangerous. When any of the contained viscera are wounded we may have shock, hæmorrhage, pneumo-thorax, or collapse of the lung to deal with in the primary period, and inflammation and its consequences in the secondary. The danger for the first three days is chiefly from bleeding, and after that from inflammatory action.

It has just been said that the pleura may in exceptional cases be opened and the lung escape injury. It is in incised wounds that this is most apt to occur, and it is difficult to be able to verify its occurrence. It is chiefly by the absence of those signs which indicate a lesion of the internal organs that we conclude they have escaped. We never probe chest wounds, and thus our judgment must be founded on considerations which were before alluded to, viz. the nature of the weapon, the extent and direction of the wound, the force with which it was inflicted, the marks on the blade, the relative position of the assailant and the wounded man, and the effects which follow. It is by a careful weighing of such points that we mainly determine the question whether the wound has penetrated. In many cases it must be obvious that all the sources of opinion above mentioned may not be accessible, and when obtainable may not be such as to command confidence. Occasionally, when the case is obscure, we prefer remaining in doubt to employing methods of investigation which may be

attended with injury to the patient. We never inject fluids now-a-days into wounds of the chest, as a means of diagnosis, nor do we cause the patient to try and force air outwards through the wound when we fear his lungs have been penetrated, both because the deductions therefrom are of no practical value, and their application may be highly injurious. It must, then, be allowed, that our means of recognising wounds penetrating the chest are not such as to put the question always beyond doubt, yet in most cases a combination of several of the following signs renders our diagnosis of a wound penetrating the thorax and injuring the lung sufficiently clear.

(1) *Shock*. This may be very severe if the wound is deep or extensive and the hæmorrhage violent, yet it is occasionally little marked when the pulmonary substance has been wounded.

(2) *Hæmorrhage*. If a considerable blood-vessel is opened blood may rapidly escape, and it will in a great measure depend on the character of the wound as to freedom outwardly, whether it is effused into the lung itself (causing its condensation), accumulate in the thoracic cavity (giving rise to hæmo-thorax), or become infiltrated into the cellular tissue of the thoracic wall, or be expelled by the external wound. It may also be to a great extent expectorated, and that from the commencement of the case. It should, however, be remembered that hæmoptysis, as a sign of wounded lung, is not by any means reliable. It may be present, appearing early and freely, without the lung being wounded at all; and it may not appear, and yet the pulmonary tissue may have been penetrated. Hæmoptysis is chiefly important when it is combined with the escape of blood by the external wound. When the blood does not gain free exit, it may filter down into the cellular tissue and cause discoloration of the loins. This was at one time supposed to be pathognomonic of hæmorrhage into the chest, but this view is no longer held.

(3) *Escape of air*. This may be by the mouth, mixed with the blood and causing it to be frothy; or into the substance of the lung, giving rise to pulmonary emphysema; or into the pleural cavity, establishing pneumo-thorax; or into the parietal cellular tissue, causing external emphysema; or it may be blown out of the wound itself. That no air escapes, then, by the wound is evidently no proof that the lung has escaped penetration, and a further consideration will show that its occurrence does not establish the fact that the lung substance has been pierced, as the air may simply enter the thorax at each inspiration through the wound in the chest walls, and be expelled again during expiration. If, however, care be taken to close the wound effectually during inspiration, and air escape freely and in volumes during expiration, then the evidence it affords of penetration is most valuable. It is when we have to deal with a narrow parietal and a free pulmonary wound that we are most apt to have air accumulating in the chest and cellular tissue. Emphysema of the parietes may occur without any implication of the lung; and pneumo-thorax may also arise when the lung is unhurt, if the wound of the chest wall be valvular, so that air is drawn in during inspiration, but not removed again during expiration.

(3) *Dyspnœa* is usually well marked in lung wounds. If the opening is free and direct into the chest the lung frequently, though by no means

always, collapses, and then the respiration will be impeded in proportion to the amount of breathing space cut off. If such collapse has taken place, or if there be blood accumulated in the chest, then the respiratory murmur will be very feeble, or may be absent altogether, and it will be longest detectable by the side of the spinal column. The voice, too, will be weak, and the ribs on the affected side fixed. The pulse will be feeble, rapid, and unsteady, and the face anxious.

If in consequence of adhesions or some other cause the lung does not collapse and the wound is large, the movements of the viscus may be seen, and the air will enter and escape with an audible noise. The respiration, though laboured, will not be so severely compromised, and the respiratory murmur will be easily heard.

To these symptoms of penetration we must further add, as being usually present, irritating cough, pain deeply fixed, and loud, rough, crepitant râles on auscultation.

The later symptoms are those of inflammation (pleuro-pneumonia) and effusion (air, blood, pus), or the protrusion of a portion of the lung (pneumatocele).

It is thus apparent that it is only by a combination of symptoms that in most cases we are able to conclude that the lung has been penetrated. In many cases the fact will be sufficiently evident, but in others it is only by observing the following points that we are able to judge.

- (1) Hæmorrhage by the mouth and wound.
- (2) The escape of air during expiration by the wound, or into the cellular tissue, or into the thorax.
- (3) Dyspnœa.
- (4) Cough and pain.
- (5) The evidence afforded by auscultation and percussion (as regards respiration, effusion, &c.)
- (6) The progress of the case.

*Treatment.*—The Shock will require careful management. The patient should be placed in the recumbent position, and be kept perfectly quiet. He should not be allowed to speak or make any exertion. Heat may be applied to the surface, and a stimulant administered, if there be need, by enema, or by the mouth if he can swallow; yet as much danger, from a recurrence of bleeding, may attend reaction, such measures must be employed with the utmost caution. It is mainly by the fainting which follows the injury that we hope the hæmorrhage will be checked.

*Hæmorrhage*, when free and into the chest, makes itself known by the usual signs of internal bleeding, combined with those which arise from embarrassment of the respiratory functions. The patient will be faint and pale, with a cold and clammy surface; the respiration will be more or less difficult. He breathes short and hurriedly after the immediate shock has passed over, during which it was slow and sighing. The pulse is small and tremulous, and the eye gets dull and ultimately glazed. The decubitus is on the wounded side, or he sits up and leans forward so long as his strength allows. There is thirst, restlessness, oppression, and anxiety. The stethoscope finds no respiratory murmur where the blood lies, and percussion indicates the dulness which is present, and this may be found to rise higher and higher with the accumulation; possibly abnormal

clearness may exist above that limit, if air has also gained admittance into the chest. The intercostal spaces may be flattened or bulged by the accumulation, and the ribs will lose their usual mobility during respiration. In occasional cases the splashing of the blood may be made out on succussion, and we may have the discoloration of the lumbar region from the infiltration of blood. If the blood escape freely by the external wound, the patient should be placed in such a position as to favour its discharge while measures are being employed to check its flow. These measures are perfect quietness, the use of ice to the chest, and cold iced drinks, digitalis or antimony to diminish the heart's action, or if need be free general depletion. However inconsistent it may seem, this hæmorrhage, which cannot be stopped by local measures, is best arrested by free venesection, a measure which quickly diminishes the rapidity and volume of the circulation, and thus renders the coagulation and spontaneous arrest of the flowing blood the more apt to take place, both by giving it more rest, and rendering it more plastic. Free, and if necessary repeated, venesection is imperative at this stage if the hæmorrhage is violent and continued, notwithstanding the use of cold locally, the observance of quietness, and the administration of digitalis or antimony internally.

If the bleeding is very violent, and fails to be arrested by the above measures, we must close the external wound, and placing the patient on the injured side, hope to arrest the hæmorrhage by the pressure which the accumulating blood will produce. This is a very unsatisfactory measure to adopt, but none else remains. After all fear of a renewal has passed, i.e. in about a week, the collected blood must be evacuated either by enlarging the original wound or an opening made at a new place, and that before the lung has become bound down or pus has formed. By the application of cupping glasses the extraction of the blood may be facilitated, and if the wound is free the cavity may be washed out with water.

If the blood is allowed to remain in the chest, and become decomposed, the utmost danger will result. Empyœma in its worst form will be established, and inflammation of a destructive kind set up. It thus becomes necessary to remove it effectually, as early as is safe to do so.

*Pneumo-thorax* will evidence itself by the oppression of respiration to which it gives rise; the inability to lie on the sound side if the accumulation is extensive; the large rounded and fixed state of the side of the chest; the diminished or absent respiratory murmur; the feeble voice; the clear tympanitic note on percussion; and finally the puerile breathing on the unaffected side. If fluid is also present then a metallic tinkle or amphoric resonance may be found. *Pneumo-thorax* may appear shortly after the receipt of the wound, or late combined with effusion. It is in small oblique or valvular wounds that it is most apt to occur, and it may even arise without any wound being present in the chest walls when the lung has been punctured by a broken rib, or even in violent contusions without fracture when the lung has been torn. *Pneumo-thorax* is generally combined with emphysema (though not necessarily so), and such emphysema may be local, affecting the parietes of the chest alone, or be general, from



the air gaining admission into the posterior mediastinum and hence into the cellular tissue of the neck, and thus over the whole body.

The treatment of pneumo-thorax will depend on its extent, and the urgency of the effects it produces. If slight, and causing little annoyance, it may be left alone, as the air will in time become absorbed, but if the quantity be great, and the effects such as to threaten life, vent must be got either by enlarging the original wound if there was one, or by piercing the chest with a trocar and canula.

*Emphysema* is most apt to occur in those wounds which do not allow of a free external escape for the air which passes from a wounded lung, and it is commonly combined with pneumo-thorax. Its occasional connection with injuries other than wounded lung has been already alluded to, as well as to its being usually local, but sometimes it is general over the greater part of the body.

When emphysema occurs after a wound penetrating the chest we find an elastic, puffy, crackling, painless swelling, covered by unchanged or unusually pale skin. This swelling is compressible, but rises again so soon as the pressure is removed; and it may occasionally be made to change its position by pressure applied along its surface. The swelling begins in the lips of the wound, and spreads therefrom. It may cause great oppression and even danger by the compression it gives rise to, and the asphyxia thus produced. The recognition of this affection is easy. It is to be managed by removing the cause as much as possible, and then, if necessary (which it seldom is), by punctures or scarifications setting free the air. These punctures should be made as near as possible to the point at which the air escapes into the cellular tissue, if that can be determined and got at, care being, however, taken not to open up the seat of fracture if a rib is broken. Bandages do little good, and may be highly injurious, as they usually greatly increase the oppression; but if pressure over the swelling or fixture is wanted, strips of adhesive plaster will be sufficient. If the air is being sucked in during respiration, the wound must be carefully closed so as to prevent it. If required by the urgency of the case the congestion of the lungs must be relieved by general bleeding, but it is the rare exception that emphysema alone calls for constitutional measures.

It is in large, free, direct wounds of the thorax that the lung is apt to collapse, and if this occurs then the breathing space may be so diminished as to become dangerous. The greater the extent of the lung thus collapsed the greater the evil. The dyspnoea, prostration, restlessness, and anxiety which attends such interference with the respiration will of course be proportioned to the extent of lung substance involved. By auscultation and percussion we can recognise the absence of pulmonary tissue, and the substitution of air or fluid at the part where the lung should be. The ribs are motionless, and the decubitus is on the affected side. In large open wounds the lung will probably be seen in action through the aperture, when from adhesions or other cause it does not collapse. If not bound down by inflammatory adhesions a collapsed lung will in time probably regain its position, and no attempt to distend it by any such absurd and futile measures as making the patient blow into a bottle, or

applying a syringe or cupping glass to the wound to draw it out, should be tried.

*Pneumatocele*, or protrusion of the lung into, or through the parietes, may be either primary or secondary—occurring either at the time when the wound has been received, or at a late date through the cicatrix. In rare cases it has been seen when no external wound existed at all, but where the ribs have been fractured; and it has been known to arise even after severe straining, as in child-bearing. The size and shape of the protrusion may vary considerably, according to the nature of the wound, and it may be reducible or not. It is where the free edge of the lung comes into contact with the chest that this accident is most apt to occur. The usual seat is in front, on a level with the nipples. There adhesions are not so common as in other parts, and the lung movements are more free. When primary, and in an open wound, the nature of the tumor cannot be mistaken, as it can be seen and handled, but when covered with soft parts it is recognised by being elastic, non-fluctuant, and soft. It is increased by cough and expiratory efforts, and recedes on suspension of the respiration, and on pressure applied during inspiration, and it can be kept reduced by pressure. When it has been reduced the finger can discover the hole by which it escaped. An impulse is observed on coughing. If the tissues are not much thickened a peculiar sensation of fine crepitation suggestive of its nature is communicated to the hand passed over its surface. The percussion is clear, and the respiratory movement strong, especially during expiration. The overlying skin retains its natural colour. It is only with pointing empyæma that this affection can be confounded, but empyæma is dull on percussion, there is absence of the respiratory murmur and thrill, and there is fluctuation. If the collection contain both pus and air, then the emphysematous crackle observed in such circumstances might mislead, but there will be, when such a tumor is reduced, a distinctive gurgle which is not noticed in protrusion of the lung. Again, an abscess in the walls of the chest has no impulse communicated to it by a cough, nor will it possess a vesicular murmur, and it cannot be reduced by pressure. There will also be fluctuation. When a pneumatocele is strangulated, then its character will vary considerably. It will become congested and dense, and ultimately may become gangrenous and slough.

The treatment of pneumatocele consists in gentle reduction, the wound if necessary being cautiously enlarged to enable this to be accomplished. It may be returned wholly within the chest, or only just within the wound, where it may remain, and by contracting adhesions serve to close the aperture hermetically. The external wound should then be closed. If the protrusion has been strangulated and become gangrenous, it should be allowed to separate spontaneously, and a graduated compress applied if necessary to counteract any further tendency to protrusion. If the part is long of separating, and any harm arise therefrom, we may apply a ligature to the protruded portion or excise it; but if no serious evil is likely to attend the delay, it is better to wait for spontaneous separation.

*Foreign bodies* should, at as early a date as possible, be removed from wounds of the chest, whether such bodies lie in the external wound, or

pass within the chest, or are impacted in the viscera. It is occasionally impossible to get at them without causing more risk than can attend their being abandoned, and small metallic bodies such as balls may become encysted, and so give rise to no further harm; but yet there is always great risk that destructive inflammation, fistulous openings, &c., may result: hence the rule is imperative to extract all foreign bodies at once so long as a greater harm may not be done by such interference than can attend their being left alone. It is from such bodies as by their nature act chemically as well as mechanically that the most harm arises, and animal substances from their decomposition are also peculiarly injurious. Balls have been removed even from the surface of the diaphragm by Larrey. Great care should be taken to examine recent wounds, if there is any possibility from the nature of the wounding agent that a portion of it may have been left within. Some very remarkable cases are on record of even considerable portions of a weapon being thus overlooked.

The secondary complications of penetrating wounds of the chest are inflammation of the pleura, lung, and heart, and the effusions which may attend these conditions. Pleuro-pneumonia followed by empyema is a most dangerous and frequent result when the original injury has been severe. The management of these complications does not fall to be considered here. While it is certainly the case, as was clearly evidenced to the writer in the Crimea, that penetrating wounds of the lung often require free depletion, yet it is to be remembered, that if this has been had recourse to, or if free hæmorrhage has attended the original wound, that any depletive or depressing remedies which may be called for during the subsequent inflammatory stage must be guided and limited by that circumstance.

From all that has been said, then, it would appear that if there be no contra-indication from effusion, foreign bodies (which cannot at first be got at), &c., penetrating wounds of the chest should be closed carefully and accurately, and inflammation in the pleura or lung watched for and combatted energetically at the outset. To close the wound adhesive plaster will probably suffice; or a more accurate closure may be obtained by slightly separating the soft parts on either side of the wound, and sliding the lips together, retaining them by suture. In the American war this was frequently accomplished even with gunshot apertures, the edges of the wound being first removed.

*The Prognosis* in penetrating wounds of the chest will, of course, mainly turn on the viscera implicated. When the lungs are wounded the risk is very great, not only from the hæmorrhage, the shock, and collapse of the lung, which may immediately arise, but also from the inflammation which follows, and the effusions that may result therefrom. The closer the wound is to the position of the great vessels at the root of the lung, the greater the danger. There is more risk of hæmorrhage from incised wounds than any other, and punctured wounds admit of the most favourable prognosis. Lacerated and contused wounds are highly dangerous, but they are not so apt to be followed by primary bleeding as incised wounds, though the lodgment of foreign bodies is a source of much danger in these accidents. In the article "Gun-shot wounds," these

injuries will be fully considered. Wounds penetrating both lungs are generally quickly fatal, though to this not a few exceptions have been recorded. Hæmorrhage and collapse of the lung are the great sources of danger in such cases.

Accumulations of serum, blood, pus, &c., in the chest are recognised by certain rational and physical symptoms to which they give rise, together with other effects which are due to the nature of the secretion. In all cases in which fluid is collected in quantity, there will be—

(1) Dyspnoea proportioned to the rapidity of the accumulation and the amount of the lung which is compressed. The breathing is short, laborious, and rapid.

(2) The respiratory murmur can only be detected at that portion of the chest where the lung exists. In the unaffected lung it will be puerile, and bronchophony will be frequently observed. If the amount of fluid is small, perhaps ægophony will be also present. If any part of the lung is prevented from collapsing by adhesions, then the respiratory murmur will be found there. If, however, the pleural cavity is filled with fluid, the respiratory murmur and voice sounds will be totally suppressed, and possibly the heart dislocated.

(3) Percussion gives a dull note up to the level of the fluid, and as this level varies in different positions of the body, the dullness changes with it.

(4) There is usually much restless agitation and anxiety.

(5) There is a sense of weight and oppression in the chest, and a dragging on the diaphragm.

(6) The decubitus is dorsal or on the affected side, or the patient remains in the semi-erect posture.

(7) The thorax may be enlarged and rounded on the affected side, the ribs being more horizontal than usual, and the intercostal spaces effaced or bulged. The side, too, of the chest is fixed. This bulging of the intercostal spaces is more common in purulent than any other effusion, and it has been so commonly observed that some have even denied its occurrence in any other kind of effusion.

(8) Blood or pus may escape from the wound on coughing.

(9) Splashing ("hippocratic fluctuation") may be observed on sudden movement.

(10) The hypochondrium of the affected side will be more prominent than normal.

(11) The abdominal organs may be displaced and pushed downwards.

Any fluid may cause the above effects, but such signs are most evident in purulent effusions.

To enable us to determine the nature of the fluid, we have the history of the case to guide us.

*Hæmorrhage* takes place generally, though not invariably, shortly after the receipt of the wound, and increases quickly, while at the same time we have present all the usual signs of internal bleeding—bloodless lips and face, paleness of the general surface, rapid diminution of the strength, tendency to fainting and collapse, cold extremities, small weak pulse, dilated pupils, &c. The anxiety and dread, too, is usually great, and we may have within a few days the infiltration of the loins with blood.

*Pus*, again, forms at a later date after hæmorrhage, or as a result of inflammation. The formation of pus will be attended with rigors, hectic, and prostration. There will also be cough and



emaciation, in all likelihood, as well as purulent expectoration. If the pus has formed after a penetrating wound, there will very likely be air in the upper part of the chest, shown by a clear note on percussion. The intercostal muscles may be so thinned as to allow the fluid to point, when an exploring needle may be used if necessary (which it very seldom is), but its use should be avoided unless preliminary to evacuating the fluid. An oedematous condition of the parietes on the affected side is common in empyœma. If the cavity is half full of pus, and air is also present, then probably "metallic tinkle" will be observed, and "amphoric resonance," too, may be obtained. It is in pus collections that "succussion" is best made out.

If the collection of pus be circumscribed, and point on the left side, the heart may communicate to it such a pulsation as to lead to the mistaken inference that we have an aneurism or malignant tumour to deal with; but the absence of the bruit and thrill of a vascular tumour, the history of its rise and progress, the evident fluctuation, and the results of percussion, will aid the distinction.

Accumulations of fluid in the chest, if considerable and causing annoyance, demand relief either by the enlargement of the original wound, or by puncture. If the fluid points, it will be drawn off there, or if not, then at the usual place of election, viz. between the 7th and 8th ribs, counting from above and two inches behind their angle. The fluid should be removed before the lung gets bound down and hopelessly solidified, and some contrivance (such as Thomson's Trocar) should be used, which will remove the fluid and yet exclude air.

Wounds in the lung substance may heal very rapidly by cicatrization and the contraction of adhesion to the pleura costalis; yet, as has been said, such wounds are so liable to serious complications, that they are always dangerous, and deserve a most guarded prognosis. Chronic disease, contraction of the side of the chest, phthisis, necrosis of a rib, and fistulous openings, are among the possible eventualities. These fistulous tracts will demand fixture of the part, and pressure; injections of a stimulating character, or counter openings, or being entirely slit up before they heal. If they are connected with a dead piece of bone, that will be required to be got rid of before the fistula will close.

The *Pericardium* may be injured in penetrating wounds of the chest, and the heart escape. Such wounds are of course rare, and peculiarly dangerous, not only immediately but also subsequently, from inflammation. They are not always fatal. Blood may be so poured out as to fill the pericardium, and fatally embarrass the action of the heart. When such effusion has taken place, the heart's sounds will be greatly obscured, and percussion will elicit a dull note over the præcordium, and there may even be a bulging of that part observed. If inflammation follows, and the effusion is considerable, the friction sounds produced by that condition may be obscured. In general, however, when the pericardium is implicated, the heart and other important structures are also injured.

When the *Heart* is wounded, a rapidly fatal termination is the usual result, yet very remarkable exceptions to this rule are on record both in military and civil practice. Dupuytren, Breschet, and others have recorded instances of survival after

most serious wounds of this important organ, and many interesting and curious circumstances have been related by Ollivier, Jamain, Purple, Sanson, and others. These wounds may penetrate or not; the coronary artery may or may not be opened; and the result will in a great measure depend on these circumstances, but the size, direction, depth, position, &c. of the wound, will greatly influence the effect as favouring or opposing hæmorrhage. Wounds of the auricles are the most fatal, but it is the right ventricle which is most frequently the part wounded. The substance of the heart, either in its external surface or its septum, may be pierced without a necessarily fatal effect. Balls are said to have been even lodged in the cavities of the heart without producing immediate death, and to have remained encysted in the walls for years. In one remarkable case, the heart is alleged to have been traversed from side to side, and yet the patient survived for some time; and Gross relates a case in which a ball, having penetrated the right ventricle, was found after death (97 hours afterwards) in the inferior cava.

The heart is occasionally lacerated by fractured ribs. The writer has in his possession the heart of a female where the apex was fairly torn open in this way, under his own eye, by a cab running over her in the street. Death in that case was almost instantaneous. There was no wound or even mark on the external surface of the chest. It seems possible for an incised wound of the heart to heal rapidly and allow of complete recovery.

Wounds of the heart are generally followed by immediate and violent shock, in which the powers of life are reduced to the lowest ebb. Alarming fainting, dyspnœa, extreme anxiety, pain behind the sternum, paleness and coldness of the surface, smallness and irregularity of the pulse, dulness on percussion over the region of the heart, &c., are the common effects, but they are subject to great variety, and occasionally, even in desperate cases, the immediate consequences are very slight, and so most deceptive. Death may be due to the intensity of the shock, or result from hæmorrhage, or it may arise afterwards from inflammation if the patient survive some time. The bleeding may take place into the cavity of the pericardium, or into the pleura, or it may escape externally by the wound, and in this last event its violence will probably be distinctive. No attempt should be made by probing to determine accurately the nature of the lesion, as such a step would be most dangerous, and may destroy any slight chance that remains of saving or prolonging life. From the direction of the wound and its effects we are usually able to surmise with accuracy what injury has been sustained. A peculiar tremulous and tumultuous sound is said to have been noticed in instances of wounded heart, but few cases admit of any accurate observations being made on this point.

As to treatment, little can be said except that the shock, hæmorrhage, &c., must be managed on general principles. The recumbent position must be carefully retained, and over stimulation during the stages of collapse avoided if hæmorrhage is to be apprehended. Heat should be cautiously applied to the surface, an enema containing aromatic spirit of ammonia administered, quietness, cool air, and careful watching while the collapse conti-

nues, and afterwards the adoption of such measures as may be required to command inflammation. If there is violent pain and augmented action after the collapse has passed off, opiates may be used with advantage. Local or even general bleeding, digitalis, salines, and blisters may be called for if the resulting inflammation is severe; and cold may also be useful if applied to the præcordium.

*Wounds of the great vessels* are not unfrequent in penetrating injuries of the chest, and they are generally fatal; yet extraordinary exceptions have been observed, as, for example, the ascending aorta being wounded and yet the patient surviving for months. The effects are similar to those produced by wounds of the heart.]

George H. B. Macleod.

THROAT, WOUNDS OF, are often attended with considerable danger, on account of the great number of important parts liable to be implicated; but mere cuts of the integuments of the throat and neck are not, generally speaking, dangerous, and do not materially differ from common incised wounds of the skin in any other part of the body. They are not liable to be followed by any particular consequences, and require the same kind of treatment as cuts in general. (See WOUNDS—INCISED WOUNDS.)

In wounds of the throat and neck, however, the larynx and trachea, pharynx and œsophagus, the common carotid artery, and all the principal branches of the external carotid, the jugular vein, the pneumogastric nerve, the descendens noni, the laryngeal nerves, are all exposed to injury; some much more so than others, but all of being occasionally reached by the edge of the knife, or razor, or the point of the sword, or other instruments.

It would be an absurdity to offer an account of what is to be done in cases attended with some part of the mischief above pointed out; for no patient, thus wounded, would ever be found alive. A wound of the pneumogastric nerve was generally considered fatal, though some doubts begin to be entertained on the point. Indeed, Klein positively states that such an injury is not fatal. (See *Journ. der Chir. B. i. p. 123. 8vo. Berlin, 1820.*) However, if the wound of one of these nerves be not absolutely fatal, there can be no doubt of its being highly perilous. The nerve, as is well known, proceeds down the neck, in the same sheath which includes the carotid artery, lying between the artery and the internal jugular vein.

A wound of the carotid artery must generally prove immediately fatal, in consequence of the great and sudden loss of blood. However, were any surgeon on the spot at the moment, he should instantly secure the vessel. In tying the carotid, one caution is highly necessary, viz. always to be sure that the pneumogastric nerve is excluded from the ligature; for were this nerve to be tied, the mistake, if not absolutely mortal, would leave but a slight possibility of recovery.

If the mouth of the vessel could not be at once secured, pressure should be instantly resorted to, for the purpose of producing a temporary suppression of the hæmorrhage. The surgeon should then either make the necessary enlargement of the wound in the integuments, with a due and constant recollection of the important parts near the vessel, or in the case of the carotid being punctured, he

should cut down to this vessel in the manner explained in the article ANEURISM.

In lacerated wounds, the carotid artery may be injured, and yet the patient not immediately bleed to death; for it is the nature of all wounds, attended with much laceration and contusion, not to bleed so freely as clean cuts. Abernethy has related a case, in which the carotid, and all the chief branches of it, were wounded in a man who was gored in the neck with a cow's horn; yet death did not directly follow, and there was time to have recourse to the ligature. Baron Larrey even reports one or two cases in which the bleeding from the carotid, injured by gunshot, was permanently stopped by pressure. (See *Mém. de Chir. mil.*) Dr. Hennen refers to another instance of a similar nature. (*On Military Surgery, p. 106. ed. 2.*)

Punctured wounds might obviously injure the carotid, or the internal jugular vein; without the patient expiring of hæmorrhage at once; because the smallness of the wound in the skin might hinder the fatal effusion of blood. Moderate pressure would also arrest the venous hæmorrhage, and thus the patient might be permanently saved.

Persons who attempt suicide by cutting their throats do not often divide the carotid artery, on account of their incision being made too high up. Where the carotid arteries emerge from the chest, they are situated by the side of the trachea, and even a little more forward than it. However, as these vessels proceed up the neck, they become more laterally situated with respect to the wind-pipe; and when they have arrived at the upper part of the neck, where persons, who aim at suicide, almost always cut, they become situated more backward, inclining towards the angle of the lower jaw.

The œsophagus is so deeply situated, lying close to the bodies of the vertebræ, and behind the trachea, that one might *a priori* expect that it would not often be concerned in any incised wounds, which do not immediately prove fatal, in consequence of the division of other important parts. Yet numerous cases are recorded, in which the œsophagus is said to have been wounded; and what is usually set down as a criterion of the fact, is the passage of the victuals through the wound. In many of these narrations, the writers seem to have forgotten, that wounds made above the hyoid bone, as they frequently are, or between it and the thyroid cartilage, may penetrate to the fauces, and the victuals escape through the cut without the œsophagus or pharynx being really involved. A case of the later kind was lately brought to University College Hospital, attended with complete detachment of the epiglottis. The patient lived but a few hours. (See EPIGLOTTIS.)

I have seen several cases in which the œsophagus was wounded, together with the trachea, not only without the patient perishing so immediately as to be incapable of receiving any succour, but without every chance of recovery being destroyed. Stabs and gunshot wounds may injure the œsophagus, and leave all other important parts untouched. Nay, when other parts of consequence are injured, the patient is sometimes saved. (See *Hennen's Military Surgery, p. 363. ed. 2.*)

Even when the œsophagus is known to be wounded, its deep situation would prohibit us



from doing anything to the breach of continuity in the tube itself. The best plan would be to have recourse to antiphlogistic means, and to introduce a flexible elastic gum catheter, from one of the nostrils into the œsophagus, for the purpose of conveying nourishment and medicines into the stomach, without any risk of their passing out at the wound. An instrument of this kind will lie in the above situation for any length of time, without occasioning much inconvenience; and besides being advantageous for injecting nourishment and medicines down the passage, and keeping them from issuing through the wound, it prevents all necessity for the wounded œsophagus to act, and become disturbed by the action of the muscles of deglutition, when there is occasion to take any kind of liquids, whether in the way of medicine or food. The outer wound should be brought together, and treated on common principles.

When persons cut their throats, as I have explained, they do not often divide the carotid artery, owing to their incision being usually made high up in the neck, where this vessel has attained a more backward situation. When any serious hæmorrhage does arise, it is sometimes from the lower branches of the lingual artery, but more frequently from the superior thyroid arteries. Such arteries may occasion a fatal bleeding, which indeed would more frequently be the event than it actually is, did not the patient often faint, in which state the bleeding spontaneously ceases, and gives time for the arrival of surgical assistance. I need hardly observe, that these arteries are to be tied, and that this important object is the first to which the surgeon should direct his attention. The danger of bleeding to death being obviated, as soon as possible, the other requisite measures may be more deliberately executed.

With respect to extensive wounds of the trachea, or larynx, the same plan of conveying food and medicines into the stomach, through an elastic gum catheter, introduced from one of the nostrils down the œsophagus, is highly proper, though too much neglected; for nothing creates such disturbance of the wound as the convulsive elevation and depression of the larynx and trachea in the act of swallowing.

When the larynx or trachea is cut, the patient's power of forming the voice is more or less impaired, in consequence of the air passing into and out of the lungs, chiefly through the wound. Besides air, a considerable quantity of the natural mucus of the passage is also continually coming out of the wound.

The grand means of healing wounds of the larynx and trachea, are a proper position of the head, and a rigorous observance of quietude. By raising the patient's head with pillows, and keeping his chin close to his breast, the edges of the wound in the skin, and in the trachea or larynx, are placed in contact, even without any other assistance, unless the division be exceedingly large. Some surgeons endeavour to promote the effect of a suitable position with strips of sticking plaster, and sometimes with a suture or two, but not always. These strips, however, are not perhaps of much utility at first, and many practitioners omit them altogether. On this point, Mr. Liston believes that "no purpose is to be gained by closing the wound accurately by stitches and plasters. If it extend laterally to a great extent, a single point of suture may

be inserted near each extremity, of course only *through the integument*; but the centre cannot heal, and no attempt need or ought to be made to close it." (*On Practical Surgery*, p. 339.) But the necessity for sutures must depend on the extent of the division; for unless most of the circle of the larynx or trachea be cut, and position be neglected, the wound in it will not gape. The stitches should never be passed through the lining of the trachea, as this method would be likely to make it inflame, and occasion considerable coughing and irritation, attended with pernicious effects.

The plan of completely closing wounds of the larynx and trachea with sutures is much less frequently followed at the present day than formerly. I have seen many cases in which the patient would have died of suffocation, if the stitches had not been quickly removed. Perhaps no surgical writer has insisted upon this danger so much as Mr. Liston. "The immediate apposition of the divided surfaces (he observes) is attended with great danger, the blood as it flows from the vessels, and encouraged by the confinement of soft coagulum, passes by suction into the windpipe: some of it may be ejected; but the lower part of the tube is not very irritable, and the power of coughing is diminished, so that great part trickles down, and fills gradually the extreme branches of the tube. The breathing is quickened and slightly embarrassed; yet everything may be supposed to promise well: the patient, however, in making some slight exertion, without warning to the inexperienced, falls suddenly into a state of asphyxia, and is lost. The same thing happens at a later period from the secretion of serum, or the accumulation of mucosity." A case then follows, in which a young woman in University College Hospital, who cut her throat, and had had the irregular incision in thyroid cartilage closely sewed up previously to her admission, was at the point of death from asphyxia from this cause and the further interruption of respiration by a clot of blood. The patient was saved by instantly cutting the stitches and taking away the coagulum. "By position of the head, by approximating the chin to the top of the sternum, securing it there by the turn of a double-headed roller, the ends being fixed to a band embracing the chest, gaping and retraction of the edges are prevented, and the parts put in a favourable state of union by the second intention." So long as air passes through the wound, no dressing need be applied, the discharges being wiped away, and the neck covered "with a muslin or gauze handkerchief, a worsted comforter, or Jeffrey's respirator." (See *Liston on Practical Surgery*, p. 338—40.)

Mr. Liston notices an error sometimes committed of feeding the patient through the wound in the neck, and not promoting the healing of the part by position, so that the surfaces cicatrise separately. "The voice is consequently lost, the patient is rendered perfectly incapable of exertion, not having any control over his respiration, and being thus unable to keep his chest expanded. The patient is moreover put in great jeopardy; he is subject to bronchitic attacks, and to inflammatory œdema of the orifice through which the air enters. He may thus be cut off suddenly if in the hands of ill-informed or inexperienced surgeons, or he may be worn out by cough, and profuse expectoration. It is possible occasionally to remedy even such

mismanaged cases; the contracted air-passage above may be widened by the introduction of instruments, and the edges of the wound pared and brought together." (*Op. cit.* p. 341.)

When from the obstruction of the rima glottidis by swelling of the lining of the larynx, respiration is dangerously interrupted, the wound in the trachea not being free, or even being nearly closed, tracheotomy or the enlargement of the original wound, together with the use of a tube, may be necessary to save the patient's life.

A few surgeons entertain considerable apprehension about the ill effects of the entrance of unwarmed atmospheric air into the air-passages. It is not a doctrine, however, to which the generality of the hospital surgeons of London attach any importance.

It appears from the investigations of M. Velpeau, that wounds in the thyro-hyoid space are more difficult to heal and more likely to become fistulous than others affecting the larynx or trachea. The healing of such fistulous opening is also less easily accomplished. The practice of M. Velpeau, for the relief of this case, consists in taking a flap of skin from the front of the larynx, paring off the edges of the fistulous opening, and fixing the flap correctly with the twisted suture. Many interesting particulars, respecting this plan, are detailed by M. Velpeau in his tract "*Des Fistules aëriiformes, et de la Broncho-Plastique.*"

Should there be much coughing, apparently arising from inflammation of the larynx or trachea, bleeding is proper. The spermaceti mixture, with opium, is frequently of great service. I never saw a wound of the trachea unite by the first intention.

See *John Bell, On Wounds*, ed. 3. *Hennen's Military Surgery*, p. 356, &c. ed. 2. 8vo. Edinb. 1820. Amongst other references made by Dr. Hennen, the following seem to me to merit particular notice:—An interesting case of wound of the neck, succeeded by hemiplegia, and another of gunshot wound of the throat, succeeded by paralysis and convulsions, are given by *Forestus* in his *Surgical Observations*. Another, with loss of motion in the arm, from a wound in the neck, is to be found in the *Edin. Med. Essays*, vol. i. And in the *Med. Commentaries*, by *Dr. Duncan*, vol. iv. p. 434. and vol. viii. p. 356, are two interesting cases. *Mursinna*, in his *Med. Chir. Beobachtungen*, relates a case of removal of the thyroid gland by a cannon-ball; the patient survived fourteen days, and died of dysentery. Wounds of the œsophagus often remain open for an indeterminate period, as is exemplified in a case reported by *Tricou*, in his *Fasciculus Observationum*, p. 40. *Lugd.* 1745. *Mr. Bruce* has recorded an interesting case of wound of the œsophagus, in *Med. Chir. Journ.* vol. i. p. 369. I would also refer to various parts of *Mém. de Chir. milit. et clinique*, t. iv., of *Baron Larrey*, *Thomson's Report of Obs. made in Mil. Hospital*, in Belgium, 8vo. Edin. 1816. *Robert Liston, On Practical Surgery*, 8vo. Lond. 1837. *W. H. Porter, On the Surgical Pathology of the Larynx and Trachea*, 8vo. Lond. 1837. *F. Ryland, On the Diseases, &c. of the Larynx and Trachea*, 8vo. Lond. 1837.

**THROMBUS.** (From *θρόμβος*, coagulated blood.) A clot of blood. The term is also applied to a tumor, formed by a collection of extravasated, coagulated blood, under the integuments after bleeding. When not considerable, it is usually called an *ecchymosis*.

A thrombus, after bleeding, generally arises from the opening in the vein not corresponding to that in the skin. The patient's altering the posture of his arm, while the blood is flowing into the basin, will often cause an interruption to the es-

cape of the fluid from the external orifice of the puncture; and consequently it insinuates itself into the cellular substance in the vicinity of the opening in the vein. In proportion as the blood issues from the vessel, it is effused in the cellular membrane between the skin and fascia; and this with more or less rapidity, and in a greater or less quantity, according as the edges of the skin more or less impede the outward escape of the fluid. Sometimes, also, a thrombus forms after venesection, when the usual dressings, compress, and bandage, have been put over the puncture, and the patient imprudently makes use of the arm on which the operation has been performed.

When the extravasation is not copious, it is of little importance, for the tumor generally admits of being easily resolved, by applying linen dipped in any discutient lotion.

It sometimes happens that a thrombus induces inflammation and suppuration of the edges of the puncture. The treatment is now like that of any little abscess; a common linseed poultice may be applied, and a considerable accumulation of matter prevented by making an opening with a lancet in proper time. As soon as the inflammatory symptoms have ceased, discutients should be employed again, for the purpose of dispersing the remaining clots of blood, and surrounding induration.

When the quantity of blood is large, many authors recommend opening the tumor at once; and despairing of the power of the absorbents to remove the extravasation, they direct as much of the blood as possible to be pressed out of the incision. However, the making of an opening is seldom necessary, and often brings on inflammation and suppuration, when they might be avoided. I have never seen any case in which this practice seemed necessary.

[**THROMBUS.** — *Embolism.* — Thrombus is an obstruction of the vascular canals by a morbid product developed at the site of the obliteration. Embolism is a vascular obstruction caused by any body detached from the internal surface of the heart or of the vessels. Embolus.]

The anatomical conditions which lead to thrombus are

1. Atheromatous and calcareous degeneration of the vessels, which, by constriction and ulceration, retard the course of the blood and lead to the coagulation of its fibrin.

Arteritis.—This condition is denied by some writers on the ground of the absence of vessels in the inner and middle coats.

The character of thrombi vary according to their origin — sometimes in great part composed of fibrin, sometimes containing globules which are neither pus globules nor white blood corpuscles; elements of connective tissue; sometimes it is a fibrous cord or membranous exudation adherent to the wall of the vessel.

Embolism.—The walls of the vessel are usually intact; it is found most frequently in the internal carotid and middle cerebral arteries.

Both thrombus and embolism lead to softening of the brain—generally with paralysis of motion on the opposite side, sensibility sometimes intact, sometimes diminished, never completely annihilated, rarely exaggerated or perverted. Loss of movement is of shorter duration than from hæmorrhage. They may result also from anæmia or from



obstructed circulation, in which case intellectual function is less severely and more rarely altered, which may be attributable to the integrities of the cortical substance in many cases.

Sight is especially liable to disturbance, the clot being continued into the ophthalmic artery.

Thickness of speech from paralysis of the muscles of the tongue is sometimes noticed.

Total loss of speech from intellectual disturbance coincides with occlusion of the arteries of Sylvius and softening of the anterior and middle lobe of the brain; sometimes with obturation of the posterior cerebral artery and softening of the cornu ammonis; in the latter case paralysis of the tongue ensues; in the former the tongue in a great measure preserves its movements, and the loss of speech is referrible to intellectual disturbance, the organ of the production of speech being the cerebral convolutions. (*M. Bouillaud.*)

The obstruction of the capillaries may result from fatty, atheromatous, or calcareous materials, pus, portions of fibrin from a purulent or gangrenous focus, pigment granules or cells, &c.

Thrombosis occurs in the cerebral sinuses. It may be—1. Non-inflammatory. 2. Connected with an inflammatory process.

The first produce the effects of inflammatory obstruction already detailed. There may be exclusively fibrin in a more or less advanced stage of alteration. Sometimes there is a false membrane, seated generally in the longitudinal sinus. It may result also from external tumors. It is frequently continued into the torcular herophili and the lateral sinuses, and is usually *symmetrical*, indicating a *general cause*, and leading to the capillary apoplexy of Cruveilhier.

The second is usually a consecutive affection from alteration of the scalp and bones, caries, wounds and injuries. The thrombus in these cases is mostly connected with suppuration, and consists of fibrin, pus, and sometimes false membrane. These morbid changes occur in caries of the bones of the cranium, as of the temporal bone with internal otitis, and always in the corresponding lateral sinus, rarely with the superior longitudinal sinus. The walls of the sinus are often thickened, friable or destroyed, and perforated, the thrombus itself preventing hæmorrhage.

Dr. Humphry concludes—

1. That large veins are liable to become obstructed with clots in states of great debility, enfeebling the circulation; in inflammations, abscesses, difficult labour, &c.

2. The clots result from altered blood, disposing it to solidify in the veins which afford the greatest facilities for their formation.

3. Inflammation of the veins is produced by the clot, and is seated chiefly in the external coat and surrounding cellular membrane.

4. The clots may soften, become connected with the walls, and produce obliteration. They more commonly shrink into delicate bands or fibres, and are removed with little or no obstruction to the circulation.

5. They may be associated with pyæmia, but have no necessary connection with it. They rarely lead to any serious result.

The clotting within the vessels is probably produced by a diminution of the volatile alkali of the blood (Richardson).

Virchow attributes clots in the pulmonary arte-

ries to the lodgment of emboli, which have been wafted with the blood through the right side of the heart, having been detached from the ends of clots projecting into the great venous trunks. A clot projecting from one iliac vein, a portion might be washed off by the blood flowing against it from the other iliac vein, and constitute a nucleus for the formation of a plug. Dr. Humphry observes in many cases there is no reason to suppose the pulmonary clots were preceded by clots in the veins, and that the effects of blood predisposed to coagulate are just as likely to exhibit themselves in the pulmonary arteries as in any other part of the system.

Dr. Humphry observing an amelioration in the general condition of patients coincident with swelling of a limb, which indicated an obstruction of a great vein, suggests that the general mass of blood may become thereby relieved of a certain quantity of redundant fibrin, and consequently better fitted to minister to nutrition. In inflammatory disease this generally takes place when the disease is subsiding, and is attendant on recovery, although evidence of a low or cachectic state of the system (p. 20). *H. Ancell.*]

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THYROID GLAND, DISEASES OF. The thyroid gland is frequently the seat of chronic disease known by the name of *bronchocele* (from *βρόγχος* the windpipe, and *κύλη* a tumor.) The Swiss call the disease *gotre*, or *gôître*. Heister thought it should be named *tracheocele*. Prosser, from its frequency in the hilly parts of Derbyshire, called it the *Derbyshire neck*; and, not satisfied respecting the similitude of this tumor to that observed on the necks of women on the Alps, the *English Bronchocele*. By Alibert the disease is called *Thyrophraxia*.

1. The simple bronchocele, or thyrophraxia, is the most common form of the disease, and is a mere hypertrophy, in which the thyroid gland is simply enlarged, but not changed in structure. It is common in young girls and in women, has a regular even surface, a uniform resistance, and seldom presents any distinct divisions, or lobes. The integuments covering the parts are quite unchanged. It is also well known to be in general free from danger; the office of the thyroid gland not being of such importance in the animal economy, as to be essential to the continuance of life. Alibert has seen one example, in which the tumor became cancerous.

2. The compound bronchocele presents the greatest variety, and astonishes every beholder. Sometimes a more or less voluminous cyst is formed round it, filled with a pultaceous, or purulent matter. Sometimes, in compound bronchoceles, calcareous, tuberculous, melanotic, cartilaginous, and other adventitious substances are found. Once, in the situation of the thyroid gland, M. Andral met with a hard body, about the natural size of that gland. It consisted of two parts; one a true osseous texture formed of very

distinctly interlaced fibres, irregular and knobby on the surface; the other, a cavity, the parietes of which were composed of this osseous investment, and which had numerous slender filaments extending across it like those of the spongy texture of bones. Between them was a small quantity of reddish fluid, of the consistence of syrup. (See *Andral, Précis d'Anat. pathol.* t. i. p. 304.) In two cases, Alibert found, on the outside of the enlarged gland, a yellow fatty mass; and, in a third instance, the gland itself formed a true sarcoma. (*Nosol. nat.* t. i. p. 464, 465, *folio, Paris*, 1817.)

Simple *bronchocele* always signifies, in this country, hypertrophy of the thyroid gland, which sometimes not only occupies all the space from one angle of the jaw to the other, but forms a considerable projection on each side of the neck, advancing forward a good way beyond the chin, and forming an enormous mass, which hangs down over the chest. The swelling, which is more or less unequal, generally has a soft spongy elastic feel, especially when the disease is not in a very advanced state; but no fluctuation is usually perceptible, and the part is exceedingly indolent. The skin retains nearly its ordinary colour; but, when the tumor is of very long standing and of great size, the veins of the neck become more or less varicose.

It is stated by Dr. Sacchi, of Treviglio, that simple hypertrophy may often be cured; but, if not dispersed, the gland becomes in time variously altered; assuming either a scrofulous or an encysted character. The scrofulous goitre frequently attains an immense size; but does not give rise to corresponding inconvenience or danger. It is generally lobulated. In time, one or more of these lobes may become soft, and present a feel of fluctuation. This constitutes the soft or lymphatic goitre of authors. The structure has become vesicular, and contains fluid, which may be watery or albuminous:—in a few cases it is more like milk or pus. Some goitres, however, having a feel like that of fluctuation, really have the consistence of a spongy substance, like that of the placenta, and do not contain fluid. According to Dr. Sacchi, some goitres undergo a partial softening, and it is a mistake to suppose that they always become harder and harder the longer they continue.

According to Prosser, the tumor generally begins between the eighth and twelfth years. It enlarges slowly during a few years; but, at last, it augments rather rapidly, and forms a bulky pendulous tumor. Women are far more subject to the disease than men, and the tumor is observed to be particularly apt to increase rapidly during their confinement in childbed. Sometimes bronchocele affects the whole of the thyroid gland, that is to say, the two lateral lobes, and the intervening portion; and in this kind of case, it is not unusual to remark three distinct swellings, for the most part of unequal size. Frequently, only one lobe is affected; while, in many other cases, the three portions of the thyroid gland are all enlarged, and so confounded together, that they make, as it were, only one connected globular mass. When only one lobe of the thyroid gland is affected, it may extend in front of the carotid artery, and be lifted up by this vessel, so as to have the pulsatory motion of an aneurism. (*A. Burns's Surgical Anatomy of the Head and Neck*, p. 195, and *Parisian Chir. Journ.* vol. ii. p. 292,

293.) Alibert believes that he first made the remark that the right lobe was more frequently enlarged than the left. (*Nosol. nat.* t. i. p. 465.)

The ordinary seat of bronchocele, as Flajani remarks, is the thyroid gland; but sometimes cysts are formed in the cellular membrane. (*Collez. d'Oss.* t. iii. p. 277.) And Postiglione also observes that the swelling is sometimes encysted and filled with matter of various degrees of consistence, resembling honey, &c.; in some cases, it is emphysematous, or filled with air; and, in other instances, it is sarcomatous, having the consistence of a gland, which is enlarged but not scirrhus. These different characters prove, says he, that the treatment ought not to be the same in all cases. (*Memoria sulla Natura del Gozzo*, p. 20.)

Bronchocele is common in some of the valleys of the Alps, Apennines, and Pyrenees. Indeed, there are certain places where the disease is so frequent, that hardly an individual is totally exempt from it. Larrey, in travelling through the valley of Maurienne, noticed that almost all the inhabitants were affected with goitres of different sizes, whereby the countenance was deformed, and the features rendered hideous. (*Mém. de Chir. mil.* t. i. p. 123.) And Postiglione remarks that in Savoy, Switzerland, the Tyrol, and Carinthia, there are villages in which all the inhabitants without exception have these swellings, the position and regularity of which are there considered as indications of beauty. (*Memoria sulla Natura del Gozzo*, p. 22.) In many the swelling is so enormous that it is impossible to conceal it by any sort of clothing. A state of idiotism is another affliction which is sometimes combined with goitre, in countries where the latter affection is endemic. However, all who have the disease are not idiots, or cretins as they have been called; and in Switzerland, and elsewhere, it is met with in persons who possess the most perfect intellectual faculties. When bronchocele and cretinism exist together, Foderé, and several other writers, ascribe the affection of the mind to the state of the thyroid gland. (See *Traité sur le Goître et le Crétinisme*, 8vo. Paris, an 8.) However, this opinion appears to want foundation, since the mental faculties are from birth weak, and in many the idiotism is complete where there is no enlargement of the thyroid gland, or when the tumor is not bigger than a walnut, so that no impediment can exist to the circulation to or from the brain. (*Burns on the Surgical Anatomy of the Head and Neck*, p. 192.) The direct testimony of Dr. Reeves also proves, that in countries where cretins are numerous, many people of sound and vigorous minds have bronchocele. (See *Dr. Reeves's Paper on Cretinism*, *Edin. Med. and Surg. Jour.* vol. v. p. 31.) Hence, as Mr. A. Burns remarked, the combination of bronchocele and cretinism must be considered as accidental; a truth that seems to derive confirmation from the fact that, in some parts of this country, bronchocele is frequent where cretinism is seldom or never seen.

Bronchocele is not confined to Europe: it is met with in almost every country on the globe. Professor Barton, in his travels amongst the Indians settled at Oneida, in the state of New York, saw the complaint in an old woman, the wife of the chief of that tribe. From this woman Barton learned that bronchoceles were by no means uncommon amongst the Oneida Indians, the complaint existing in



several of their villages. He found also that the disease resembled that seen in Europe in respect to its varieties. In North America, bronchocele attacks persons of every age, but it is most frequently seen in adults; a difference from what is noticed in Europe. Bronchocele is said to be frequent in Lower Canada. Bonpland, the companion of Humboldt, informed Alibert that the disease was endemic in New Granada, and that it prevailed in such a degree in the little towns of Honda and Monpa, on the banks of the Magdalena river, that scarcely any of the inhabitants were free from it. The blacks, and those who led an active laborious life, however, are reported to escape the complaint. Some of the natives of the Isthmus of Darien are said to be terribly disfigured by it. (*Alibert, Nosol. nat. t. i. p. 469.* Also, *Observations sur quelques Phénomènes peu connus qu'offre le Goître sous les Tropiques, dans les Plaines et sur les Plateaux des Andes, par A. de Humboldt, in Journ. de Physiologie, par F. Magendie, t. iv. p. 109. Paris, 1824.*)

In European women, bronchocele usually makes its appearance at an early age, generally between the eighth and twelfth year, and it continues to increase gradually for three, four, or five years, and is said sometimes to enlarge more during the last half-year, than for a year or two previously. It does not generally rise so high as the ears, as in the cases mentioned by Wiseman. Sometimes, however, this happens, as we see in the case of Clement Desenne, of whom Alibert has given an engraving. In this patient, a part of the tumor, as large as a hen's egg, projected into the mouth. (*Nosol. nat. t. i. p. 466.*) The swelling extended from the ears to the middle of the breast. A seton produced a partial subsidence of it; but, when it was withdrawn, the orifices closed. After two years more, the swelling became painful, suppuration took place, and fifteen pints of matter were discharged; and six ounces every day after the swelling had burst, came away with the dressings for three months; but, notwithstanding all this suppuration and more afterwards, the tumor was only partially lessened. The disease mostly has a pendulous form, not unlike, as Albucasis says, the flap, or dewlap, of a turkey-cock, the bottom being the largest part of the tumor. Alibert mentions a case in which the swelling hung down to the middle of the sternum, and the large mass, which was quite a burthen to the patient, used to become hard, and, as it were, frozen, in very cold weather. (*Nosol. nat. t. i. p. 466.*) In another curious instance, the tumor formed a long cylinder, which reached down to the middle of the thigh, the diameter becoming gradually smaller downwards. (*P. 468.*) The common seat of bronchocele is the thyroid gland; but, frequently, the surrounding cellular membrane is more or less thickened, and contributes to the swelling. Sometimes also the neighbouring lymphatic glands are affected, when its base is widened, and extends from one side of the neck to the other. In this circumstance, the swelling gradually loses itself in the surrounding parts, and is not circumscribed, as in ordinary instances. (*Postiglione, Mem. sulla Natura del Gozzo, p. 20.*) When the disease is very large, it generally occasions a difficulty of breathing which is increased by the patient catching cold or attempting to run. In some subjects the tumor is so large, and affects the breathing so much, that a

loud wheezing is occasioned; but there are many exceptions to this remark. Sometimes, when the swelling is of great size, patients suffer very little inconvenience; while others are greatly incommoded though the tumor is small. In general the inconvenience is trivial. The voice is sometimes rendered hoarse; and, in particular cases, the difficulty of speech is very considerable. (See *Flajani, Collec. d' Oss. t. iii. p. 271.*)

The difficulty of respiration, produced by the pressure of the tumor, and the enlargement of other glands, as this author remarks, is the most dangerous effect of the disease, since, by disordering the pulmonary circulation, it renders the pulse irregular and intermittent, and a strong throbbing is excited in the region of the heart, followed by fatal disease of the lungs themselves; consequences often not suspected to have any connection with the bronchocele, though it is in reality the immediate cause of them. (*Vol. cit. p. 278.*)

The causes of bronchocele are little known. To the doctrine, that bronchocele is brought on by the earthy impregnation of water used for drink, the following objections offer themselves:—1. The water of Derbyshire, in districts where this disease is considered endemic, contains much supercarbonate of lime; but that in common use about Nottingham, where the disease is also prevalent, is impregnated with sulphate of lime. However, that the disease is not produced by water, impregnated with sulphate of lime, is evident; for, as Alibert observes, the waters of St. Jean, St. Sulpice, and St. Pierre, where bronchocele is frequent, contain much less of this earth than the waters of Upper Maurienne, where the disease is hardly ever noticed, though the houses are built upon a vast quarry of gypsum. The same fact was observed by Bonpland in New Granada. (*Nosol. nat. t. i. p. 471.*) Nor, as Foderé explained, can the cause of the disease be correctly referred to the use of any particular kind of food. Certain localities, however, seem to contribute to its frequency; for this author observes, that the disease is not prevalent in very high places, nor in open plains; but that it becomes more and more common as we descend into deep valleys made by torrents, where there is a good deal of marsh and abundance of fruit trees. The air is here constantly humid. 2. Abstinence from unboiled water does not diminish or interrupt the gradual progress of the disease. 3. Patients are cured of the disease who still continue to drink water from the same source as before, without taking any precaution, as boiling, &c. 4. The disease in this country is less frequently found among men. 5. Many instances may be related of a swelling in the neck, sometimes very painful, and generally termed bronchocele, being produced very suddenly, by difficult parturition, violent coughing, or any other unusually powerful effort. (See *Edin. Med. and Surg. Journ., vol. iv. p. 279.*) In Derbyshire, Genoa, and Piedmont, bronchocele has been attributed to drinking water cooled with ice. To this theory, many of the objections, concerning the earthy impregnation of water, stand in full force; with this additional reflection, that "in Greenland, where snow-water is commonly used, these unsightly protuberances are never met with; nor (says Watson) did I ever see one of them in Westmoreland, where we have higher mountains and more snow than in Derbyshire, in which country they are very common."

But what puts the matter beyond a doubt is, that these wens are common in Sumatra, where there is no snow during any part of the year." (*Watson's Chemical Essays*, vol. ii. p. 157.) The above opinion was also refuted by Foderé, who remarks that the Swiss, who reside at the bottom of the glaciers, are the least subject to the disease. Bronchoceles are also said to be unknown in Lapland.

Respecting the influence of particular water in bringing on the disease, Dr. Odier gives credit to the opinion; because it has appeared to him that distilled water prevented the increase of the tumor, and even tended to lessen its bulk. (See *Manuel de Médecine pratique*, 8vo. Geneva. 1811.) However, that every explanation, hitherto devised of the causes of bronchocele, is quite unsatisfactory, is fully proved by the observations of the celebrated Humboldt. Persons afflicted with bronchocele (he remarks) are met with in the lower course of the Magdalen river (from Honda to the conflux of the Cauca); in the upper part of its course (between Neiva and Honda); and on the flat high country of Bogota, six thousand feet above the bed of the river. The first of these three regions is a thick forest, while the second and third present a soil destitute of vegetation; the first and third are exceedingly damp, the second is peculiarly dry: in the second and third regions, the winds are impetuous; in the first, the air is stagnant. To these striking differences we will add those relative to temperature. In the first and second regions, the thermometer keeps up, all the year, between 22 and 33 centigrade degrees; in the third, between 4 and 17 degrees. The waters drunk by the inhabitants of Mariquita, Honda, and Santa Fé de Bogota, where bronchoceles occur, are not those of snow; and issue from rocks of granite, freestone, and lime. The temperature of the waters of Santa Fé and Mompo, drunk by those who have this disease, varies from nine to ten degrees. Bronchoceles are the most hideous at Mariquita, where the springs, which flow over granite are, according to my experiments, chemically more pure than those of Honda and Bogota, and where the climate is much less sultry, than upon the banks of the Magdalen river. Perhaps it may be thought, that the atony of the glandular system (?) depends less upon the absolute temperature than upon the sudden refrigeration of the atmosphere, the difference of temperature in the night and day; but, in the Magdalen valley, where the constancy of low tropical regions prevails, the extent of the scale that the thermometer pervades in the course of the whole year is only a small number of degrees, &c. (*Humboldt, in Journ. de Physiologie, par F. Magendie*, t. iv. p. 116.)

The same distinguished observer confirms previous accounts of the variety of bronchoceles amongst the original copper-coloured natives of America and negroes. It appears, also, that in South America, bronchocele is progressively extending itself from the lower provinces to the flat elevated regions of the Cordilleras; and this, in so serious a degree, that in 1823 the subject was adverted to in a report made to Congress by M. Restreppo, one of the Colombian ministers.

An observation, lately made by an intelligent writer, would lead one to conclude, that cretinism depends upon malformation of the head. Speak-

ing of goître, as it appears among the inhabitants of the valley of Maurienne, Baron Larrey informs us, that, in many of these people, with this frightful deformity is joined that of the cranium, of which the smallness and excessive thickness are especially remarkable. (*Mém. de Chir. milit.* t. i. p. 123.)

Prosser is inclined to consider the bronchocele as a kind of dropsy of the thyroid gland, similar to the dropsy of the ovary; and he mentions, that Dr. Hunter dissected one thyroid gland, which had been considerably enlarged, and contained many cysts filled with water. Dr. Baillie remarks, that when a section is made of the thyroid gland affected with this disease, the part is found to consist of a number of cells containing a transparent viscid fluid.

In all probability, the ordinary bronchocele is entirely a local disease, patients usually finding themselves, in other respects, perfectly well. The tumor itself frequently occasions no particular inconvenience, and is only a deformity. There is no malignancy in the disease, and the swelling is not prone to inflame or suppurate, though, as Dr. Hunter remarks, abscesses do occasionally form in it. The pressure of a large bronchocele may not only greatly afflict the patient, by rendering respiration difficult, but actually cause death by suffocation. (See *Obs. sur un Goître volumineux, comprimant la Trachée-artère, par L. Winslow, in Bulletin de l'Athénée de Méd.*, etc. "Some persons, as Alibert remarks, have the disease all their lives, without suffering any inconvenience from it; some experience a suffocating oppression of the breathing; and in others there is an impediment in the circulation, and a tendency to apoplexy, arising from the strangulation which afflicts them." (*Nosol. nat.* t. i. p. 466.) Dr. Hunter says, that the bronchocele frequently appears two or three years before or after the commencement of menstruation, and that it sometimes spontaneously disappears, when this evacuation goes on in a regular manner. Mr. A. Burns affirms the same thing.

Besides the forms of goître already noticed, there is another sometimes termed *aneurismatic*, and consisting of an extraordinary development of the thyroid arteries and their branches. Every point of the tumor has a strong pulsation, not however, like that of an aneurism, but giving a sensation as if the blood were flowing very rapidly into numerous vessels, with an obscure buzzing noise, or tremulous murmur, which is more distinct over the thyroid trunks. A case of this description was once shown to me by Mr. Pilcher. In two cases recorded by Dr. Sacchi, the tumors had existed many years, and begun during the efforts of parturition.

Dr. Parry remarked a frequent coincidence, either as cause or effect, between enlargement of the thyroid gland, and cardiac diseases. (*Elements of Pathology*, &c. p. 181.) And another modern writer mentions that he has lately seen three cases of this complication. (*Medico-Chir. Journ.* vol. i. p. 181.) A case is detailed by Flajani, where the disease was accompanied with extraordinary palpitations of the heart. (See *Collezione d'Osservazioni, etc., di Chirurgia*, t. iii. p. 270.) In the instance here referred to, there was great irregularity of the pulse; and the oppression of the breathing was such, that the patient was obliged



to submit to venesection at least every month, whereby he was rendered quite emaciated.

[Enlargement of the thyroid gland is found associated with an assemblage of symptoms described by Dr. Stokes (*Diseases of the Heart and Aorta*, 1854) and by Dr. Begbie (*Contributions to Practical Medicine*, 1862), in which the vascular system, especially of the head and neck, appears to be morbidly excited; the eyeballs become preternaturally prominent, and the general system anæmic and debilitated. In this affection the pulse is quickened, and the pulsations of the carotids and of the thyroid arteries are greatly increased both to the touch and sight, accompanied by a *bruit de soufflet* on applying the stethoscope. The various terms of anæmic exophthalmos, goitre exophthalmique, exophthalmic bronchocele, have been applied to this complaint. As the thyroid gland is only one of the organs affected in this peculiar state of the vascular system, it will be evident that the treatment required must differ from that of ordinary bronchocele. Remedies directed to the improvement of the general health, and calculated to influence the attendant symptoms of anæmia, of vascular excitement, and of imperfect innervation as depending upon imperfect function of the vaso motor system of nerves, will be most likely to succeed in relieving and even in restoring the patient's health. Such are the preparations of steel, quinine, and other tonics, combined with administration of digitalis, and various anodyne medicines.]

#### TREATMENT OF BRONCHOCELE.

That certain localities, perhaps not yet correctly understood, contribute to the origin of this disease, is well proved by a fact stated by Alibert, viz. that change of air has more effect on the complaint than medicines, as he has known many Swiss ladies who came to Paris with bronchoceles, in whom the tumor subsided after they had resided some time in that city. (*Nosol. nat. t. i. p. 473.*)

A blister, kept open, has put a stop to the growth of the tumor; but this method is not much followed at present, as better plans of treatment have been discovered. Many years ago the favourite mode of curing bronchocele consisted in giving internally burnt sponge, and occasionally a calomel purge, at the same time that frictions were made upon the tumor itself.

The efficacy of burnt sponge was thought to be greatest when exhibited in the form of a lozenge, composed of ten grains of this substance, ten of burnt cork, and the same quantity of pumice stone. These powders were made into the proper form with a little syrup, and the lozenge was then put under the tongue and allowed to dissolve. To the latter circumstance much importance was attached. Some practitioners gave a scruple of burnt sponge alone, thrice every day; while others added a grain of calomel to each dose. A purge of calomel was ordered about once a week, or fortnight, as long as the patient persevered in the use of the calcined sponge; but, when mercury was combined with each dose of this medicine, no occasional purgative was deemed requisite.

External means were supposed to assist the above internal remedies, such as frequently rubbing the swelling with a dry towel, bathing the part with cold water; rubbing the tumor two or three

times a day with the liq. ammon. acet. or the camphor liniment.

"In the treatment of bronchocele," says Mr. A. Burns, "repeated topical detraction of blood from the tumor is highly beneficial. Electricity also has sometimes a marked effect; but there is no remedy which I would more strongly advise than regular and long-continued friction over the tumor. By perseverance in this plan, a bronchocele, treated in London, was materially reduced in the course of six weeks. Its good effects I have likewise witnessed myself; and it is a remedy highly recommended by Girard, in his *Traité des Loupes*." Mr. A. Burns recommends the friction to be made with flannel, covered with hair-powder, and the part to be rubbed, at least three times a day, for twenty minutes.

The virtues of burnt sponge, in the cure of certain forms of bronchocele, are now ascertained to be owing to the iodine which it contains. Iodine was discovered in 1813 by Courtois, manufacturer of saltpetre at Paris; but six years elapsed before it was tried as a medicine. From the first memoir of Dr. Coindet, addressed in 1820 to the Helvetian Society of Natural Sciences, it appears, that, as he was searching for a formula in the work of Cadet de Gassicourt, he found, that Russell had recommended the ashes of the *fucus vesiculosus*, or bladder wrack, under the name of *Æthiops vegetabilis*, for the cure of bronchocele; and he was led from analogy, between this substance and burnt sponge, so long celebrated for its efficacy in the treatment of bronchocele, to suspect that iodine was the active principle of both. "The great and unequalled success which resulted from its use in the treatment of bronchocele, at once indicated the power of iodine as a therapeutic agent, and encouraged Dr. Coindet to pursue his researches in rendering it an efficient article of the materia medica; and about the close of the same year, when Dr. Coindet had employed iodine in treating goitre for six months at least, his conjecture was confirmed by the discovery which Dr. Fyfe, of Edinburgh, made, that this substance was actually contained in the ashes of the burnt sponge, &c.

"It has been generally understood among the profession, that the happy conjecture which introduced iodine into medical treatment, originated with Dr. Coindet, of Geneva; yet we find that his claim to this honour is disputed by one of his countrymen, Dr. J. C. Straub, of Hofwyl, in the Canton of Berne.

"Dr. Straub, whose communication is found in Professor Meisner's *Physical Intelligence* of the General Helvetian Society for 1820, states, that, before the discovery of iodine, attempts had been made to compound a substitute for burnt sponge, but without success; and that this failure, and his observation of the similarity of smell between iodine, burnt sponge, and other marine productions, led him to suspect the existence of iodine, or its salts, in these substances, and that its absence in the artificial compounds was the cause of failure in these experiments. This conjecture, which appears to have been made previously to 1819, led Dr. Straub to examine the real burnt sponge; and he informs us, that, though his time did not permit him to ascertain exact quantities, yet he obtained from  $1\frac{1}{2}$  oz. of burnt sponge as much iodine as to render his conjecture

probable, and to be astonished that the ingredient should have escaped notice. He was therefore at once induced to think of its use in medicine; and in the same paper, from which we obtain these facts, impressed with the poisonous quality ascribed by Orfila to iodine, he recommended, first the trial of its salts, especially the hydriodates of soda and lime, and then that of the substance itself.

"The communication of Dr. Straub is dated Dec. 1819, and was actually published in Professor Meisner's periodical work in February, 1820; five months, at least, before the first memoir of Dr. Coindet was communicated to the Helvetic society of Natural Sciences at Geneva. It is unnecessary to have recourse to any supposition of injustice done to Dr. Straub; much less would it be right to deprive Dr. Coindet of the merit of originality in substituting the direct and certain action of iodine for the irregular, and sometimes inert, qualities of burnt sponge in the treatment of goître. Coincidence of this kind is not uncommon in science: in the present instance, the ingenuity of Dr. Straub does not diminish the merit of Dr. Coindet." (See *Edin. Med. and Surg. Journal*, No. 80. p. 210, &c.)

In the *Archives Générales de Médecine* for July, 1823, Dr. Coster mentions the opportunity which he had had of remaining eight months at Geneva with Dr. Coindet, and of observing correctly the good effects of iodine in enlargements of the thyroid gland, and in scrofulous tumors. Dr. Coindet first of all employed this medicine under the form of alcoholic tincture, and obtained very surprising effects from its administration in goître. He next tried friction on the tumor itself, with an ointment, composed of the iodide of potassium and lard; and the success of this practice was so great, that of nearly one hundred individuals affected with goître, whose cases Dr. Coster collected, more than two-thirds were completely cured by it. Soon after these successful results, iodine was employed, sometimes internally, and sometimes in the form of friction, in scrofula. "I shall not affirm (says Dr. Coster) that success was as uniform in the latter, as in the former disease; but it is certain, that scrofulous tumors yield sooner to the action of iodine than to that of any other remedy at present known: when the tumors, whether of the thyroid gland, or of the lymphatic glands, are hard and renitent, experience proves that the effects of iodine are much more prompt, when the frictions are preceded by the application of leeches, and a low regimen. Notwithstanding these precautions, however, the tumor sometimes continues stationary." In such a case, Dr. Coster put the tumor twice a day, for ten or twelve minutes, under the influence of the positive pole of the voltaic pile, taking care to change sides each time of using it: so that, in the morning, he made use of friction with iodine on the right side, and the action of the pile on the left; and, in the evening, applied the friction to the left side, and the galvanism to the right. In twenty days, not the least trace of the bronchocele was left. It is stated, that, in this instance, the voltaic pile, unassisted with the frictions of iodine was as ineffectual as the friction by itself had been. By the internal and external use of iodine, I once dispersed a bronchocele, which had formed in the neck of a young lady, aged about 12.

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The disease began to diminish in less than a week from the commencement of the treatment, and in six weeks the cure was complete. Since this, I have treated several other cases with an equally favourable result. An interesting case, in which a similar plan was attended with success, is recorded by Dr. Roots. (See *Med.-Chir. Trans.* vol. xii. p. 310.) Another instance of its decided efficacy is reported by Dr. Barlow, of Bath (see *Edin. Med. Journ.* No. 79. p. 337.); but, whoever wishes to have a large and convincing body of evidence on this point, should consult the cases and observations published by Dr. Manson, of Nottingham, where bronchocele is said to be endemic. He gives the results of one hundred and twenty cases of bronchocele in which he administered iodine. Fifteen were in males, and one hundred and five in females. When the disease was complicated with diseased lymphatic glands, the thyroid gland first yielded, and then the others. In the fourth case, a scrofulous swelling of the foot yielded during the use of iodine. Of the hundred and twenty cases referred to, eighty-seven were cured, ten much relieved, and only two or three discharged without relief. (See *Manson or Medical Research on the Effects of Iodine in Bronchocele, Paralysis, Chorea, Scrofula, Fistula Lacrymalis, Deafness, Dysphagia, White Swellings, and Distortions of the Spine*, Lond. 1825.)

In South America a remedy for bronchocele, called *aceyte de sal*, was found, by M. Roulin, to contain a proportion of iodine. (See *Magendie, Journ. de Physiologie*, t. v. p. 273.) The same gentleman has also proposed the trial of chlorine, or the free hydrochloric acid.

Notwithstanding the numerous cures of bronchocele, accomplished by means of iodine, the plan fails in many instances. As Dupuytren observes, the disease depends on different causes. Sometimes it is a simple hypertrophy; sometimes a scirrhus degeneration; and, on other occasions, it is composed of cysts, filled with matter of different kinds. Iodine cannot answer equally for so many affections of diverse character. (*Clinique Chir.* t. iv. p. 467.) According to Dr. Sacchi, iodine is chiefly useful in the hypertrophic and scrofulous forms; less so in the lymphatic; and perfectly ineffectual against small isolated hard goîtres. The best mode of using iodine seems, to Dr. Sacchi, to be friction, with an ointment of hydriodate of potass, continued from one to several months.

Petit, Heister, and Schmucker make mention of inveterate bronchoceles, which gradually subsided, in consequence of suppuration. Volpi states, that such ulcerations are not unfrequent. He has published two facts of this kind, which occurred after a nervous fever; and he records a third case, where the swelling inflamed in consequence of a blow, suppurated, and sloughed, so as entirely to disappear. (See *Léveillé, Nouvelle, Doctrine Chir.* t. iv. p. 128.) A similar fact is recorded by Zipp. (*Siebold, Samml. Chir. Beob.* b. ii. p. 229.)

The disease, in its inveterate form, has also been sometimes removed by the application of caustic; (*Mesny in Journ. de Médecine*, t. xxiv. p. 75.; *Timæus, Cas.* p. 238.); the establishment of issues (*Jeitteles, Obs. Med.*); the making of an incision into the swelling, or the introduction of a seton through it. (*Fodéré, Essai sur le Goître et le Cré-*



tinage, p. 75; Klein, in v. Siebold *Sammlung Chir. Beobacht.*, b. ii. p. 11.; Flajani, *Collezione d' Osservazioni di Chirurgia*, t. iii. p. 283.)

Bronchoceles have sometimes been removed by the part having been accidentally or purposely burnt to a considerable depth. (*Motte, in Blegny, Zodiac. ann.* 2. Febr. Obs. 11.; *Severinus de Efficaci Medicina*, p. 220.) The disappearance of bronchoceles has also been known to follow a wound. (*Schmidmüller über die Ausführungsgänge der Schilddrüse*, p. 37, Landshut, 1805.) A. Burns sometimes employed blisters, and found them useful. (*Surgical Anatomy of the Head and Neck*, p. 204.) With respect to caustic which is spoken of by Celsus (lib. 7. cap. 13.), Flajani states that its operation is tedious and painful, and attended with danger; and what he says about the practice of an incision is not more encouraging. When the disease contains a cyst, he prefers making an opening with a trocar, though he confesses that this plan is apt to be followed by a relapse, when the cyst is very thick and hard; in which circumstance it will be necessary to have recourse either to an incision, or the seton, for the purpose of exciting suppuration. Should the disease, however, be merely composed of one cyst of moderate size, Flajani recommends its entire removal. "Of all these methods (says he), proposed for the extirpation of bronchoceles, the seton is the least dangerous, and by means of it a radical cure may be generally effected without any severe symptoms, as I have found by experience in many cases. On the contrary, I have been an eye-witness of the fatal consequences induced by the other plans. I was called to assist a gentleman, about forty years of age, brought to death's door by a bleeding, which arose from the application of caustic to the fore part of the neck. As tourniquets, bandages, &c. proved quite ineffectual, it was indispensable to make pressure on the part with the finger of an assistant, for twenty-four hours, ere the hæmorrhage could be stopped; a copious suppuration ensued; and it was three months before the parts were healed. I was likewise present (says he) at the opening of a similar, but larger swelling in the same situation, the disease having afflicted an elderly respectable patient for several years. The incision caused the evacuation of a small quantity of serum, contained in the cellular membrane, but the following day the tumor inflamed, the difficulty of respiration increased, and for some days the patient was in great danger. At length, suppuration was established, followed by a destruction of a great deal of the cellular membrane, and several sinuses, and, in five months, the patient lost his life. (*Flajani, Collezione d' Osserv.* t. iii. p. 283. 8vo. Roma, 1802.)

The first proposer of the employment of setons for the cure of diseases of the thyroid gland, is perhaps not exactly known; but it is certain, that the method has been known, and occasionally practised, ever since the middle of the last century. "Dr. Monro, senior (as a well-informed writer has observed), mentions in his lectures, that he has seen a dropsy in the centre of the gland, complicated with bronchocele, cured by a seton, although the glandular swelling still continued." (*A. Burns on the Surgical Anatomy of the Head and Neck*, p. 191.) This statement is given on the authority of some MS. notes taken by Dr. Brown from Dr.

Monro's lectures. According to Girard, many cases in his time had been communicated to the Royal Academy of Surgery, at Paris, in which the disease was got rid of either by means of a seton, drawn through the swelling, or the application of an issue. (*Lupulogic*, &c. 8vo. Paris, 1775. (The occasional success of setons was also adverted to by Richter, in the year 1788. (*Bibliothek*, b. ix. p. 478.) And the plan is spoken of in another work, published in 1790, as being eligible, where the disease is conjoined with a cyst. (*Encyclopédie Méthod. Partie Chir.* t. i. p. 231.) The practice was particularly noticed by Fodéré, in his valuable treatise on bronchocele; and Alibert mentions the seton as being used at the Hospital St. Louis. (*Nosol. Nat.* t. i. p. 466. fol. Paris, 1817.)

In November, 1817, Dr. Quadri, of Naples, tried this practice, which he erroneously supposed to be quite new. "By means of a trocar-pointed needle, six and a half inches long, I passed (says he) a seton from above downwards through the gland, at the depth of about four lines from its surface. Suppuration took place in forty-eight hours. On the 18th of November, the seton escaped, when the matter was squeezed out, and the irritation, occasioned by replacing it, produced an abscess on the right side of the neck, which was opened on the 23d, when it was found that the suppuration had affected the destruction of nearly the whole gland." The woman, who was thirty-six years of age, was seen by Dr. Somerville, in April, 1818, with the circumference of her neck lessened, from sixteen to thirteen inches French measure. In another case, referred to, a seton was passed through each side of the thyroid gland, and the result was the removal of the tumor on the side where the seton had been maintained long enough; but, on the opposite side, the seton being withdrawn too early, the matter collected in the sac, and at the end of four months, a sinus and discharge still continued, the patient refusing to have a counter opening practised. When the seton does not prove stimulating enough, Dr. Quadri sometimes enlarges it, or attaches to it escharotic, or irritating substances. He also frequently uses two setons. In one example, in endeavouring to perforate the gland rather deeply, Dr. Quadri appears to have injured the larger branches of the thyroid arteries, as more than an ounce of blood was discharged, and the tumor swelled, as if injected with blood. The bleeding, however, ceased spontaneously. He states, that the seton has been passed through the tumor not less than sixteen times, the direction being varied in every instance, without untoward accident; and he is confident, that, unless the needle be pushed deep enough almost to touch the thyroid cartilage, the trunks of the thyroid arteries will not be exposed to injury, while the branches, in the track of the needle, will not cause any danger. He insists also upon the propriety of retaining the seton in the tumor a considerable time; and observes, that it remains to be ascertained whether this practice will answer in every description of bronchocele. For these and several other cases and particulars, the profession is indebted to Dr. Somerville. (See *Med. Chir. Trans.* vol. x. p. 16, &c.)

Mr. Gunning applied a seton in a case of bronchocele in St. George's Hospital; but, in this in-

stance, the irritation brought on sloughing, and the patient after a time died. The particulars of this case, and of three successful examples of the practice in England, have been recorded. One of the successful cases was treated by Mr. James, of Exeter, another by Mr. A. Hutchinson, who has taken the trouble to collect the history of them, and the third, by Dr. A. T. Thomson. (See *Med. Chir. Trans.* vol. xi. p. 235.) Percy and Dupuytren also employed setons in bronchocele with success. The plan, however, is sometimes inefficient, as is proved by two cases under Dr. Kennedy, of Glasgow. (See *London Medical Repository*, No. 99. Feb. 1822.) The exact nature of cases relieved by this practice, and their difference from other examples, which are benefited by treatment of a different kind, are still desiderata in surgery.

When a seton was passed through the thyroid gland, Dupuytren always noticed a copious discharge of venous blood; but, he found it soon stop, on desiring the patient to make full inspirations, and applying cold water, and moderate pressure. (See *Clinique Chir.* t. iv. p. 470.) Dupuytren would not have the seton looked upon as capable of curing every bronchocele. Of course, it will produce no favourable change in the scirrhus degeneration of the thyroid gland; but, in cases of hypertrophy, cysts, and hydatids, where iodine and other specifics frequently fail, the disease will be more likely to yield to the seton. (*Id.* p. 471.)

*Ligature of Thyroid Arteries.*—When bronchoceles by their pressure dangerously obstruct respiration, deglutition, and the return of blood from the head; and when the disease resists the efficacy of iodine, a seton, blisters, and every other plan of treatment found deserving of trial, the operation of exposing and tying one or both of the upper thyroid arteries has been practised.

When the quantity of blood flowing into a tumor is suddenly, and greatly, lessened, the size of the swelling commonly soon undergoes a considerable diminution. The experiment was once made by Sir W. Blizard: he tied the arteries of an enlarged thyroid gland, and in a week the tumor was reduced one-third in its size. The ligatures then sloughed off, repeated bleeding took place from the arteries, and, by the extension of hospital gangrene, the carotid itself was exposed. The patient died; yet, as Mr. A. Burns observes, this does not militate against a repetition of the experiment; as the same thing might have happened from merely opening a vein, and, in the confined air of an hospital, has actually happened. (*Surgical Anatomy of the Head and Neck*, p. 202.)

In fact, the rationality of the experiment prevented surgeons from being intimidated by the failure in question, and other gentlemen were soon found who had judgment enough to make further trials of the practice. In a young man, twenty-four years of age, whose breathing was much impeded by a bronchocele, and whose upper thyroid arteries were very large, and affected with strong pulsations, Walther of Landshut tied the left of these vessels, the left side of the gland being the largest. The operation was done on the 3rd of June, 1814. An incision, an inch and a half in length, was made in the direction of the inner edge of the sterno-cleido mastoid muscle, where

the throbbing of the artery was quite distinct. By a second stroke of the knife, the platysma-myoides was divided in the same direction, and to an equal extent. The vessel was then exposed by a cautious dissection, and separated from the surrounding parts, and one arterial branch, which was divided, was immediately secured. A ligature, composed of three silk threads, was then conveyed with an aneurism-needle under the left thyroid artery, and tied with two simple knots. The wound was then closed with adhesive plaster, and the ends of the ligatures brought out at the angles. The ligature on the large artery came away on the twelfth day; and, without any febrile symptoms or other bad consequences, the wound was perfectly healed on the 23rd day. As early as the third day after the application of the ligature, the left part of the tumor began to be less tense, and the throbbing feel in it soon ceased. By degrees, it dwindled away, becoming, as it lessened, harder, and, as it were, cartilaginous. In a fortnight, the left half of the swelling was one-third smaller than before the operation; and, at length, only one-third of it remained, while the right side also was somewhat smaller. On the 17th of June Walther took up the right superior thyroideal artery, which was more difficult to get at, as it lay more deeply, and was much concealed under the enlarged gland, which had pushed it out of its natural situation. The operation lasted three-quarters of an hour; and several large and small arteries which were cut were tied. With respect to the thyroid artery itself, it could not be tied without including a part of the gland in the ligature. No unfavourable symptoms followed this second operation; the ligatures were detached in good time, and the wound healed up very well. The right portion of the bronchocele also now diminished: but, though it was originally smaller than the left, it did not dwindle away so completely as the latter. The remains of the tumor, however, two years afterwards, produced no inconvenience, and respiration was quite easy. (See *Neue Heilart der Kropfes, &c. von Ph. Fr. von Walther*, p. 25, &c. 8vo. Sulzbach, 1817.) On the 28th of December, 1818, Mr. H. Coates, of Salisbury, took up the superior thyroideal artery for the cure of a bronchocele, which, in a young woman, aged seventeen, made pressure on the trachea and œsophagus, attended with a great noise in breathing. The superior thyroideal arteries were in this instance large, and pulsated strongly. Mr. Coates cut down upon the left of these vessels, and passed under it a small round ligature, which was drawn moderately tight, and tied. The next day there was headache, and some swelling of the neck and side of the head, with increased difficulty of swallowing, and febrile symptoms. These complaints, however, were relieved by bleeding and antimonial medicines. The ligature came away on the 9th day; and, on the 14th, the wound was completely healed. On the 14th of February, the breathing being much improved, and the tumor reduced nearly to one-half of its former size, the patient was well enough to be discharged from the infirmary. (See *Med. Chir. Trans.* vol. x. p. 312.) The late Mr. Rose once mentioned to me a case, in which a similar operation, done by Sir Benjamin Brodie, did not produce any material diminution of the tumor.

Two successful cases of ligature of the superior



thyroid artery are recorded by Chelius. (See *J. G. Crosse in Provincial Med.-Chir. Trans.*)

*Extirpation of the Thyroid Gland.*—The diseased thyroid gland has been successfully extirpated; but the operation is one of so much danger that it ought never to be attempted, except under the most pressing circumstances. The many large arteries naturally distributed to the gland itself; their still greater size in bronchocele, and the vicinity of the carotid arteries and important nerves, render the undertaking a thing of no common difficulty. But that it is not impracticable is proved by the following example:—

On the 20th of March, 1791, a woman presented herself for admission at the Hôtel Dieu, with a tumor of the right portion of the thyroid gland. The swelling was two inches in diameter, round, hard, and attached to the right and middle part of the trachea, and it pushed outwards the sterno-mastoideus muscle. Independently of its being sensibly raised by each pulsation of the arteries, it followed the motions of deglutition, and in a slight degree impeded the passage of solid aliment. Desault made an incision through the middle of the tumor, beginning one inch above, and finishing one inch below the swelling. By the first stroke he cut down as far as the gland, dividing the integuments, the platysma myoides, and some fibres of the sterno-hyoid and sterno-thyroid muscles. An assistant, with the view of fixing the tumor, drew it towards the inner edge of the wound, whilst the operator detached it from the sterno-mastoid muscle. In dissecting the cellular substance, two small arteries were divided, which were secured with ligatures. The outer portion of the tumor being thus disengaged, the inner was detached in the same way. The tumor was then drawn outwards by means of a hook, that it might be separated with more ease from the trachea. In the course of this dissection, the branches of the thyroid arteries were successively tied, as fast as they were divided. The assistant who held the hook pulled the gland from within and forwards, whilst the surgeon finished the dissection outwards and from above downwards. This part of the operation was the most difficult: It was necessary continually to wipe away the blood with a sponge, which necessarily prevented the parts from being easily distinguished. By cautious dissection, the superior and inferior thyroid arteries were laid bare, and afterwards tied with the aid of a blunt crooked needle. They were then transversely divided, and the remaining part of the tumor detached from the trachea, to which it strongly adhered. The wound resulting from this operation was nearly three inches in depth; outwardly bounded by the sterno-mastoideus muscle, inwardly by the trachea and œsophagus; and posteriorly by the carotid artery and par vagum, which were exposed at the bottom of the wound. The extirpated tumor was five inches in circumference, and on examination was found to differ in no particular from scirrhus glands, except that in the centre there was a cartilaginous nucleus. The patient got well and left the hospital on the thirty-fourth day after the operation. (See *Desault's Parisian Chir. Journ.* vol. ii. p. 292, 296.)

The extirpation of the thyroid gland is an operation so extremely difficult and dangerous, that whether it ought to be recognised as a justifiable

operation is a question on which well-founded doubts may be entertained. The number and size of the arteries divided, the proximity of the trachea, œsophagus, jugular vein, and carotid, near which the knife must necessarily pass, are the principal dangers, which have deterred the majority of practitioners from performing the operation. The first time that Gooch undertook it, he was deterred from finishing it by the hæmorrhage, and his patient died on the eighth day. The second time he succeeded better, but was incapable of securing the vessels; and the hæmorrhage, which would have been mortal, was only stopped by the pressure of the hands of assistants for the space of eight days. (*Gooch's Med. and Chir. Obs.* p. 130. *Bell's System of Surgery*, vol. v. p. 525. *Richter's Bibl.* t. ii. p. 128.)

Vogel and Theden also performed the operation with success; but no surgeon who has attempted this bold operation has signalled himself so much by it as Dr. Hedenus, of Dresden, who has removed the diseased thyroid gland in six instances with success. His reasons for resorting so often to this difficult operation, he says, are—1st, because he has seen a patient with enlarged thyroid gland, for which the seton had been employed, seized on the ninth day with violent tetanus, which proved fatal in seventeen hours; 2dly, because he considers setons and other similar means unlikely to do good, as he has almost always found portions of cartilage or bone within the diseased part. In one of his cases, the gland was as large as a skittle-ball; it covered the whole of the front of the neck, reaching from the os hyoides to the upper part of the sternum, and pushing back on each side the sterno-cleido-mastoideus and adjacent parts. The circumference of its base was fourteen inches, and its transverse diameter seven. It had a firm, tense, heavy feel. The skin was full of enlarged veins; and the tumor communicated to the hand a throbbing motion, which might have been taken for that of an aneurismal swelling.

The patient was laid on a mattress. Dr. Hedenus then divided the skin in a longitudinal direction, from the hyoid bone to the top of the sternum, and dissected and turned back the skin and platysma myoides, on each side, to the extent of two inches. The sterno-hyoid and sterno-thyroid muscles were then seen firmly adherent to the whole tumor. An attempt was made to separate them from the swelling; but, scarcely had the dissection extended a quarter of an inch, when a copious stream of blood proceeded from numerous small arteries, which could neither be tied, on account of their minuteness, nor stopped with styptics. Hedenus, therefore, determined immediately to cut through the above-named muscles at their points of attachment, above and below, and to remove the intervening portions with the tumor.

Respecting this part of the operation, it merits particular notice, that, after the cure, the motions of the hyoid bone and larynx, and the functions of respiration, speech, and deglutition, all remained unimpaired; which was also the case in four other instances, in which Hedenus removed portions of the sterno-hyoidei and sterno-thyroidei muscles.

Hedenus next separated the swelling, above and below, from the sterno-cleido-mastoid and

omo-hyoid muscles, and also from the jugular vein and carotid arteries, to which it was closely adherent, until he had freed it as far as the point, where the thyroid arteries originate. He then tied the superior and inferior thyroideal arteries, close to the tumor, and, on account of the free anastomoses, applied to each vessel two ligatures, and divided it in the interspace. The more deeply the dissection now reached, the more hazardous did the operation appear, as, at every cut of four or five lines, he was obliged to tie two or three arteries, which was done with great difficulty. After most cautiously dissecting to the base of the tumor, which was firmly attached to the thyroid cartilage, and the three upper rings of the trachea, he met with so many arteries, for the most part as large as the radial, or digital, that, in order to prevent further loss of blood, he decided to tie the base of the swelling, and then cut away the tumor above the ligature. For this purpose, he used a blunt-pointed aneurismal needle, armed with two four-threaded ligatures. This was passed through the middle of the base, while the tumor was pulled upwards; and one ligature was then firmly tied over the lower, and the other over the upper half of the base. For the sake of being still more sure of commanding the hæmorrhage, Hedenus also applied a third ligature all round the swelling, and he then extirpated the diseased gland, without any bleeding from the part included in the ligatures. These were now fastened at the sides of the wound with adhesive plaister. The whole surface of the wound was sprinkled with powdered gum arabic, over which was laid agaric, wet with Theden's vulnerary lotion. These applications having been covered with charpie, the lips of the wound were drawn towards each other with adhesive plaister, which was also covered with compresses, wet with vinegar, and renewed every six or eight minutes.

The patient suffered a great deal of indisposition, which at first chiefly consisted of difficult deglutition, severe pain all over the right side of the head, imperfect use of the arm, frequent cough, and hoarseness. In the afternoon, blood began to flow through the bandage, and, as the bleeding had not abated, after an hour's pressure with the hand, the dressings were removed, and the blood found to proceed not from any particular artery, but from all the wounded surface. The wound was again sprinkled with gum arabic, which was covered with sponge and a bandage: two surgeons were also directed to keep up pressure with their hands. The day after the operation, the febrile symptoms ran high, but in two days subsided again. On the eighth day, all the ligatures came away, even that which had encircled the tumor, and a large quantity of fetid matter was discharged. Soon afterwards a considerable bleeding arose, which however was stopped with sponge and alum powder. On the sixteenth day, another serious hæmorrhage was occasioned by a convulsive cough, and life was endangered by the loss of not less than two pounds of blood. The bleeding, which came from the upper angle of the wound, was stopped by means of a piece of sponge, dipped in rectified spirit, and covering the wound and indeed the whole neck with compresses, wet with vinegar, pressure being also kept up on the sponge with the hand. The dangerous state of the patient may be conceived, when it is known that

there was now a deadly paleness of his whole body, languid eyes, dimness of vision, loss of hearing and speech, and extreme prostration of the vital powers. With the aid of judicious treatment, however, he rallied, and in the end left the hospital quite cured.

In another case operated upon by Hedenus, the difficulties were even greater, owing to the extension of a portion of the right lobe of the thyroid gland, as far back as the transverse processes of the cervical vertebræ; but after the third day from the operation, the progress to recovery was not interrupted by any bleedings. (See *Graefe's Journ.* b. ii. p. 237, &c. or the *Quarterly Journ. of Foreign Med.* No. xix.)

There can be no doubt that the method adopted by Hedenus was well calculated to obviate the great source of immediate danger, viz. the bleeding. So long as it was practicable, he took up every vessel, which he exposed or divided; and when this plan could not be continued, he tied the base of the tumor, ere he detached the enlarged gland from the larynx. This tying of the base of the swelling, though sometimes practised on other occasions, as in the removal of diseased axillary glands, constitutes the chief peculiarity of Hedenus's method.

Mr. Liston has more than once removed enlarged portions of the thyroid body, which had caused serious inconvenience, and with safety, by combining incision and ligature. The coverings of the tumor are divided and turned back, the dissection is continued towards the base of the mass, as far as it can be done with safety; strong needles, fixed in handles, are passed underneath it from above downwards, and from the side, crossing the first at right angles. (*On Practical Surgery*, p. 276.) By means of these, the tumour is strangulated. I saw one case in University College Hospital, where Mr. Liston thus extirpated a considerable portion of a large bronchocele from a young woman's neck.

A case has been published, in which Klein attempted the removal of an enlarged thyroid gland: the patient, a boy, eleven years of age, died on the operating table. (See *Journ. der Chir.* b. i. p. 120. 8vo. Berlin, 1820; or the *Quarterly Journ. of Foreign Medicine*, vol. ii. p. 380.) The removal of the thyroid gland was attempted by M. Roux: after an operation, which lasted above an hour, and the application of 47 ligatures, about one half of the gland, of the size of an orange, was removed; the patient surviving 56 hours. The Hôpital-Interne, who relates this case, remarks, that we may place this amongst the operations which the prudent surgeon will scarcely feel himself justified in undertaking. (See *J. G. Crosse*, in *Provincial Med. Chir. Trans.* vol. v.)

*Albucasis*, gave the first good account of Bronchocele, *Wilmer's Cases and Remarks in Surgery*, with an Appendix on the Method of Curing the Bronchocele in Coventry, 8vo. Lond. 1779. *Prosser*, An Account and Method of Cure of Bronchocele, or Derby-neck, 8vo. Lond. 1769: also, 3rd edit. 4to. Lond. 1782. *Memoirs of the Med. Society of London*, vol. i. *Gooch's Chirurgical Works*, vol. ii. p. 96; vol. iii. p. 157. *Desault's Parisian Chirurgical Journal*, vol. ii. p. 292. *Œuvres Chirurgicales de Desault*, par Bichat, t. ii. p. 298. *V. Malacarne*, Lettre sur l'Etat de Crétin: (Frank. Del. Op.) Edin. Med. and Surgical Journal, vol. iv. p. 279. *Otier's Manuel de Médecine Pratique*, 8vo. Genève, 1811. *Dr. Reeves's Paper on Cretinism*, in Edin. Med. and Surg. Journal, vol. v. *Traité du Goître, et du Crétinisme*, par F. E. Podère,



svo. Paris. an. 8. *Richter's* Anfangsgründe der Wundarzneikunst, b. iv. kap. 13. von Kropfe. Surgical Anatomy, of the Head and Neck, by *A. Burns*, p. 191, &c. *Larrey*, Mémoires de Chirurgie Militaire, tom. i. p. 123; t. iii. p. 199, &c. *J. F. Ackermann*, über die Kretinen, eine besondere Menschenabart in den Alpen. svo. Getha, 1790. *B. S. Barton*, A Memoir concerning the Disease of Goitre, as it prevails in different parts of North America, svo. Philadelphia, 1800. Memoria Patologico-Practica sulla Natura di Gozzo, &c. del Dottor Prospero Postiglione, 12mo. Firenze, 1811. *Kartum*. Comment. de Vitio Scrofuloso, t. ii. *Giuseppe Flajani*, Collezione d'Osservazioni e Riflessioni di Chirurgia, t. iii. p. 270. &c. svo. Roma, 1802. *Quadri*, in Med.-Chir. Trans. vol. x. p. 16. Dict. des Sciences, Méd., art. Bronchocele. *Ph. Fr. Walther*, Neue Heilart des Kropfes durch die Unterbindung der obern Schilddrüsen Schlagadern nebst der Geschichte eines durch die Operation geheilten Aneurismas der Carotis, svo. Sulzbach, 1817. *H. Coates*, in Med.-Chir. Trans. vol. x. p. 312. &c. *Gautieri Tyroliensis*, Carynthiorum, Styriorumque Struma; Vienna, 1794. *Maas*, Diss. de Glandula Thyroidea tam Sana quam Morbosa, &c. Wircebi. 1810. *Hausleutner*, über Erkenntniss, &c. des Kropfes, in *Horn's* Archiv. b. xiii. 1813. *Mühlbach* der Kropf, nach seiner Ursache, Vehrütung, und Heilung. Wien. 1822. *Hedenus*, Tractatus de Glandula Thyroidea, &c. Lips. 1822. *Lassus*, Pathologie Chirurg. t. i. p. 408, &c. *Petit*, Œuvres Posthumes, t. i. p. 255. *Haller*, Opuscula Pathologica, Obs. v. p. 16. *J. L. Alibert*, Nosologie Naturelle, t. i. p. 464, &c. fol. Paris, 1817. *A. C. Hutchinson*, Cases of Bronchocele, or Goitre, treated by Seton: Med.-Chir. Trans. vol. xi. p. 235, &c. *A. de Humboldt*, Observations sur quelques Phénomènes peu connus qu'offre le Goitre sous les Tropiques, dans les Plaines et sur les Plateaux des Andes; in Journ. de Physiologie par *F. Magendie*, t. iv. p. 109, svo. Paris, 1824. Observations on the remarkable Effects of Iodine in Bronchocele and Scrofula; being a translation of three memoirs published by *J. R. Coindet*, M.D. Lond. 1821. *J. C. Straub*, in Naturwissenschaftlicher Anzeiger der Allgemeinen Schweizerischen Gesellschaft, &c. herausgegeben von *Fr. Meisner*, 4to. Bern. Feb. 1820. *Breya*, Saggio Clinico sull' Iodio, &c. Padova, 1822. *W. Gairdner*, M.D., Essay on the Effects of Iodine, with Practical Observations on its use in Bronchocele, Scrofula, &c. Lond. 1824. *H. S. Roots*, in Med.-Chir. Trans. vol. xii. p. 310. *Coster* in Archives Générales de Médecine, Juillet, 1823. *J. Kennedy*, in London Med. Depository for Feb. 1822. *Dr. A. Manson*, Medical Researches on the Effects of Iodine in Bronchocele, &c. Lond. 1825. *M. Roulin*, Note sur quelques Faits relatifs à l'Histoire des Goîtres; in *Magendie's* Journ. de Physiologie Expér. t. v. p. 266. *J. A. W. Hedenus*, Ausrottung der Schilddrüse, in Journ. der Chir. von *C. F. Graefe* und *Ph. Von Walther*, b. ii. p. 237, &c. or Journ. of Foreign Medicine, vol. v. p. 317, &c. *Sacchi*, Annali Universali, Dec. 1832. *Dupuytren*, Leçons Orales de Clinique Chir. t. iv. p. 464. Paris, 1834. For the best plates of the disease, see *Dr. Baillie's* Series of Engravings, &c. fasc. ii. tab. 1.

**TONGUE, DISEASES OF.** This organ is subject to various diseases, as inflammation, ulcers, cancers, paralysis, tumors, and a rapid swelling of it, sometimes causing imminent danger of suffocation.

When any morbid action is set up in the tongue many things contribute to maintain it. "The extreme mobility of the organ; the almost continual use of it in eating, drinking, and speaking; the contact of the teeth, which are often irregular and decayed, are quite sufficient to interrupt any efforts to restore a healthy action. It often happens, too, that the part is so very tender that the patient cannot bear to cleanse the mouth and teeth, which soon become incrustated; and, from this source alone, the complaint will be greatly aggravated, and the discharge rendered fetid and irritating." *H. Earle*, in *Med. Chir. Trans.* vol. xii. p. 283.) The matter with which the

teeth become incrustated in these cases is composed of phosphate of lime and mucus; and in a case recorded by *Paletta* the quantity of it was very considerable.

Carious teeth, with points and inequalities, producing continual irritation, are the most frequent cause of ulcerations of the tongue. The sores thus arising often resist every kind of remedy, and ignorance of the cause sometimes leads the practitioner to consider them as irremediable; whereas a cure may easily be effected by extracting the carious tooth, or simply filing off its sharp irregularities, as was anciently directed by *Celsus*.

*Glossitis*.—*Dr. Graves* has recorded the particulars of an interesting case of an idiopathic glossitis, affecting only one half of the tongue, the median line forming a perfect boundary between the swollen and the healthy parts. The swelling nearly filled the entire cavity of the mouth, which could scarcely be closed on account of the protrusion of the tongue. "Two or three applications of six leeches at a time to the inflamed half, part of which at my first visit, appeared on the verge of gangrene, produced a speedy decrease of the tumor and the inflammation. The bleeding from the leech-bites was very great. In consequence of the detumescence of the tongue, articulation and deglutition, which before had been very difficult, were quickly restored. The patient is at present (two years since the attack) able to speak perfectly, although the left half of his tongue is still perceptibly increased in size." (*Dr. Graves*, in *Dublin Hospital Reports*, vol. iv. p. 43.) As this gentleman has observed, true idiopathic glossitis is an extremely rare disease. *J. P. Frank* only saw one case of it during his whole life. In none of the four cases observed of late years in different parts of Europe was the inflammation limited to one half of the tongue. (See *Elbuig* in *Graefe and Walther's Journ.* b. vii. 2 tes. Hest and *Edinb. Journ. of Med. Science*, No. i.) The disease is formidable and tedious, unless blood be taken directly from the tongue. For this purpose *Dr. Graves* prefers leeches both to incisions in the dorsum of this organ and to puncturing the sublingual veins.

For further information on idiopathic glossitis, a paper by *Orgill* may be referred to. (See *Glasgow Journ.* vol. iv.)

The whole of the tongue sometimes inflames, and becomes considerably enlarged, either spontaneously and without any apparent cause, or in consequence of some other disease; or else from some particular irritation, such as that of mercury, or some poisonous substance. *Slegel*, who was at Paris about the middle of the 17th century, saw a patient in a salivation, whose tongue became so enormously enlarged that the mouth could not contain it. *Pimprinelle*, an eminent surgeon of that time, was sent for, and finding that all trials to relieve the affection were in vain, amputated one half of the tongue, with the view of preventing its mortification. After the wound had healed it is said the patient could articulate very well. *Louis*, from whom this fact is quoted, justly remarks that the measure resorted to by *Pimprinelle* was an exceedingly violent one, for he had often seen urgent symptoms, occasioned during a salivation by a rapid and enormous swelling of the tongue, quickly yield to bleeding, purgative clysters, change

of air, and the discontinuance of mercury. Several facts confirming this statement have fallen under my own notice.

Trincavellius mentions two women who had considerable enlargement of their tongues. One, who was young, had been rubbed with mercurial ointment on her head; but in the other, who was about fifty years old, the complaint arose from the small-pox. The excessive swelling of the tongue, in both these instances, terminated in resolution. Another case of ulceration, enlargement, and protrusion of the tongue is recorded by Paletta, who recommended the reduction of the part into the mouth, keeping the jaw closed with a bandage, and the frequent use of vinegar and alum gargles. The result is not stated. (See *Journ. of Foreign Med.* No. xix. p. 457.)

When the urgency is such that an immediate diminution of the swelling becomes necessary for the relief of the symptoms, the plan of making one or two deep incisions along the tongue is strongly recommended. See the cases inserted by De la Malle, in the 5th volume 4to. of the *Mém. de l'Acad. de Chirurgie*, and some others, related by Louis in the paper above cited.

A man, recovering from a bad fever, was suddenly attacked with pain in the tongue, followed by a swelling equally large and rapid in its formation. In less than five hours the part became thrice as large as it is in its natural state, and in this space of time, De la Malle, who had been consulted, bled the patient successively in his arm, neck, and foot. The man felt very acute pain, his skin was excessively hot; his face was swelled, his pulse was hard and contracted, and his look wild. He could hardly breathe; the tongue filled all the cavity of the mouth, and protruded between the lips. In this very urgent case three parallel incisions were made along this organ; one along its middle, and the other two between the one in the centre and the edges of the part affected. The cuts extended through two-thirds of the preternatural swelling, and had all the good effect which could possibly be desired. There was a great deal of hæmorrhage, and the enlargement of the tongue subsided so much, that, an hour after the operation the patient was able to speak. The next day, the incisions had the appearance of being only superficial scarifications, and the tongue was in its natural state. In short, the incisions healed in a few days, with the use of a simple gargle.

De la Malle quotes several other cases, all of which exhibit the success which he met with from this practice. He quotes also the testimony of authors, antecedent to him, who recommended this method; and, in particular, he cites Job à Meckren, who adopted the plan in a case where the tongue, together with the tonsils and palate, became spontaneously affected with a sudden and dangerous degree of swelling. This treatment is found to answer by modern practitioners. (See *Journ. Universel*, &c. June, 1823.)

*Tongue, Prolapsus of.* I am indebted to Mr. Crosse, of Norwich, for the following observations. In some infants, at the time of birth, the tongue projects constantly beyond the lips, forming the first stage of this disease; and if irritants or astringents be not applied, so as to cause the tongue to retract itself into the mouth, the displacement will gradually increase, until it assumes a formidable appearance and creates serious inconveniences.

When once a portion of the tongue remains permanently out of the mouth in this prolapsed state, it goes on augmenting in size from constant irritation by exposure, from dependent position, and from constriction of the sphincter oris, and at length hangs over the chin, causing eversion of the lower lip. The organ is elongated and hypertrophied, without any separate organic disease being present. The great weight of the dependent mass draws up the *os hyoides* and *larynx*, whilst it depresses the mental portion of the lower jaw, and gives to the front teeth a forward or horizontal direction. The saliva escapes continually; the speech is defective; food can only be very imperfectly taken into the mouth, and is swallowed with effort. When the malady has existed for years several inches of the tongue are permanently exposed, the upper surface becoming furred and parched, and the inferior ulcerated by pressure of the decayed incisor teeth. The patient, a disgusting object, suffers in his health from being imperfectly nourished, and perhaps also from being mentally depressed.

In numerous instances where this malady has been present in an extreme degree, and its nature and causes not clearly understood, excision by the knife or ligature has been practised, and a recovery effected; but the right and more scientific treatment, ably pointed out by Professor Lassus, though adopted by few of his successors, consists in the gradual reduction of the prolapsed and swollen mass by leeches, lotions, bandages, and support, until the tongue can be replaced within the mouth, where it will return to its normal size, even before there has been sufficient time for the deformity of the lower jaw, and of the teeth to be corrected by proper mechanical aid, and for the lower front teeth to meet the upper. In a girl six years of age, where the tongue prolapsed between three and four inches, and was above six inches in circumference, Mr. Crosse, of Norwich, recently succeeded in replacing the prolapsed part within the mouth in a few weeks, avoiding the severe operation of excision, which it is rarely, if ever, justifiable to perform for the disease in question. (*Lassus, Pathologie Chirurgicale*, t. ii. p. 160. *London Med. and Phys. Journal*, vol. vi. p. 354. *Edinb. Med. and Surg. Journal*, vol. i. p. 317. *Mr. Crosse's Memoir*.)

[Abscess occasionally occurs in the tongue, but it is by no means common. It is usually deeply seated in the substance of the organ, and occasions more or less suffering, with much difficulty in articulation. It is mostly the sequel of inflammation of the gland follicles, and should be opened as soon as detected. Mr. Erichsen mentions a case in a boy, and Sir W. Fergusson and Mr. Holmes Coote relate one or two in adults. These abscesses require a deep incision into the swelling, and that the contents of the cyst should be pressed out, the mouth being afterwards frequently cleansed with warm water, and subsequently an astringent gargle of alum and myrrh may be used to contract and obliterate the cyst.]

*Ulcers of the tongue* frequently arise not only from irritation occasioned by the friction of carious teeth, but they are often seen in persons of dyspeptic or intemperate habits. These ulcerations assume the appearance of small white aphthous spots, with a cracked or fissured condition of the tongue, and often with indurated lumps of epi-



thelium on its surface, especially at the posterior part of the organ. These merely require the removal of any exciting cause, and a slight alterative treatment, to be followed by the administration of Quin. Sulph. in Tinct. Cinchon. Comp. or perhaps the dilute Nitro-Hydrochl. Acid. in the Infus. Anthemidis.

*Syphilitic ulcers* are not unfrequently seen on the sides of the tongue, and on the mucous lining of the mouth and lips. They appear as irregular elongated sores of a pale, unhealthy hue, and secreting a thin ichorous discharge. They generally follow certain severer symptoms of constitutional syphilis, and create much derangement of the health from the suffering occasioned by them in mastication.

The *syphilitic induration* of the tongue often accompanies the above condition, and assumes the form of a round hard tubercle; it is mostly seen in the centre, or thickest part of the organ. This tubercle sometimes ulcerates; but in most instances remains quiescent, and yields, like the former symptoms, to a mild treatment. The Potass. Iodid., with Sarsaparilla, is most efficacious, or small doses of Hydr. Perchlor. with Tinct. Cinch. Comp. may be given.]

Under the name of *glossanthrax*, or *malignant pustule of the tongue*, a variety of gangrene has been described, which has its seat in this organ. It commences with a vesicle, which appears on some point of the surface of the part, and is filled with bloody serum. From being at first livid it soon puts on a black appearance, bursts, and under it the gangrenous ravages may proceed further and further, until the whole of the tongue is left in a state of sphacelus. In a case of this degree of severity delirium comes on, and the patient soon dies. It is alleged to be a common disease in horses kept in damp places and upon moist food. (See *Andral, Anat. Pathol.* s. 2, p. 243.) The treatment should be conducted according to the plans found most efficient in other examples of malignant pustule.

[*Wounds of the tongue* are frequently witnessed, and may be the results of either external violence, or of injury by the teeth in fits of epilepsy. These may be only superficial, or they may be deep-seated, penetrating through the substance of the organ, or perhaps the apex of the tongue may be bitten off. In these cases, should the bleeding be profuse, ice should be kept in the mouth for some time, which generally suppresses it, or, if necessary, the bleeding vessel should be secured by passing a strong needle, armed with a ligature, through the adjoining parts, or the application of the perchloride of iron may be resorted to; but in most cases the injured parts will recover their previous condition with little or no treatment.

*Tongue-tie.*—We are often consulted by parents to know if their child is tongue-tied, in consequence of some difficulty being experienced in their articulation, or if in an infant, in the process of sucking. The mother generally complains of the infant making a clucking noise, together with an inability to retain the nipple within the gums. The frænum is generally too short, and depresses the anterior part of the tongue, thus preventing its free movement forwards. To remedy this the frænum should be slightly divided with blunt-pointed scissors, their point being directed towards the floor of the mouth, in order to avoid any injury to the

ranine arteries. A short time ago the writer was sent for in consequence of continued bleeding from the ranine artery after this operation by a surgeon, but it was soon stopped by pressure with the finger, and the infant was denied the nipple for a time.

*Nævi* are occasionally met with in the tongue; but are extremely rare. They appear as a swelling of a livid blue color, occupying the under part and sides of the organ. Sometimes they bleed profusely, and demand either the ligature or extirpation by the knife; but in many instances they remain quiet, and call for no active treatment.

*Warts* sometimes grow on the tongue, and produce much pain and annoyance from their friction in articulation or in eating. They are considered by some surgeons as arising from a syphilitic taint, but in most instances they appear without any such evil. They should be cut off with scissors, and the surface frequently touched with Argenti Nitras, or the Cupri Sulphas afterwards.]

The glandular papillæ, situated on the dorsum of the tongue, have a narrow base, and a broad termination or head, like a mushroom. They are capable of becoming considerably enlarged, so as to form preternatural tumors, which may be mistaken for cancerous excrescences. A young man, eighteen years of age, had on the middle of his tongue a circumscribed tumor, about as large as a middle-sized nutmeg. Louis, who was consulted, perceived that the swelling was only of a fungous nature, and he tied its base with a ligature, with the noose of which he contracted the diameter of the pedicle, while with the ends he kept down the tongue. Then with one stroke of a pair of curved scissors, he cut off the tubercle. Caustic was afterwards applied to the base of the tumor, and the patient was perfectly well in five or six days. (*Mém. de l'Acad. de Chir.* t. v.) Similar tubercles are mentioned by Morgagni.

A peculiar disease of the tongue was met with in a boy by Mr. Earle. "Clusters of very minute semitransparent vesicles pervaded the whole thickness of the tongue, occupying nearly one-half, and projecting considerably both above and below that organ. The slightest injury caused them to bleed profusely, and in some places the clusters were separated by deep clefts, which discharged a fetid irritating sanies. This disease, which had resisted various plans of treatment, both local and constitutional, gradually yielded to perfect quiet, cleanliness, large doses of hyoscyamus, which were increased to 3j. of the extract daily." (*Med. Chir. Trans.* vol. xii. p. 285.) The same medicine, he says, he employed with most unequivocal good effect in many cases of ragged irritable ulcers of the tongue.

*Cancer.*—The tongue is occasionally affected with a true cancerous disease; one of the most afflicting cases, indeed, which can possibly happen, as in the advanced stage of the disease the patient can hardly take his food, which must be conveyed over the tongue before it can be swallowed, while he is obliged to write whatever he wishes to say. (See *Home's Pract. Obs. on Cancer*, p. 112.) Cancer of the tongue seems to differ from other carcinomatous affections in sometimes occurring in youngish subjects. In the course of the disease the glands behind the jaw and in the neck become affected. M. Louis saw a lady, who had an ulcerated

cancerous tubercle on the left edge of the tongue. The little swelling was circumscribed; its size did not exceed that of a filbert; the pains were lancinating; the sore had penetrated deeply, and its tuberculated edges were affected with scirrhus hardness. Extirpation of the disease seemed to present the only chance of cure; but the patient refused to accede to anything but palliative plans, and she died in the course of a few months.

One of the best descriptions of cancer of the tongue is that of Mr. Travers. "The disease," he says, "is not a smooth and firm rounded tubercle, such as is often met with in this organ, but an irregular rugged knob in its first stage, generally situated in the anterior third, and midway between the raphe and one edge. It sometimes, but seldom, extends across the middle line, although it often extends alongside of it. The hardness is unyielding, inelastic, and the mucous surface puckered and rigid. It also gives to the finger and thumb of the surgeon the sensation of solidity, or of its penetrating the entire muscular substance, being perceived equally on either surface. Sharp shoots of pain are felt through the side of the affected organ, towards the angle of the jaw and ear. The disease tends to run backward towards the base or posterior edge. It sometimes acquires great bulk before ulceration takes place, so as to project the tongue from the mouth. In this state, a female patient of mine was seen some time ago in St. Thomas's Hospital, in whom the permanent projection of the diseased organ, beyond the widely distended lips, was from three to four inches. Life was sustained for a time by nutritive injections. The ulceration often extends from the edge of the tongue to the membrane of the mouth and gums, when the elevated and distended membrane at length gives way, and ulceration is rapid. The surface of the ulcer is very uneven, clean and bright granulations appearing in parts, and in others deep and sloughy hollows. The darting pain is very acute, but only occasional. There is a dull aching always present, and as constant a spitting as in deep salivation. The irritation is such as soon impairs the powers of life. It happens to strong and hitherto healthy persons, for the most part males from the age of forty onwards. There is generally an evening paroxysm of pain, and the nights are much disturbed by the secretion accumulating in the throat and exciting cough. Often the patient is roused by a painful compression of the tongue falling between the jaws. The leaden hue of the countenance, the loss of flesh, and difficulty of taking food, although symptoms of the advanced stage of the disease, are observed long before the appetite or muscular powers fail in proportion. Frequent moisture with mild fluids, as tepid milk and water, or confectioner's whey, is grateful to the patient. Towards the fatal termination of the disease occasional profuse hæmorrhages take place at shortening intervals, and alarm and weaken the patient, who ultimately dies tabid and exhausted, generally with symptoms of more extensive disease of the mucous membrane in other parts." (*Med. Chir. Trans.* vol. xv. p. 245.)

[According to Mr. Erichsen, these affections usually commence as epithelioma, with tubercles or fissures, more rarely as scirrhus in a solid mass in the body of the organ; most commonly the dis-

ease is situated at the sides, but occasionally the tip is affected. If it appears as a tubercle, or warty growth, it is usually flat, indurated, and of a purplish-red colour, gradually running into ulceration; if with a fissure, this from the commencement has an indurated base, a foul surface, and an everted edge. As the ulceration extends, a chasm with ragged sides, a sloughy surface that cannot be cleansed, and a widely indurated base gradually form; there are great fetor of the breath, profuse salivation, and, as the disease progresses, implication of the mucous membrane and of the structures of the floor of the mouth, and of the sub-maxillary or sub-lingual glands takes place. The lymphatic glands under the jaw usually become involved at an early period, but the disease may exist for a year or two without their becoming implicated. Cachexy at last supervenes, and the patient dies from the conjoined effects of exhaustion, irritation, and poisoning of the system (*Erichsen's Science and Art of Surgery*).]

Forestus relates the cases of four women who were attacked with cancer of their tongues, and died from the ravages of the disease and hæmorrhage. In the writings of Hildanus there is a description of the origin and progress of a cancerous tubercle on a young man's tongue, whose breath was intolerably fetid, and who died in the most excruciating pain. The same author informs us of another case, exhibiting the good effects of sedative remedies in palliating a cancerous ulcer of the tongue.

[Cancer appears in the tongue in three different forms, as epithelioma, true hard cancer, or as a warty excrescence with an indurated base, and at a later stage these forms assume the same appearances in every respect. The symptoms in the early stage are very similar in each; they gradually ulcerate on their surface, forming a foul sore, and infiltrate the glands, muscles, and neighbouring tissues with cancerous deposit. The disease may occur on the apex of the tongue, or the sides, or towards the base, and, according to the situation of the cancer, a peculiar treatment is to be adopted. It is a well-known fact that no therapeutical agents have any effect on it, either when applied externally or administered internally, but on the contrary their adoption is productive of a delay which eventually proves fatal to the sufferer. At the earliest period of discovery, before any glandular enlargement has taken place, or constitutional effects have shown themselves, the diseased portion should be removed, wide of the affected part, to afford the patient any chance of recovery, or even of a temporary cessation of suffering.]

Diseased portions of the tongue admit of removal with the ligature. (*La Motte, Chirurgie, Obs.* 208; *Godart, in Journ. de Méd.* t. xiii. p. 66; *Sir E. Home, Pract. Obs. on Cancer, p.* 208; *Inglis, in Edin. Med. and Surgical Journ.* 1803. No. i. p. 34.) Sir E. Home generally passed a double ligature through the centre of the tongue, behind the diseased portion, and then tied the threads tightly over each half of the organ, so as to make all the part in front of the constriction slough away. If a large portion of the tongue is involved, Mr. Liston has recourse to ligatures: "these are passed wide of the disease, by means of needles fixed in handles, the perforations for the thread being close to their points. Two or more



ligatures are introduced, and by these others and stronger ones are drawn through and tied, so as to strangulate the whole base. With the view of saving pain and abridging the process as much as possible, they should be drawn with extreme tightness. The salivation is most profuse, and the discharges and effluvia very offensive. Some lotion, to correct this as much as possible, may be prescribed, and after the separation of the dead part the healing promoted by various applications. Tumors situated on the posterior part of the tongue, and projecting from it, may be thus removed, care being taken in introducing the needles to guard with the finger the epiglottis, &c." (See *Liston on Practical Surgery*, p. 250.)

When the diseased portion is favourably situated, and not extensive, Mr. Liston prefers the vulsellum and knife, "there being no great difficulty in holding the organ so as to secure any vessel or take other means of arresting the flow of blood." (*On Practical Surgery*, p. 250.)

When any part of the tongue has been amputated the bleeding vessels are to be tied, if possible; but when this cannot be accomplished powerful styptics may be applied, and if these fail the actual cautery. When only a piece of the tongue is cut out, in the shape of the letter V, the best mode of stopping the bleeding is to bring the sides of the incision together with a suture, by which plan the deformity will also be lessened, and the union expedited, as was exemplified in a case recorded by Langenbeck. (*Neue Bill.* b. ii. p. 489.) Rather than suffer a patient to die of hæmorrhage, if the cautery or other means fail, the lingual artery should be taken up where it passes just above the cornu of the os hyoides.

If the apex be the seat of the disease, it may be removed without much difficulty. The patient should be placed opposite a window where the light falls upon the mouth, and the head should be steadied by an assistant, when the surgeon grasps the tumor with a vulsellum, and removes the diseased portion with a probe-pointed bistoury to avoid wounding the floor of the mouth. The ranine artery may require a ligature, but any other bleeding may be suppressed by keeping ice in contact with the bleeding surface for a short time. The wounded surfaces usually granulate, and perhaps heal quicker and more agreeably to the patient than if sutures were passed through to approximate the edges. When the disease is situated in the centre or sides of the tongue the ligature should be resorted to, and the diseased portion strangled with strong whipcord passed through with an ordinary nævus needle.

[This mode of procedure is tedious and painful to the patient, but much suffering may be spared by the division of the gustatory nerve previous to this operation, as recommended and performed by Messrs. Hilton and Moore. If the base of the tongue or its deeper portion should be diseased, the *écraseur* must be used, and worked slowly and cautiously until the tongue is extirpated. The hæmorrhage from the lingual arteries will not be considerable, and, according to M. Chassaignac, will be followed by a favourable result. This surgeon removed the tongue at its base by passing the chain of an *écraseur* from without through the floor of the mouth, and a second chain to detach the tongue from the surrounding soft parts. M. Rignoli has removed considerable portions of the

tongue with cancerous disease at its base by carrying his incision from one angle of the lower jaw to the other, dividing all the intervening parts vertically, and afterwards, by drawing the tongue downwards and forwards through the wound, large portions of it were both excised and ligatured by him. Mr. Arnott and others recommend an incision being made through the floor of the mouth, passing between the genio-hyoid muscles to the base of the tongue, when a ligature may be placed around that portion, or it may be excised if thought necessary.

Mr. Syme and Mr. Fiddes have both excised the tongue by making an incision through the lower lip, and symphysis of the lower jaw, at the same time forcibly separating the two halves of the bone.

The two first operations performed by Mr. Syme for removal of the tongue were attended with fatal results. The third, however, proved successful. In the latter case, he thus describes the operation, performed December 29, 1864:—

"Having extracted one of the front incisors, I cut through the middle of the lip, and continued the incision down to the os hyoides, then sawed through the jaw in the same line, and, insinuating my finger under the tongue as a guide to the knife, divided the mucous lining of the mouth, together with the attachment of the genio hyoglossi. While the two halves of the bone were held apart, I dissected backwards, and cut through the hyoglossi, along with the mucous membrane covering them, so as to allow the tongue to be pulled forward, and bring into view the situation of the lingual arteries, which were cut and tied, first on one side and then on the other. The process might now have been at once completed had I not feared that the epiglottis might be implicated in the disease, which extended beyond the reach of my finger, and thus suffer injury from the knife if used without a guide. I therefore cut away about two-thirds of the tongue, and then, being able to reach the os hyoides with my finger, retained it there while the remaining attachments were divided by the knife in my other hand close to the bone. Some small arterial branches having been tied, the edges of the wound were brought together and retained by silver sutures, except at the lowest part, where the ligatures were allowed to maintain a drain for the discharge of fluids from the cavity.

"Next day I visited the patient, and finding him in all respects comfortable, inquired if he could swallow. In reply he pointed to a drinking cup containing milk, and intimated that he wished it to be filled; then, placing the spout between his lips, while his head was bent backwards, he drank the whole without any cough or sputtering. Having seen this, I felt assured that the result would be satisfactory, and was not disappointed, as everything went on well afterwards. The only inconvenience experienced was from the edges of the jaw being occasionally displaced; but this was easily remedied by an ingenious contrivance of Mr. Wilson, the dentist, who, finding that a silver cap inclosing the teeth was not sufficient for the purpose, fashioned a shield of gutta percha, embracing the chin on each side, and secured to the metal plate by a wire.

Under an ample supply of nourishment by milk, soup, and soft solid food, there was a rapid return

of strength, so that an improvement in this respect was almost daily observable; and before the end of three weeks the patient declared that he had never felt better in his life. He returned to Manchester on January 23rd.

"Excision of the tongue has thus afforded complete relief in a case of the most formidable and distressing disease. How far the relief thus obtained may prove permanent, and how far it may admit of being extended to cases of similar kind, are questions that can be determined only by experience. But the frequency of malignant growth affecting the tongue in an otherwise sound state of the system urgently requires the truth to be ascertained in regard to the value of a remedial measure; and if the operation is now, as I trust it has been, freed from the chief danger attending its performance, facts sufficient for the purpose will probably ere long be accumulated."—*Lancet*, Feb. 4, 1865, p. 115.

After a lapse of twelve months, Mr. Syme thus reports on the condition of this patient:—

"The wound made in the operation through the jawbone and lip had soundly united without any deformity. The opening between the mouth and pharynx was diminished and irregular in shape, but he could swallow as well as ever, provided the food was finely divided. He could also masticate solid substances, though difficulty was experienced sometimes from their getting into awkward parts of the mouth. He could speak very clearly, and sing without difficulty. A few consonants (d, j, g, and s) were not quite clearly articulated. He could distinguish different articles and their qualities by the taste; but the sense of taste resided in the upper part of the pharynx, as was proved both by the patient's own sensations and by applying sapid but non-odorous solutions (salt and sugar) to the mucous membrane of the mouth, when their taste was not distinguished." Prof. Syme observes: "Of the facts above mentioned, the one which seems most curious is the connection between taste and deglutition, from which it appears that the latter is essential for a full perception of the former. If the pleasure of taste could be perfectly gratified by mastication without deglutition, there would be no limit to the consumption of food; but the instinctive desire to swallow an agreeable morsel affords a check to any such abuse."—*Lancet*, Jan. 27, 1866.

An operation of a much less formidable character, by means of the *écraseur*, has been devised by Mr. Nunneley, and has been attended with very remarkable success.

The following is his description of the method he adopts:—

"I take a sharp-pointed, curved blade, about four inches long, and of just sufficient thickness and breadth to carry the wire rope of the *écraseur*. This rope I have made somewhat thicker than those ordinarily supplied by Messrs. Weiss, with Hlick's instrument, and I always have a second in reserve, in case the first one should give way. The middle of the rope should be attached by a piece of string to an eye made in the broad end of the blade. The patient reclining on his back in a semi-recumbent position, this blade is plunged exactly in the median line between the base of the jaw and the os hyoides, but somewhat nearer to the latter than to the former, into the mouth, and brought up at the *frænum lingue*, and so out of the mouth, the

wire rope following. A good-sized loop of the rope must be drawn through, and the needle cut off. The rope must now be carried well back and spread over the base of the tongue, the tip of which, being then drawn through the loop, is seized with Leur's tongue-forceps and pulled forcibly outwards, and somewhat upwards. Two or three long and strong hare-lip pins, somewhat curved towards their points, should next be carefully thrust from the under-side of the anterior attachment of the tongue through its substance, and brought out on its upper surface as near to the base as possible. One of these pins should pass on each side, and if a third be used it should traverse the median line. Their points should just appear on the upper surface, and over them should the rope be carried. They will thus serve to prevent its slipping forward when it begins to be tightened, as it might otherwise do. They are not absolutely necessary, but I think are useful, and give rise to very little pain; besides which they serve to indicate the exact portion which has to be removed. Of course the larger this is, the more carefully must the pins be carried well back. The screw of the instrument should now be turned so as to gently fix the wire, that it may not move from the line in which it is intended to cut.

"Hitherto very little pain has been inflicted, and the voluntary efforts of the patient have been useful in facilitating the proceedings; but at this stage he should be put fully under the influence of an anæsthetic, so that he may not feel, and the screw of the *écraseur* be steadily, but very deliberately turned, the tongue being forcibly extended. It speedily becomes strangulated, and is cut off. The operator must be prepared to find in most cases considerable resistance, and to employ more force in turning the screw than possibly, *à priori*, he might anticipate would be required; though as the force necessary varies considerably in different tongues, he must be on his guard, or the wire may cut through too rapidly, and serious bleeding from the lingual arteries may ensue. To meet this contingency I have always had in readiness different forms of cauterising-irons, as well as the solid perchloride of iron (in a liquid state it is of very little use in free, deep hæmorrhage), though in only one case has there been any bleeding whatever from the divided base. In that case—the last in which I have operated—the tongue yielded with much less force than it had done in any other, and was cut through more rapidly than I intended it should have been. For a moment there was free bleeding from one lingual artery, but none from the other. Though the mouth of the vessel could not be seen the part was seized with forceps and a ligature placed upon it, when the bleeding at once stopped and did not return.

"The small submental wound has in every case healed by the first intention. The mouth and pharynx, for the first thirty-six hours, are painful, and deglutition is difficult, but these symptoms very soon mitigate, and the patient is able to swallow liquids; though I think it in all cases advisable to administer nutritious enemata and opiates, and thus keep the throat quiet. A little ice placed in the mouth is usually very grateful. In a fortnight or three weeks the wound heals. The two last cases I had, a man and a woman, both returned home in three weeks quite well. It is surprising how speedily the patient improves in condition. The



cessation of the horrible pain and restlessness caused by the disease seems to enable the patient at once to rally, and to counterbalance any shock which the operation might otherwise inflict."

Mr. Nunneley goes on to say, "I do not assert that the operation will be a permanent cure in all cases of cancer of the tongue, any more than the removal of a cancerous tumor in other situations of the body will secure immunity from relapse; but of this I am confident, that by affording the means of removing a larger portion than has formerly been thought to be practicable, and inducing an earlier performance of the operation, so as to secure the entire removal of all parts involved in the disease, it will, in accordance with all practical teaching, give the patient a far better chance of recovery, and, should the disease have been local, and not dependent upon a constitutional diathesis, this may be permanent." (*British Med. Journal*, Nov. 3, 1866.)

At the above date Mr. Nunneley had operated on five cases, but more recently (August, 1869) he states, "I have, up to the present time, removed the entire tongue nineteen times without any untoward symptom following in a single instance. In most cases the patient has not required any after treatment, being able to sit up the following day, and in ten days to be considered well. In the majority of operations not a drachm of blood has been lost. In two cases only has there been any hæmorrhage, and in those not more than half an ounce of blood was lost. In one a point of hot wire, and in the other a ligature at once arrested the bleeding. The little constitutional disturbance which follows this operation is surprising; indeed in the majority of cases there is none." (*British Med. Journal*, August 7, 1869, p. 146.)

Mr. Paget has also removed the tongue successfully with the *écraseur*, and speaks highly of the safety and efficiency of the method. He does not employ the submental incision recommended by Mr. Nunneley, but has the tongue well drawn forward out of the mouth; and, in order that this may be effectually done, he previously divides the attachments of the tongue to the jaw, both in front, where there are the *genio-hyo-glossi* muscles, and at the sides, where it is connected with the mucous membrane.

In a clinical lecture Mr. Paget observes, "The motive to operate here, as in other cases, is either to prolong life or, without shortening, to comfort what remains. For the first there is, I believe, some advantage—not a great prolongation of life, yet enough to justify an operation which is attended with very little suffering or risk; but the chief motive is in the hope of comfort, and the comfort that may be gained is in many cases so great as to justify a greater risk of life than is incurred in any of the ordinary operations for the removal of cancer of the tongue. The risk is really very small. I have not had a fatal case, or witnessed one; and the comfort given is that the patient is delivered for the time from all the misery of one of the most distressing and disabling conditions of disease, and, till the cancerous growth is renewed, may enjoy complete health and do all his work. Doubtless the disease will return after the operation; but it is as unreasonable to refuse a painless operation, and one free from risk of life, because the disease will return at some time soon after it, as it would be to refuse a course of medicine because it gives only temporary relief. When a man

has only suppose two or three years to live, it is no small advantage if at least half the time can be spent in comfort rather than in misery, and in profitable work rather than in painful idleness. Looking back on the many cases of cancer of the tongue that I have had to do with, I should be disposed to say that there is no organ on which operations for cancer are more justly performed or more to be urged, even in extreme cases. For the method of operation the choice lies between the knife and the *écraseur*. Caustic is not to be thought of, unless in a case of the very smallest extent; and the cases in which the ligature should be used must be extremely rare. I have never employed it, for the only advantage which it offers—that of avoiding hæmorrhage—is just as well, and much less offensively, obtained by the *écraseur*. The risks and trouble of hæmorrhage are, however, much over-rated; and I believe the knife may be preferred to the *écraseur* in all but the largest operations, such as those for the removal of the whole tongue." (*Med. Times and Gazette*, Feb. 10, 1866.)

*Ligature of Lingual Arteries.*—M. Demarquay recommends ligature of both lingual arteries in severe cases of cancer of the tongue, with a view, not to cure the disease, but to produce atrophy of the morbid growth, and thus to obtain prolongation of life. He states that he has practised this operation three times on patients in a bad condition, and the result has been satisfactory in every case. In one patient, who was exhibited to the *Société de Chirurgie*, the tumor, which had been so large as almost entirely to preclude speaking, mastication, and swallowing, was much diminished in size by the operation, and the patient could eat, speak, and swallow without any great difficulty. The operation was attended with no inconvenient results beyond a little temporary dysphagia, and the wounds always cicatrised rapidly." (*See Gaz. des Hôpitaux*, May 20, 1865; and *Gaz. Méd. de Paris*, 1867, p. 634.)

In an aggravated case of cancer of the tongue in St. Mary's Hospital, one of the lingual arteries was tied by Mr. J. Lane, but without any perceptible effect upon the tumor. It was proposed to tie the artery on the opposite side shortly afterwards, but the patient refused to submit. The mode of operation practised in this case was that recommended by Malgaigne (see *Glem. de Méd. Opér.* Ed. v. p. 171), by which the vessel may be exposed with great certainty and facility. An incision about  $1\frac{1}{2}$  inches in length is made parallel with the cornu of the *os hyoides*, and just above it. The *platysma* must be divided to the same extent, and if any large vein be found in the way beneath it it must either be drawn aside or divided and ligatured. The submaxillary gland, the lower edge of which is exposed, must be pushed a little upwards. The tendon of the digastric is then clearly seen, connected by the fascia with the *os hyoides*, where it forms two sides of a small triangular space, the base of which, situated above, is formed by the hypoglossal nerve. Both tendon and nerve are here lying upon the *hyoglossus* muscle, while the artery runs beneath it. If the fibres of this muscle be divided in the small triangular space above mentioned, the artery will at once be seen, and a ligature can be passed under it with a curved probe or aneurism needle.]

Some exceedingly painful ulcers on the tongue

have been cured without the removal of the part, and certain obstinate cases have yielded to the repeated application of leeches under the tongue, after a vast number of other remedies had been tried in vain. In the *Encyclopédie Méthodique*, art. *Langue*, there is an account of an affection of the tongue (reputed to be cancerous, though this may be doubted), which got completely well under a very simple plan of treatment. A woman, thirty-five years of age, subject to cutaneous diseases and ill-conditioned ulcers, complained for seven or eight months of little swellings, accompanied with heat and pain, which made their appearance on the edge and towards the apex of the tongue. At length the part began to swell, harden, and to be the seat of lancinating pains. Its surface became irregular and rough, and all one side of it was considerably swollen. The patient could not put her tongue out of her mouth, nor swallow any thing except liquids, and her breath was intolerably fetid. Various sedative remedies had been employed without success. Cicuta had been used as a topical application: it had also been exhibited internally in large doses. The patient had taken for a long while the bichloride of mercury; but nothing proved of any avail. At length the patient was so tired of trying the effect of medicines and applications that she gave them up entirely, and contented herself with trying the experiment of keeping honey continually in her mouth. As this method seemed to give her some ease, she was prevailed upon to persist in it, and in this way the pains were gradually appeased, the swelling was diminished, and at the end of two or three months she was quite well, except that an indurated cicatrix remained on the part affected, and considerably obstructed the extension of the tongue on that side.

On this case, however, it might be remarked, that the retardation of the cure seems also ascribable to the injury of the health produced by the hemlock, mercury, &c, and that the amendment following their discontinuance might rather have arisen from the consequent improvement of the patient's health than from any effect of the honey.

Some inveterate diseases of the tongue may be cured by hemlock. In the work last cited is mentioned an instance of a very unhealthy-looking ulcer, near the apex of the tongue, attended with a considerable thickening of the part, and of some duration, which was cured by giving large doses of cicuta. But of all the medicines which have the greatest reputation for their beneficial effects upon malignant ulcers of the lip and tongue, none perhaps is deserving of so much confidence as arsenic. (See *C. Lane's Case of ill-conditioned Ulcer of the Tongue successfully treated by Arsenic*; *Med. Chir. Trans.* vol. viii. p. 201.) Mr. Earle's report of the favourable effects of hyoscyamus I have already noticed: he speaks also in praise of the pulp of carrots, retained on the ulcer and frequently changed. (*Op. cit.* vol. xii. p. 286.)

However, notwithstanding many facts of this kind on record, medicines should not be tried too long, that is to say, so as to let the disease attain a condition in which it will no longer admit of being cut away. When the disease makes progress the knife should be employed before it is too late.

Baron Dupuytren refers to an instance of *paralysis of the left half of the tongue*, with an atrophy confined to the same portion of it: the

faculty of taste, however, was retained, which led Dupuytren to suspect that the lingual nerve was principally concerned. The patient lived two years with this affection, preserving his intellectual powers nearly to the last moments of his existence; but his genital functions had been much impaired. A few days before he died symptoms of compression of the brain came on. In the *post mortem* examination many hydatids were found at the base of the cerebellum, one of which had insinuated itself into the anterior condyloid foramen, and made pressure on the lingual nerve. This fact seemed to Dupuytren to corroborate the physiological doctrine, that this nerve is more especially concerned in motion and nutrition. (See *Dupuytren, in Clinique Chir.* t. iii. p. 364.)

Sometimes *polypi* grow from the tongue. A case of removal of such a tumor is given in a modern work. (See *Edinb. Med. Chir. Trans.* vol. iii.)

*Solid tumors*, generally fatty, are sometimes formed in the loose cellular tissue under the tongue, and cause the same kind of inconvenience as a ranula. Mr. Liston has removed some tumors of large size from this situation by dividing freely the membrane of the mouth, and detaching the swellings with the finger from its cellular attachments. (See *Liston on Practical Surgery*, p. 249.) There is a good specimen of this disease in Mr. Liston's museum.

George Lewis Cooper.

*Louis*, in *Mém. de l'Acad. de Chir.* t. v. *J. Rowland*, *Aglossostomographie, ou Description d'une Bouche sans Langue, laquelle parle, et fait naturellement toutes ses autres fonctions.* 12mo. Saumur, 1630. *Louis*, *Sur les Maladies de la Langue*, in *Mémoires de l'Acad. de Chir.* t. v.; also the *Memoir of De la Malle*, in the same volume. *Encyclopédie Méthodique*, Partie Chir. art. *Langue*. *Sir Everard Home's Pract. Obs. on Cancer*, 8vo. Lond. 1805. *Langenbeck*, *Neue Bibl.* b. ii. p. 487, 8vo. Hanover, 1820. *C. Lane and H. Earle*, in *Med. Chir. Trans.* vol. viii. and xii. *B. Travers*, *Op. cit.* vol. xv. *R. Liston*, *On Practical Surgery*, p. 250. 8vo. Lond. 1837; and other works cited in this article.

**TONSILS.**—[The tonsils are subject to acute inflammation, terminating usually in abscess; to chronic enlargement or hypertrophy unaccompanied for the most part by inflammatory action; and to sloughing and rapid destructive ulceration. The first of these affections is known by the name of *Cynanche tonsillar*is.]

*Cynanche tonsillar*is appears to be dependent upon a disturbed state of the constitution, to occur in early adult life, and in middle age, rarely in childhood or old age, frequently recurring in the same individual, and to affect many members of the same family. It is usually ushered in by general malaise, rigors, and by great debility. The pulse is quickened, the tongue is coated with a white creamy secretion, the face becomes flushed, and much difficulty in swallowing is experienced. The local symptoms are pain at the back of the throat, some external swelling at the lateral and upper part of the neck with tenderness on pressure, the mouth is opened with difficulty, and on examining its interior, the tonsils and soft palate are found to be tumefied, red, and excessively tender to the touch. As these symptoms increase, the voice becomes hoarse and indistinct, and thick tenacious mucus escapes in large quantity from the mouth, or requires removal. The deglutition becomes more difficult, and after much suffering and distress



from pain, from want of food, and inability to sleep, an abscess forms, implicating the soft palate, as well as the tonsil, and no relief is experienced till the abscess either gives way spontaneously, or is opened by the surgeon. In some fortunate cases the tonsillitis may terminate in resolution, and is often supposed to do so when the spontaneous escape of matter has really taken place, but has been overlooked. This latter occurrence is indicated by the sudden relief experienced of all the symptoms, accompanied by an unusual and nauseous taste in the mouth.

Cynanche tonsillaris is not considered contagious, and in this respect differs from cynanche parotidea. It is often attributed to cold and damp, and appears to be influenced by atmospheric changes, so that more than one of the same family may be affected about the same time. The attacks are more frequent in spring and autumn, and a person who has once suffered from the disease is very liable to its recurrence.

The treatment of tonsillitis consists in administering internally saline and antiseptic medicines, such as chlorate of potash, or the mineral acids. An emetic of mustard or of ipecacuanha has been found of great service in some cases, given at the commencement of the attack, and the exhibition of guaiacum is highly spoken of by Mr. Joseph Bell, of Barrhead, as beneficially influencing the complaint in all its stages. (*Watson's Lectures on the Practice of Physic*, p. 789, vol. i.) Locally the steam of warm water, medicated by anodynes or not, inhaled from an appropriate apparatus, gives relief in the swollen state of the tonsils and soft palate. Gargles containing antiseptic solutions, in which chloride of lime, chlorate of potash, carbolic acid, or Condyl's fluid may form the principal ingredient are also useful. The tenacious mucus which collects in the mouth, and is difficult to remove, may be loosened by acid gargles, and other applications which increase the flow of the saliva, also jellies, particularly the black currant, have been used with advantage. Leeches applied to the throat are not generally had recourse to in the present day, but may be found useful in young and plethoric patients before matter has formed. Counter-irritants have also been applied with advantage; of these the mustard poultice is generally preferred, but blisters, or the linimentum ammoniæ have also their advocates. The patient should be kept in a uniform temperature, and his nourishment should consist of broths, jellies, arrowroot, light puddings, milk, eggs, and other soft solids. Wine, or wine and water, will be admissible, and is often required in cases where the exhaustion from want of the accustomed amount of food and stimulus becomes extreme. When the matter is fully formed, and fluctuation can be distinguished by the finger carefully pressed against the painful swelling at the back of the throat, there can be no doubt that a lancet or bistoury should be plunged into it to permit of the escape of the pent-up matter. For although the abscess would in a day or two spontaneously give way, yet many hours of intense suffering and discomfort may be immediately saved by the evacuation of the abscess.

In performing this operation, which must be done through the narrow space left between the teeth, and which is often not sufficient to admit the finger, great care must be taken to direct the cutting instrument backwards and inwards, so as

to avoid the possibility of wounding the internal carotid artery, which lies completely to the outside of the swelling. The other risks in opening these almost concealed abscesses arise from the position of the tongue on the one side, and of the cheek on the other, which are more or less swollen, and in danger of being wounded, especially in withdrawing the lancet or bistoury. Most surgeons provide against this difficulty by protecting the cutting edge of the instrument to within half or three-quarters of an inch of its point by means of a strip of adhesive plaster wrapped round the blade, and if a common lancet be used, wrapped round its moveable handles as well, which will render them firm and resisting. An instrument has been invented for the express purpose of opening these abscesses at the back of the mouth. It consists of a silver sheath containing a concealed lancet, which may be thrust forward by pressing a spring at the extremity of the handle of the instrument and becomes again concealed on removing the pressure. In using this instrument, which is well suited to secure the safe evacuation of these abscesses, the silver sheath is, in the first instance, placed in contact with the part of the swelling intended to be incised, the lancet is then made instantaneously to project and recede, and thus all other parts of the mouth are free from any danger of being wounded.

When an exit has been made for the matter by the surgeon, or when the abscess gives way spontaneously, a marked and rapid improvement is experienced in all the symptoms, both constitutional and local; the appetite quickly returns, the fever and debility disappear, and the health and strength of the patient are rapidly restored. Tonic remedies are usually prescribed and stimulants are freely given in this stage of the complaint; but so rapid is the convalescence that all necessity for treatment soon ceases. Tonsillitis in the great majority of cases thus terminates safely either by resolution or after a free suppuration, but in exceptional instances some complications are met with. The suppuration occasionally extends beyond the usual bounds, and a large abscess may occupy the whole side of the neck, requiring openings and counter-openings in different positions. The editor has now under his care, at St. Mary's Hospital, a man about 40 years of age, who has had a very severe attack of cynanche tonsillaris. Matter freely discharges into the mouth from a spontaneous outlet, but an extensive abscess also occupies the side of the neck from the margin of the jaw to within an inch of the clavicle; in this two incisions have been made, permitting the escape of half a pint of rather fetid pus. One or two fatal cases are mentioned by Sir Thomas Watson (*Op. cit.* lect. xlv., p. 784), where the lingual artery was implicated in the abscess, and death from hæmorrhage occurred.

*Chronic enlargement or hypertrophy* of the tonsils is a complaint which frequently comes under the cognisance of the surgeon, and occasionally requires surgical interference. The tonsils in this affection present an irregular surface, with numerous deep excavations separated from each other by prominent ridges, produced by the enlargement of the follicles and crypts of the gland, and of their surrounding fibro-cellular boundaries, belonging to the natural structure of the tonsil. The ducts of the gland are often pressed upon and concealed, and their contents

detained, so that they become inspissated and foetid, and may be seen in some cases and picked out in the form of small yellow particles of the size of pins' heads, or larger. They are of the consistency of sebaceous matter, which they much resemble, and are extremely foetid when crushed between the fingers. This detained and irritating secretion can hardly fail to keep up considerable irritation, and to form one of the principal causes of the hypertrophy of the gland. Superficial ulcerations also are frequently noticed, occupying chiefly the prominences of the irregular surface of the enlarged tonsil. The degree of enlargement varies greatly in different cases, so also does the form the tonsils assume under the disease. In some cases they are almost globular, at other times oval, with the long diameter from above downwards. The enlargement varies from double to three times the size of the natural structure, from the size of a filbert to the size of the largest walnut. In the extreme cases the tonsils of opposite sides are habitually in contact with each other, and their form is flattened and variously modified by pressure. Their consistency is also entirely changed; they become as indurated and resisting as a scirrhus tumor by the pressure thus occasioned. In such cases the deglutition, the voice, the respiration, and even the circulation, are considerably interfered with. On looking into the mouth and examining the back of the fauces, it is difficult to understand how the important structures here situated can perform their critical functions of protecting the entrances to the air-passages and to the alimentary canal during respiration and deglutition. Doubtless the parts have by degrees become, as it were, educated to their duties under the difficulties and obstacles gradually presented, which, if suddenly produced, would fatally have interfered with their performance and rendered existence almost impossible. This disease is common in strumous children, and also in early adult age, and appears to attack persons prone to affections of the mucous membranes generally, such as preternatural vascularity and turgescence of these structures and their follicles.

The symptoms of enlarged tonsils are, as might be expected, comprised, first in impediments to respiration, as indicated in children by habitual audible breathing with the mouth open, and by almost constant stertor and occasionally arrested breathing during sleep, the patient, in consequence, waking suddenly in alarm and struggling for breath. The voice also becomes thick, nasal, and indistinct, and, in adults, interferes much with the intonation of the voice in singing, which in young adult females is greatly complained of. The enlarged tonsils and the thickening of the adjacent mucous membrane encroach in many cases on the Eustachian tube and cause considerable deafness. As regards deglutition, the principal inconvenience arises from the want of power in extreme cases to adjust the soft palate, so as to protect the posterior nares and prevent fluids passing into the nostrils. The circulation is also somewhat interfered with in the head and neck from venous congestion, depending upon the impeded respiration.

The treatment of hypertrophy of the tonsils greatly depends upon the extent to which the enlargement has advanced, and on the consequent disturbance of the functions of articulation, of respiration, and of deglutition. In the majority of cases the tonsils are affected in a moderate degree,

and although evidently enlarged, produce but slight inconvenience. In this condition either no treatment at all, or that which is merely palliative, should be had recourse to. Attention to the general health, and the constitutional remedies most relied upon in the management of a strumous diathesis, are those that are indicated. Cod-liver oil, steel medicines, preparations of iodine, quinine, or a combination of one or more, of these; while the digestive functions should be carefully watched, and any existing defects treated by their appropriate remedies. Change of locality from a moist to a dry atmosphere, from a town to a country, or from an inland to a sea-side residence, may be attended with advantage. To the tonsils themselves various astringent and escharotic applications are usually applied. The lunar caustic, either in substance or in strong solution, the tincture of catechu or kino, the tincture of iodine, and similar local remedies have been recommended and have been followed by more or less benefit; but it should be borne in mind that in children the less severe cases in time greatly improve, and that many of these cases in adult age have ceased to be even a source of inconvenience.]

But when these or other means fail, and the isthmus faucium is so obstructed that serious difficulty of deglutition and respiration are occasioned, the removal of part of the tonsil should not be deferred. As Mr. Liston observes, "it is by no means necessary to remove the whole tonsil, and the attempt would be attended with the greatest danger. The enlargement is but an opening out, or simple hypertrophy of the gland. The surface heals kindly, and there is no reproduction of the tumor."

[For the purpose of removing the hypertrophied gland, the ligature, the actual cautery, the potassa fusa were formerly advised and practised, but in the present day cutting instruments are alone depended upon. The fear of excessive hæmorrhage, now found to be groundless, induced the older surgeons to prefer the more cautious means of removing what they considered to be a very vascular growth by ligature or caustic, but the great inconvenience of allowing the mass to slough off when a ligature was applied, and when the actual cautery or potassa fusa were used, the difficulty of applying them to the back of the throat so as to burn away to a sufficient extent the enlarged gland without injury to surrounding and contiguous structures, have led to their being entirely discarded. It will not be necessary, therefore, to describe these obsolete methods of operating.]

With regard to the removal of hypertrophied tonsils by cutting instruments, as practised in the present day, two principal methods have been adopted. The one by the forceps, or vulsellum, and a cutting blunt-pointed bistoury; the other by means of various instruments, invented for the express purpose, in the form of scissors or guillotine.]

The first mode is the more simple proceeding, and is well and shortly described by Mr. Liston, who directs the patient to be placed opposite a strong light; the surgeon depresses the tongue with the fore-finger of one hand, and seizes the body of the gland with the vulsellum held in the other. He then introduces the narrow, straight, blunt-pointed knife, with its edge directed upwards under the gland, and by a few gentle sawing motions severs



it on a level with the folds of the velum. (See *Liston's Practical Surgery*, p. 251.)

[With respect to the second means alluded to for extirpating the tonsils, although the guillotine is the most perfect invention for the purpose, it may be as well to mention two or three other instruments that have been from time to time introduced by different surgeons to effect the same purpose, and which have gradually led to the more perfect contrivance in use in the present day.]

Desault used to employ an instrument which consisted of a sharp-edged blade, which was included in a silver sheath. The latter had at its extremity a kind of notch, in which the gland, about to be extirpated, was received. The surgeon seizes the tonsil with a double hook, with which he is to raise and draw it a little forwards. He is then to take the cystitome, and put the tonsil in the notch, on a level with the place where the incision is intended to be made. When the portion which is to be cut off is engaged in the notch, the operator is to draw the part towards him, so as to stretch it, and press the instrument against it from below upward. The blade being next pushed across the notch, the necessary section is accomplished.

Dr. Physic, of Philadelphia, constructed an instrument for excision of the tonsils, which he latterly preferred to the ligature. It is composed of two steel pieces: attached to one end of each is a steel ring; between the two is a lancet-shaped blade moveable on two screws which connect the pieces. The tonsil is fixed in the rings, and the blade thrust forwards by pressing with the thumb on a button at the extremity of the handle, when it will be divided. Dr. Cox, of New York, likewise proposed a method of excising the tonsils, which seems to Dr. Reese to be superior to either of the numerous processes which have been published by way of improvements in this operation. A description of his instrument may be found in the *New York Med. and Phys. Journal* for 1829.

[The guillotine in its improved modern form consists of a metallic frame six or eight inches long, about an inch wide, and two or three lines only in thickness, fixed in a wooden handle, which is attached to the metallic position at an obtuse angle, so that when used the view of the interior of the mouth is not obscured by the operator's hand. The metallic frame terminates at its distal extremity in an oval ring or fenestra intended to receive the tonsil to be removed. A groove is formed in the lateral margins of the frame and its opening, in which a cutting blade slides. By pressing a projection in the handle by which the blade here terminates it is made to slide across the opening containing the structure to be removed. A prong or fork for the purpose of transfixing the tonsil when protruded through the fenestra of the instrument has been added to the guillotine by M. Chassaignac and which is made to move simultaneously with the blade. The mechanism of these instruments is readily understood on inspecting them and the mode of applying them is equally apparent. The patient being seated opposite a good light, his head supported by an assistant, the operator stands in front of him, and having introduced the instrument edgewise to the back of the mouth, its fenestrated extremity is with care adjusted so as to embrace as much of the enlarged tonsil as it is thought advisable to remove. The handle

being now held firmly, the thumb is used to press upon the projection moving the blade, and it is made rapidly to glide across the fenestra, severing the projecting portion of the diseased structure. Some difficulty is occasionally experienced in getting the gland to protrude to the extent desired by the operator, arising sometimes from the unsteadiness of the patient, at others from the form and size of the enlarged gland being unsuited to the instrument at hand. Under these circumstances some surgeons avail themselves of a vulsellum, by which instrument the gland may be readily forced and held in the position required before thrusting the cutting blade across it. Hæmorrhage to a moderate extent usually takes place at the time of the operation, but it soon ceases, and seldom causes trouble or anxiety afterwards. In exceptional instances, however, it has been known to continue for many hours, and to cause considerable uneasiness in the mind of the patient and of the surgeon. These cases should not, therefore, be entirely lost sight of after the operation. Children especially should be watched, as the bleeding which takes place in them may not be suspected till the patient becomes pale and faint, as the blood will be swallowed as fast as it escapes. The remedies most depended upon to arrest the bleeding when inordinate are—ice placed in the mouth, painting the cut surface with tincture of catechu, tincture of iodine, or of the perchloride of iron, or other styptics, and in the last resort the application of the actual cautery. After the operation the patient experiences for a few days a smarting or cutting pain on swallowing solids or even fluids possessing any pungent or irritating qualities. Wine or spirits, if taken, will be more agreeable when freely diluted with water. It is seldom that any medical treatment beyond a simple astringent gargle is required. Half a glass of port wine in a tumbler of water is as suitable a fluid as any for the purpose. The diet should consist of soft, unirritating materials at first, and of nutriment principally in a fluid form—milk, eggs, jellies, broths, light puddings, arrowroot, &c., but in a few days, fish, fowl, and other meats may be allowed, and will be swallowed without inconvenience. In the course of ten days or a fortnight the cut surfaces will become covered with mucous membrane, and the distressing symptoms for which the operation was performed will be greatly relieved, if not entirely removed.

The *gangrenous and destructive ulcerations* which occasionally destroy the tonsils are shared in by the soft palate, the arches of the palate and fauces generally. The tonsil, indeed, is seldom if ever the first structure affected, the diseased action usually commencing in the soft palate, and thence spreading to its arches and then to the tonsils. The cause of this destructive morbid action is usually traced to a cachexia in the system, either from the poison of syphilis, from that of scarlet fever, diphtheria, or some other contagious or infectious disease. There is always great debility and serious disturbance of the nutrition of the structures in these cases, and their symptoms and treatment belong more to the particular morbid condition in which they occur than to the diseases of the tonsil. The great majority of the cases we see in which the soft palate, arches of the palate, and tonsils have been destroyed and the patients have recovered, have resulted from syphilitic ca-

chexia, and at one period required the appropriate remedies for that disease. These were, of course, not mercury but sarsaparilla, iodide of potassium, and other tonics, together with a stimulating and nutritious diet in a form that can be taken under the circumstance of the great difficulty of deglutition which necessarily attends the case, while stimulating local applications, such as the tinctura benzoini comp., or Peruvian balsam, or even the nitric acid with caution, should be had recourse to. (See VENEREAL DISEASE.) The gangrenous and destructive ulceration occurring as one of the symptoms of scarlet fever (*Cynanche Maligna*) is more frequently fatal, and it rarely happens that we have the opportunity of seeing the ravages effected by this disease after recovery upon the tonsils or fauces. With regard to the affection now under consideration, Sir Thomas Watson observes:—

“But another source of danger arises from the gangrenous ulceration which is apt to ensue in the fauces when the patient is not killed by the first violence of the contagion. The system is re-inoculated, I believe, with the poisonous secretion from the throat. Now, under these circumstances also, quina or wine—and upon the whole I should give the preference to wine—are to be diligently, though carefully given. And something may be done by way of gargles to correct the state of the throat, and to prevent the distressing and perilous consequences which would otherwise be likely to flow from it. A weak solution of chloride of soda may be employed for this purpose, and if the disease occur in a child that is not able to gargle, this solution may be injected into the nostrils and against the fauces by means of a syringe or elastic bottle. The effect of this application is sometimes most encouraging. A quantity of sloughy matter is brought away, the acrid discharge is rendered harmless, the running from the nose and diarrhoea cease, and the disease is converted into a form which approximates to the scarlatina anginosa.” (Watson's *Lectures*, vol. ii. p. 793.)

Other tonics and antiseptic lotions besides those above-mentioned may be tried and varied according to circumstances.

The tonsils are very rarely the primary seat of scirrhus or of epithelioma, but of course these affections may, and occasionally do, spread to the tonsils.]

Sometimes the tonsils are suddenly attacked with such a degree of swelling, that respiration is dangerously obstructed. This case is analogous to the occasional enormous inflammatory swelling of the tongue, and, if it resists venesection and leeches, the most prompt mode of relief is that of making several deep scarifications with a knife in the parts. Many examples, confirming the good effects of this practice, have been seen by Laugenbeck. (See *Neue Bibl.* b. ii. p. 492, &c.)

**TOURNIQUET.** (*French*, from *tourner*, to turn.) An instrument for stopping the flow of blood into a limb, until some requisite operation has been performed, or a more permanent plan of checking hæmorrhage has been put in practice.

The old surgeons used to surround the limb with a band, with which they made such a degree of constriction, that the circulation was quite stopped. They also believed that the pressure of the band was advantageous in benumbing the

limb, and moderating the pain of operations. The violent pain and contusion, however, which such a tourniquet occasioned, being frequently followed by abscesses, and even by mortification, surgeons found it necessary to devise some other method. The application of the circular band was first improved, so that it caused less pain, and less mischief to the skin. The limb was surrounded with a very thick compress, over which the band was placed. Two small sticks were next put under the band; one on the inside, the other on the outside of the limb; and they were twisted till the band was rendered sufficiently tight. It is in this manner, says Dionis, in his *Traité d'Opérations*, that carriers tighten the cords which fasten the bales of goods in their carts. A French surgeon, named Morel, made this first improvement in the application of tourniquets.

In 1718, J. L. Petit presented to the Academy of Sciences a tourniquet of his own invention, which was much more perfect, though certainly complex, when compared with that used by modern practitioners; still it is the original of the latter, and both are constructed on the same principles. All the pieces of modern tourniquets are connected together; and, instead of two pieces of wood, used by Petit, there is a brass bridge, which is capable of being elevated, or depressed, by means of a screw, made of the same metal. Over this bridge a very strong band proceeds, and by passing under two little rollers, at each end of the bridge, it always remains connected with the instrument. A convex firm pad is sewed to the band, and put immediately over the artery, when the instrument is applied. There is no cushion for the opposite side of the limb under the screw; but a thick piece of leather, through which the band proceeds in two places, is always situated under the lower surface of the brass, and serves to prevent any bad effects of its pressure. It is usual also for the surgeon to fold some rag, and to put it in this situation, at the time of applying the instrument. (See HÆMORRHAGE.)

The following are the advantages of the modern tourniquet, formed on the principles of that first invented by Petit: 1. It compresses the lateral parts of the limb less than the tourniquet previously in use. 2. It requires the aid of no assistant, either to hold, tighten, or loosen it. 3. The operator is able of himself to stop the flow of blood in the artery, by means of the screw. 4. When there is any danger of hæmorrhage after an operation, it may be left on the limb, and, in case of bleeding, the patient, if no assistant be at hand, can tighten the instrument himself. 5. Its constriction produces less danger of mortification, because it does not altogether stop the flow of blood through the collateral arteries.

Although the employment of the tourniquet in amputations is still continued by the majority of hospital surgeons in this metropolis, a certain number of them dispense with it. In University College Hospital I have never seen it applied. Mr. Guthrie states that he usually amputates without it; and one of my colleagues is decidedly against its employment. “In the greater amputations (says he) the flow of blood into the limb may be effectually checked by exact compression with the hand on the principal vessel. This mode of arresting hæmorrhage during operations on the limbs, possesses considerable advantages. The



pressure is not made till the instant the incisions are commenced, and then only on one point. The limb, therefore, is not gorged with blood, and the soft parts can be much more readily carried back from the bone, than when they are confined by a circular band. A strong spring, with pads, one placed in the course of the vessel, and the other on the opposite point, may be used in cases where there is a scarcity of assistants, or where there is a probability of many vessels requiring ligature." (See *Liston on Practical Surgery*, p. 297.)

Dr. Moore, of Massachusetts, has described, in the *New England Journal*, a tourniquet of his invention, which is very generally adopted by the surgeons in that country who have not laid aside the use of this instrument in their amputations. Many of the most distinguished American surgeons dispense with the tourniquet altogether, preferring to rely upon compression made on the principal artery of the limb by a competent assistant. It is asserted, that much less hæmorrhage attends an amputation without a tourniquet, than when any modification of this instrument is used, and, in very many cases, the success of the operation is overthrown by the loss of blood.

That the use of the tourniquet does increase the hæmorrhage, Dr. Reese thinks will be apparent to all who compare the two methods, "and although the bleeding is chiefly from the portion of the limb amputated, yet the debility induced is not the less on this account. On the first application of this instrument to the thigh, for example, the compression is made on the superficial veins, the return of the blood prevented, and the morbid state of the limb often favours the consequent engorgement. As the instrument is screwed, the turgescence of the limb, below the point at which the compression is made, continues to increase until the circulation is stopped. No sooner is the incision made, than a hæmorrhage of very considerable extent takes place, and the assistant is directed to tighten the instrument, which fails to suppress it, because the blood flows from the vessels of the limb below the incision, thus unnaturally distended. Every operative surgeon must have suffered inconvenience and often anxiety from this source, and yet few have blamed the tourniquet, which is the true cause of the mischief.

"I have operated myself, and witnessed the amputation of the thigh by Dr. Bushe and others, where the femoral artery was suddenly compressed by the fingers of an assistant, and the hæmorrhage was always very inconsiderable, often not more than half a pint during the whole operation. I believe the time is not very remote when this instrument will be everywhere abandoned, except where the surgeon is obliged to operate without an assistant, and in such cases the inconvenience will have to be submitted to of course." (See *Reese, in American Ed. of this Dictionary*.)

In the article HÆMORRHAGE, I ought to have noticed the ring tourniquet, which is adapted to cases of compound fracture complicated with hæmorrhage, wound of the brachial artery in venesection, aneurism, &c. The ring tourniquet consists of a metal ring, having a diameter larger than that of the limb, to which it is to be applied, and a width of about an inch. The circumference is pierced at one point, so as to admit a screw, to the inner extremity of which a pad is fixed, and to the outer end a small handle to turn

the screw with, by the action of which the pad can be carried towards, or away from, the centre of the circle. This instrument, when applied, makes pressure only on two parts, viz. by the pad on the side of the artery, or by the portion of the ring immediately opposed to the pad, on the surface of the limb directly opposed to the position of the artery. Thus it does not interfere with the collateral circulation. (See *Tyrell, in St. Thomas's Hospital Reports*, p. 20.) Sir Astley Cooper informs me that he has often known hæmorrhage from broken limbs stopped by the use of this instrument. It merits a trial, therefore, before following the practice of Dupuytren and Delpech, which consists in exposing and tying the femoral artery at a distance from the seat of injury in the leg. The employment of ring tourniquets has prevailed more in some hospitals than others; and I know that it was sometimes resorted to by Dupuytren himself, as well as by some of the surgeons of Italy, and other parts of the world. The late Sir William Blizard long ago had an instrument constructed on the same principles, for the compression of the artery in cases of aneurism.

[The Italian tourniquet, *Signorini's*, or horse-shoe compress, acts on the same principle of only causing pressure on two opposite points; but as it only half encircles the limb, it has been found wanting in steadiness and security. Mr. Skey's tourniquet is intended to obviate this disadvantage. It is composed of two semicircles of steel, one fitting into the other by running in a groove. Each half is fixed by a spring catch to the other, and may be enlarged or reduced at will to any size required. In the centre of each semicircle is the pad for pressure and counterpressure, the former being provided with a screw. (*Op. Surg.* p. 328.)]

TRACHEOTOMY. Τραχεία, the windpipe, and τέμνω, to cut. The operation of opening the trachea.

[The term Bronchotomy (βρόγχος, the windpipe, and τέμνω, to cut) is the general term used to denote all the operations undertaken to open the air tube at any part of its extent, and tracheotomy is thus one of its sub-divisions. Tracheotomy is the oldest of all the operations performed on the windpipe, having been suggested, according to Galen, by Asclepiades of Bithynia, about B.C. 100. His mode of operating is unknown. It was apparently repeatedly performed by Antyllus of Rome (about A.D. 340), whose procedure Paulus Aegineta describes. Cælius Aurelianus and Aretæus also performed it. It was not, however, till the publication, in the *Memoirs of the Royal Academy of Surgery*, at the beginning of this century, of two papers on the subject by Louis, that the true value and comparatively small danger of the operation were known.

In opening the windpipe we may wish to fulfil a temporary object, or obtain a permanent orifice. There are many purposes which an artificial opening may serve.

1st. It may be required to admit air into the lungs when from any cause the communication with the atmosphere is obstructed. This may be due to swelling in the mouth itself or throat, as enlargement of the tongue or tonsils; any closure of the pharynx or glottis by inflammatory swelling or effusion; or by growths existing either external to the canal and pressing upon it, or filling up its interior. If such sources of obstruction cannot be quickly re-

moved, and if suffocation threaten, then an opening below their seat may be called for. In sudden and violent inflammation, as that which follows the imbibition of hot water or steam, or caustic solutions; in œdema, or spasm of the glottis, arising from any cause; in laryngitis; in pressure on the windpipe by a foreign body impacted in the gullet; occasionally in cut throat, and wounds and rupture of the windpipe; in sloughing of the throat, as after scarlet fever; in "epilepsea laryngea;" sometimes even in extensive emphysema, or in cellular inflammation of the neck; in croup, diphtheria, &c. where false membranes obstruct the air passages; in fractures and displacement of the hyoid bone or the cartilages of the larynx, and sometimes in necrosis of these bodies; in narrowing or partial obliteration of the windpipe by cicatrices or disease; more rarely in paralysis of the larynx, and as a palliative in hydrophobia, tetanus, poisoning, &c. The growths which may obstruct the windpipe, and which may lie external to it or occupying its interior, are very numerous. Cancer, tubercle, aneurism, abscess, polypi, syphilitic or other warts, calculi, cysts, goitre, hydatids, &c., &c.

2nd. For the removal of foreign bodies from the air passages. Tracheotomy is for obvious reasons more successful in such cases than when performed for the relief of disease.

3rd. The windpipe may also require to be opened, in cases of asphyxia, to allow of artificial respiration being more easily and effectually performed.

4th, and lastly. It may be undertaken solely to give rest to the upper part of the windpipe, or to allow of direct medication of the diseased parts, as in inflammation, ulceration, and sloughing of the larynx from any cause, wounds, growth within the canal, fracture and necrosis of cartilage, &c., &c.

It is doubtless mainly due to the too delayed performance of the operation in many cases that practical results have not always responded to the promise theory suggested. Secondary complications have been allowed to arise, and the removal of the primary condition has become of less moment. This remark is especially true as regards tracheotomy in croup and diphtheria, when a natural hesitation is felt to undertake what appears a formidable or possibly needless operation, while in truth it is the sole safety by preventing those fatal complications which so soon render all treatment abortive. So long as tracheotomy is looked on as a last resource, nothing more can be expected of it than of other remedies vainly had recourse to in like desperate circumstances.

The windpipe, subcutaneous in its upper portions, gets deeper as it passes downwards, especially in short-necked, fat persons, till at the episternal notch it reaches a considerable depth. This circumstance, of itself, renders operations on the upper parts of the passage easier and less dangerous than those on the lower.

The windpipe is opened at various parts of its extent. In tracheotomy the aperture may be made either above or below the isthmus of the thyroid; or the crico-thyroid membrane may be opened ("laryngotomy"), or that membrane may be first incised, and the cricoid cartilage and a few rings of the trachea afterwards split ("laryngo-tracheotomy"), or yet again, in certain rare circum-

stances, an opening may be made much higher in the canal, viz. in the hyo-thyroid membrane ("sus-hyoidienne" operation of Vidal de Cassis).

*Anatomy.*—The different portions of the windpipe and their relationship to one another must be carefully studied as regards these operations. In passing from above downwards we have the following parts occurring in succession in the middle line. The hyoid bone, lying a short way below the chin, can be easily defined, then the hyo-thyroid space divides it from the thyroid cartilage, which, by its projection in the neck, forms one of the leading landmarks, especially in the male. A bursa occasionally lies in front of the "pomum Adami," or more prominent part of the cartilage, and the notch which occupies the middle space above the projection is a useful guide to the centre line of the neck. The thyroid cartilage has been split for the removal of a foreign body from the neighbourhood of the vocal cords. About an inch below the prominence of the thyroid, and lying quite superficially, we have the crico-thyroid space, then the cricoid cartilage, which, from being a complete circle of cartilage, presents a firmness and resistance which can be distinguished with ease at every age, and in all states. In any case of doubt it is best found by searching upwards from the episternal notch for the first point of resistance. Beneath the cricoid comes the trachea, passing backwards as well as downwards, and measuring in the adult  $4\frac{1}{2}$  inches to the sternum. It is crossed on its 2nd or 3rd ring (rarely as high as its 1st), i.e. about an inch below the cricoid, by the isthmus of the thyroid gland. The breadth of this isthmus varies considerably, being usually greater in females. The gland is little developed in infants. The windpipe occupies the centre of a triangular space, the base of which is formed by the hyoid bone and the sides by the sterno-mastoid muscles. The apex is formed by the episternal notch.

Over the trachea lies the skin, which is very movable and easily displaced, a circumstance which should be borne in mind in making incisions through it, as in tracheotomy. The superficial and deep cervical fascia, the anterior fibres of the sterno-hyoid and sterno-thyroid muscles, which, meeting in the middle line, are connected by some cellular tissue, and below these we have some loose cellular tissue lying over the air tube. The middle thyroid veins lie above the sternum, and cover the lower part of the trachea, on the middle line of which there are usually two chief trunks, and in the infant the thymus gland may project some way above the sternum.

The hyo-thyroid membrane is pierced by the superior laryngeal nerve and artery—a vessel of insignificant size. The crico-thyroid membrane again is crossed by a small arterial communication: while the isthmus of the thyroid gland is occupied by a venous plexus formed by the thyroid veins, which is capable of giving the utmost annoyance if wounded, and will consequently require to be avoided or secured before being divided. These are the chief vessels met with in front of the windpipe. Occasionally a small artery—the *arteria thyroidea ima* ("middle thyroid" of Harrison, "the artery of Neubauer"), arising from the arch of the aorta or the innominate, or, in yet rarer cases, from the internal mammary, traverses the middle line under the deep fascia, passing upwards



to the lower border of the isthmus. There is no need to recall the position of the carotid arteries or jugular veins, as they are well clear of the windpipe, and cannot be injured if the most ordinary knowledge and skill is possessed by the operator, but it is requisite to say that occasionally a substitute for the anterior jugular lies in front of the trachea, and that a transverse branch is not uncommon passing from one anterior jugular to another across the front of the trachea at its lower part. Lastly, the innominate artery crosses the trachea obliquely at the inferior part of the tube, and has been found to rise considerably above the level of the sternum. Burns met with five instances of this, and in one case saw it reach the border of the thyroid gland. The left carotid has been known to arise from the innominate and cross the lower part of the trachea considerably above the sternum. These anomalies are fortunately rare, yet they should be held in mind.

A general consideration of the anatomical relationships of the windpipe teaches two lessons. 1st. The necessity of carefully confining our incisions to the middle line, especially in children in whom the windpipe is very small, easily displaced, and easily missed when the soft parts are swelled and infiltrated, as they often are, in consequence of the measures which have been employed previous to the operation. And, 2nd. That we should not prolong our incisions further downwards towards the sternum than is absolutely necessary.

The great movability of the windpipe, both laterally and from above downwards, especially in the young, is necessitated by its functions, and is attained by the bed of loose cellular tissue in which it lies. The mode in which it rises in deglutition is of advantage to the operator, as enabling him to open the tube lower than he otherwise could; but the ease with which it is displaced laterally is often a source of considerable embarrassment, both when the canal is being exposed and when it is being opened.

The mucous membrane lining the trachea is attached with considerable firmness to the cartilages; yet that it can be detached and carried before the point of the canula, has been proved by the cases related by Dupuytren and Fizeau.

*Tracheotomy is thus Performed:—Position:* The recumbent is best, on a firm narrow table with a good light. In the case of children, it is very important that they be placed quite parallel with the table, so that we may not be deceived in the line of our incisions. The head and shoulders should be slightly elevated, and the neck gently (not too much) stretched. This position is better than sitting with the head supported on the breast of an assistant; but sometimes, from the extreme dyspnoea caused by lying down, a sitting posture must be adopted. The aid rendered by the assistants is very important. One should steady the head by standing opposite the operator and placing a hand on either side, and, by keeping some of the fingers below the jaw the neck may at the same time be sufficiently extended. The limbs should be secured by a second assistant, and a third should be ready to aid the operator. As, however, we are most frequently called upon hurriedly to execute this operation, and that often at night, when assistants cannot readily be obtained, the services of the second may be dispensed with in children by binding the child's limbs firmly in a sheet before beginning,

and passing another sheet over the body and limbs and round the table. Chloroform should be used if there is much spasm and restlessness, especially in children, when tracheotomy is to be performed: for laryngotomy it is hardly necessary. It greatly facilitates the operation. If true asphyxia, however, is present, i.e. when the blood is surcharged with carbonic acid, chloroform should not be employed; nor is it required, as the patient is then almost quite insensible to pain, and lies quiet. Faure and Demarquay have shown how long this state of anæsthesia continues in those who have been asphyxiated. Even after intelligence and the power of motion have returned, if the dyspnoea is increased by the chloroform, its use should not be continued.

The instruments required are sharp and probe pointed knives, dissecting and artery forceps, director, retractors with long handles, sponges (some fastened on whalebone), a dilator, double canula with tapes attached, ligatures, tenaculum, needle and thread, adhesive plaister, scissors, elastic catheter, a syringe with slender and long nozzle, sharp and blunt hooks, small catch or bull-dog forceps. If the operation is performed for the removal of a foreign body, a piece of pliant wire may be of use, and long slender forceps of different shapes. If for croup, a solution of nitrate of silver should be at hand.

The operator stands facing the patient and on his right side. This is better than leaning over the face as some do. The different parts of the windpipe should be traced and the position of the cricoid carefully noted. In very young children the thyroid cartilage cannot be recognised. The incision is begun close to that cartilage and continued downwards for an inch and a half or more, according to the length of the patient's neck and the depth of the tube from the surface. This incision may be made in the ordinary way, or the skin may be pinched up by the left hand of the surgeon and the assistant and so divided. This latter method is a good one, as it enables a greater depth to be reached at once with less chance of dividing the veins. The utmost care should be taken to keep the middle line, but it is unnecessary to mark it before beginning by applying any caustic or other agent to the skin. Careful sponging of the cut surface, and retraction where necessary by appropriate hooks, is to be attended to by the second assistant, but such retraction must throughout the operation be very steadily, evenly, and judiciously applied, otherwise the centre line will be lost, and the operator incommoded and not aided. The dissection passes between the pre-tracheal muscles, all vessels which are observed being avoided if possible, and those which are cut being, if necessary, secured either by ligature, or with a small bull-dog forceps, or twisted, or the pressure of the assistant's finger applied. If the exigencies of the case are not such as to render such a proceeding impossible, the operator should be in no hurry, but use great caution. It is very desirable to save the patient's blood, as economising his strength and so improving his chances of recovery. It is true that the most effectual means of arresting the venous bleeding is to re-establish the respiration, the embarrassment of which is the cause of the congestion of the vessels, and it is also probably true that the danger of suffocation by the passing of blood into the trachea after it has been opened has been much exaggerated, as it is

well known that, except in cases of great exhaustion, the patient's natural effort instantly ejects any such intruder so soon as a free exit has been provided for it; yet it is desirable if the call for rapid action is not very imperative to secure as we proceed any vessel in the wound which bleeds much before we open the windpipe. In this way considerable trouble, both at the time of operation and afterwards, is avoided. In some cases, however, we must sacrifice all minor considerations to the main one of re-establishing the respiration. Recamier very needlessly recommended the trachea not to be opened for some hours after the preliminary incisions had been completed, so as to be certain that all fear of hæmorrhage had passed.

The deeper portions of the dissection are best effected by means of the handle of the scalpel. The trachea should be clearly seen and exposed before any attempt is made to open it. All the most experienced operators have strongly advocated this. When the tube is about to be opened, Chassaignac's hook with a groove on the back should be employed to perforate and fix the trachea. It is inserted below the lower border of the cricoid, the handle being at first turned to the side, so as to allow of the easy introduction of the point, and then held upwards towards the chin by the surgeon himself or his assistant while the knife is slid along the groove into the tube and the necessary incision made downwards; or, what is better, the hook being held by the assistant is employed merely to fix, elevate, and steady the windpipe, while the operator, placing the forefinger of his left hand at the lower angle of the wound, and so keeping down the soft parts and guarding the veins lying there by gentle pressure, opens the tube with the back of the knife turned downwards, and cuts upwards as far as may be requisite. There is much less chance of harm in this way. The knife should be entered between the rings and with a slight jerk. The slightly curved abscess lancet does admirably for opening the tube. The trachea should not be cut downwards more than is required, but the extent to which it is opened must be regulated by the object for which the operation is performed. If a foreign body is to be removed, much more room will be wanted than when the mere admission of air is required.

The mode in which Chassaignac employs his hook is not that above recommended. He inserts it through the skin as the first step in the operation before any incision is made at all. The difficulty of accomplishing this in many cases on account of the gliding of the skin is fully acknowledged, but all difficulty vanishes if the incisions are first completed as above recommended.

The knife should be next turned on its side so as to open the lips of the wound, or what is better the handle of the scalpel should be inserted and turned half round, and the canula (if such is to be used) passed along it into the canal. Mr. Worthington has lately (1866) described in the *Medical Times and Gazette* an ingenious device to facilitate the passing of the canula. A deeply grooved steel director fits closely to the back of the scalpel, and is adjusted by means of a slit into which a button on the handle of the knife projects. The director lies out of the way till pushed forward after the trachea has been opened, and as it is then freed from the scalpel it remains in the wound as a

guide for the canula. Many different patterns of "dilators" have been suggested, intended to open the wound and facilitate the introduction of the canula. These will be again referred to.

The space between the lower edge of the cricoid cartilage and the isthmus of the thyroid is so small in young children, and the vascularity of the isthmus so great, that if we cannot hook it down and so keep it out of the way, we must divide the cricoid as well ("laryngo-tracheotomy") as the tracheal rings, in order to get sufficient room for the canula. In children of 6 or 8 years of age, the opening may be made, if so wished, below the isthmus.

If there is much mucus or other foreign matter in the windpipe to be expelled, it is better to wait a short time before introducing the tube, the lips of the wound being held asunder by retractors or by the simple expedient of passing a strong thread through the lips of the tracheal wound, on either side, which can be held or if necessary tied behind the back of the neck, or as is suggested by Chassaignac, twisted round pins passed through a plait of the soft parts at a short distance on either side of the wound. If the opening is only intended for temporary purposes, it is often best not to use a tube at all, and thus avoid the irritation it unavoidably causes and the clogging with mucus it is so apt to give rise to, but to keep the opening patent by means of blunt hooks or some of the many means which have been suggested for the purpose, such as two pieces of elastic watch-spring, having their points slightly bent outwards, so as to catch the edges of the tracheal wound, and these may be kept in place by being tied behind the neck or united there by a sliding screw which enables them to be adjusted to the circumference of the neck. Two pieces of bent copper wire, or pewter or lead or some such appliance, will serve the same end. If the patient is very much exhausted, any foreign body, such as blood or mucus or tube casts, present in the windpipe will be forcibly ejected by a violent, and often to an inexperienced person, dangerous looking spasmodic effort. If they fail to be removed by a spontaneous effort, they can be got quit of by turning the patient on his side or face, or by withdrawing them by means of a syringe. To suck them out by the mouth or an elastic catheter, as Roux and others (including the writer of this article, on one occasion when the patient's life could not otherwise have been saved) have done, might be justified when the danger is imminent, but in some of the cases in which tracheotomy is performed, such a proceeding might be attended with the utmost danger to the operator. If bleeding to any annoying extent takes place from the interior of the windpipe after it is opened, as when a false membrane has been detached, it is best suppressed by the application of ice to the upper part of the sternum and elevating the head. Dupuytren's advice to make the patient, if sensible, respire deeply should then also be remembered. Some operators put great weight on the removal of the tracheal fascia from the edges of the orifice made in the windpipe, so as to avoid its subsequent interference with the patency of the opening.

Such is an outline of the usual steps in the operation of tracheotomy. The manipulations may be divided into three stages, each of which are attended by certain difficulties. First, exposing



the trachea; second, opening it when found; third, introducing the tube.

1st. *Reaching the windpipe.* In thin adults with long necks there is no difficulty in this part of the operation; but in short-necked fat persons whose respiration has been gravely compromised, and whose sterno-mastoid muscles are contracted so as to bury the trachea deeper, and in whom as a consequence the veins are very full and the restlessness great; and in children where, as a result of the various local applications which have been used, the tissues are infiltrated and the landmarks in a great measure lost, and where the patient exercises no control, the incisions are frequently accomplished with much difficulty and anxiety. The very small size of the windpipe in young children is also, of course, a great source of difficulty. The touch must, after the skin is divided, be as much trusted to as the sight, and the greatest care taken in all cases as to what is cut.

2nd. *To open the trachea when laid bare* needs considerable care, for reasons before mentioned. Its extreme movability, both longitudinally and laterally; its small size in young persons, and the ease with which in them it is effaced or transfixed or greatly injured; the near neighbourhood of great vessels, &c., are all points to be borne in mind.

Chassaignac's or Edwards' hook (which is better from having a straight back), or a simple tenaculum, help the operator greatly. The tenaculum director was first recommended by Bauchot.

Various instruments have been invented to supersede the knife, but few of these present any advantage, while many of them are highly objectionable. Mr. Erichsen describes a hook which cuts on its concave side, and which aims at both fixing and opening the tube at the same time. Sharp pointed scissors with outer cutting edges, and a notch to prevent their too deep insertion, is another contrivance, suggested by Dr. Marshall Hall, but one of very doubtful efficacy. The skin is pinched up and cut, and then the scissors are pushed in at the proper part, the blades expanded so as to enlarge the wound, and the canula passed between the blades. Garius' trachea forceps are very much of the same character. Various other "tracheotomes" have been suggested. In Thomson's the limbs are obtusely curved near their termination and have cutting points. After being passed transversely between two rings of the trachea at one plunge, and without any preliminary cutting, the limbs are separated by a screw and the canula passed between them. The opening made in the windpipe being here limited to the space between two rings is quite inadequate to the removal of foreign bodies. Gerson's tracheotome consists of three movable blades sharp at their point and meeting closely. These blades are separated by the action of a vice. An incision is made in the first instance, but of limited extent, down to one of the spaces between the rings, and then the tracheotome is inserted and the blades separated and the canula passed between them.

Mr. Bill, of the American army, has recently proposed to use a trochar of steel enclosed in a silver canula. The instrument is curved like Belloque's canula for plugging the nares. The point of the trochar is sharp like that of a curved bistoury, and the back of the blade is blunt. There

is an opening on the back of the canula near its point and rings for fastening it in its place after insertion. The instrument is passed into the windpipe through the crico-thyroid space, and its point withdrawn. The concavity being forwards, the extremity is passed down inside of the windpipe and made to press on the wall at the part where it is wished to make the opening, and that should be as low as possible. When got into place, the centre line being carefully observed, the point is made again to protrude and the windpipe pierced from within outwards. The opening in the back of the canula permits of breathing. So soon as the trachea is pierced the opening made is enlarged by the knife, the point of which is passed into the orifice of the canula and the whole drawn upwards or pushed downwards in the middle line. It will be seen that this is truly a double operation, and is in reality both clumsy, complicated, and more dangerous than that it proposes to replace. Langenbec uses a double hook, the limbs of which are separated by a spring. The windpipe is fixed by the hooks, the knife cuts between them so as to open the trachea, and the hooks being separated keep the wound open for the canula. A double knife, or rather a knife whose blade splits when the soft parts have been divided, and the windpipe opened, so as to give passage to the canula, has been suggested by Lühr. M. Sèes' instrument, again, consists of a cutting blade concealed between the limbs of a dilator, one of which is a hook. This is intended to fix, cut, and dilate in succession. Maisonneuve uses an instrument which cuts from within outwards, after having pierced the windpipe.

Curved or straight trochars (first used in tracheotomy by Santorius) having a trachea tube as canula, have been made of many forms, as those of Decker, Bill, Michaelis, &c. They propose to render the opening of the windpipe quicker, easier, and safer from hæmorrhage, and to enable the canula to be put in place at once.

Some instruments again remove a portion of the trachea after perforating it, and thus allow of a larger opening. Dr. Marshall Hall used an instrument of this kind. The objection to such a proceeding is that serious contraction of the trachea is said by some, who have tried it, to follow. This, however, has been denied by other operators.

It may be said, however, that in the hand of a skilful and well-educated surgeon, the knife is infinitely safer than any of these contrivances, which are apt to beget an ill-founded confidence in those employing them, and to cause them to undertake an operation they are incapable of performing aright, whereas the proper and safe use of such instruments in most cases requires actually more care and skill than the knife does. Some of these instruments are used without any preliminary incision of the soft parts, and are blindly driven into the windpipe. How easily may the elastic and most movable trachea of a young person be pushed aside, effaced or transfixed! The aperture, moreover, made by a trochar is far too limited for any purpose except the mere admission of air, and is quite inadequate to give exit to a foreign body of any size, or even to allow of the escape of mucus or false membrane.

The windpipe has been repeatedly transfixed with the knife, and both sides opened; and thus, in one case, related by Sedillot, fatal hæmorrhage

took place from a large vein on the œsophagus, and in others, fistulous communications between the trachea and œsophagus have resulted.

3rd. *Introducing the canula* is not always easy. It has been pushed between the trachea and the overlying tissues, and also between the lining membrane of the windpipe and the cartilages, by no less able a surgeon than Dupuytren. Sometimes in young children its introduction is impeded by fat. The elasticity of the canal makes the wound in it very ready to close, and if the orifice is small and the tube or forceps not introduced before the knife is withdrawn, the opening in it may be lost. It is to keep the opening patent till the canula is in position that the various "Dilators" have been invented. Gerdy used an elastic catheter, and Dionis a probe, as a guide, and these or the finger will frequently suffice as a mere guide to the orifice. Trousseau's dilator consists of a double-limbed instrument, like a pair of forceps, having the points turned outwards, so as to fix the edges of the wound, and a spring between the blades which keeps them separate when the pressure of the hand is removed. They are of course inserted closed, and then the blades are allowed to separate. Chassaignac uses a long-limbed instrument, the points of which meet at an obtuse angle, and allow of the passage of the tube between them. Garnier, Marshall Hall, Marjolin, Garius, Laborde and other have varied the form or arrangement of such instruments. They are all, however, somewhat objectionable from the space that they occupy in the wound. Dilators of wire fulfil the end very well. The double hook, whose points are separated by pressing the handle, or by sliding up a ring, as Mr. Maunder suggests, may also be useful, as they serve to fix the trachea while being opened, and then, as their points are allowed to separate, give passage to the canula. Reference was before made to Mr. Worthington's director guide.

In passing a canula into the trachea the wound should be first accurately seen, and then the point of the tube carefully introduced, observing the curve and its relationship to the direction of the windpipe. Trousseau recommends that a piece of oiled silk or caoutchouc should be interposed between the canula and the skin.

Trachea tubes are of endless shapes and modes of construction. They vary in size according to the calibre of the windpipe into which they are to be introduced. The idea is that they should provide as nearly as possible the same area as the glottis, whose function they are in some measure to replace. In adults they should allow of 30 cubic inches of air to pass at each respiration, and in children half as much.

Trousseau gives tables indicating the size, curve, length, &c. of canulæ, according to the patient's age, founded on careful measurements of the diameter of the trachea. So, too, Guersant recognises four sizes for use in children between two and fifteen years of age, but such minute distinctions are not by any means necessary, as a fair guess may in any case be made of what size of tube we should employ. Guersant's numbers are No. 1 for infants from 1 to 4 years, a canula 6 millimeters in diameter and 5 centimeters in length; No. 2 for children from 4 to 8, 8 millimeters in diameter; No. 3 for children from 8 to 12, 10 millimeters in diameter, and 6 centimeters in length; No. 4 for those from 12 to 15, the same length as the last, and 12 mil-

limeters in diameter. A fifth size comprehends canulas for adults. Its measurement is 15 millimeters in diameter. Since the above was written the author has seen a table of Mr. Marsh's measurements of the trachea and cricoid at various ages. It is given in vol. iii. of *St. Bartholomew's Hospital Reports*, to which the reader is referred.

As the perfect freedom of the tube is of the utmost moment, double tubes (as first employed by George Martins) should always be used, as then the inner one can be taken out and cleaned without displacing the outer. The inner tube should slightly exceed the outer in length, and should be easily withdrawn and inserted, otherwise those left in charge (as happened in a case of the writer's) may be unable to withdraw it, or at least fear to use the necessary force, and so allow the passage to become closed. The outer orifice or shield of the tube should lie flat on the neck, being parallel with the surface, and then the curve of the tube should correspond to the direction of the windpipe in which it lies, the point not projecting against either of its walls, as it would do if the curve is too great or too small. The point, too, should not be too sharp, for fear of causing ulceration in the interior of the windpipe. This has been known to arise, and fatal hæmorrhage from the innominate artery to follow on the fifth day after the operation. The instrument is more easily introduced if the point is somewhat conical (an arrangement, however, which, to a small extent, diminishes the calibre of the tube), or if, like Dr. Fuller's canula, it can be contracted at its point when it is being passed. Trachea tubes are best fabricated in two separate portions, and they should be solid, not having the rim soldered on to the tubular part, but forming an indivisible part of it, as then the risk of its separating and allowing the tube to fall into the windpipe (which has several times occurred) will be obviated.

It would be useless, as well as endless, to refer to the many trachea tubes which have been suggested; every instrument-maker's catalogue contains several patterns. Dr. Fuller's bivalve tube is wider, shorter, and less curved than most. Both inner and outer tubes are of equal diameter throughout,—the inner being longer than the outer. The outer tube is divided longitudinally into two portions, which are flattened towards their inferior extremity so as to lie close together, and admit of easy introduction, while when the inner tube is inserted they are made to diverge to their full extent. Air is admitted on the withdrawal of the inner tube, not merely at the extremity, but also between the blades.

Bretonneau's outer canula in the same way consists of an upper and lower half, which are kept firmly apart by an inner tube, which is easily withdrawn when requiring to be cleansed. Demarquay's outer tube, in its inferior part, divides into three branches, which are held together on introduction and separated afterwards by the insertion of the inner tube. By using inner tubes of increasing size, any constriction in the larynx can be dilated. Krishaber's canula has three valves and allows of speaking and expectoration. Some instruments, again, admit of being lengthened or shortened, so as to compensate for the amount of swelling present. Some are perforated so as to allow of the expiratory current of air passing up-



wards into the larynx. Luërs' ball valve is an admirable addition, as it allows of articulation. The subdivision of the extremity of the inner tube into small apertures is a great disadvantage.

Whatever form of tube is employed, it should be frequently and carefully cleaned, either by being withdrawn and washed, which is best, or a feather or a small bit of soft sponge attached to whalebone inserted so as to remove all foreign bodies. Various ingenious forceps have been invented for passing through the canula and removing shreds of false membrane, &c. Even this, however, is not enough to insure cleanliness. Inspissated gummy mucus may so adhere to the extremity of the outer tube, even when shorter than the inner one, as to embarrass the respiration. This is best got quit of by introducing a feather or a small heated and oiled elastic catheter. Pouring in a little warm water (and a good deal may thus with advantage be from time to time introduced if the interior of the canal becomes dry) or heated oil will also be found useful. This promotes expectoration and the expulsion of any foreign body. Any large portion of thick mucus or false membrane must be withdrawn with forceps. If it be wished to withdraw the outer tube as well as the inner, it can be safely done by first introducing an elastic catheter. This will serve as a guide for the reintroduction of the tube and also as a breathing passage till the canula is returned. For fastening the canula in its place a ribbon, or, what is better, an elastic india-rubber cord may be used, which should be tied sufficiently tight to prevent the risk of a cough displacing it, and yet not so firmly as to embarrass the circulation. A hook and eye on the ends of the cords will secure them. Chassaignac proposes to attach the canula to a long pin, made to traverse both lips of the wound at its upper angle, to which it is fixed by a thread applied as in the twisted suture.

It is of the utmost consequence after the operation to keep the air of the apartment moist and warm by boiling water in the room and conducting the steam towards the patient's bed by means of tin pipes. If this is attended to, not only will there be less risk of the canula closing, but the chances of inflammatory action occurring in the bronchia or lungs will be greatly diminished. The temperature of the apartment should be uniform and about 65 deg. All mucus, saliva, &c., should be at once wiped away, and a piece of muslin loosely put over the orifice of the tube to prevent the entrance of dust, and retain the moist hot air of respiration. If the tube is worn continuously, a knitted worsted muffler should be placed round the neck and over the orifice of the canula when the patient is out of doors.

It is probably more in the careful nursing and surveillance of the patient after operation than in the performance of the operation itself, that success is to be obtained in tracheotomy. Trousseau and others drop in, or swab, the interior of the windpipe after it is opened in croup and diphtheria for some days with a solution of nitrate of silver (ten or twenty grains to the ounce), and they believe that this diminishes irritation, and also the tendency to the formation of false membranes. Quietness, absence of all sources of bodily or mental irritation, and the regulation of the secretions by the simplest means, with a nourishing and easily digested diet, comprises the after treat-

ment. By closing the end of the tube with the finger, the patient can articulate and expectorate.

The complications which may arise after tracheotomy are hæmorrhage; emphysema (from too limited a superficial wound or the parallelism between the external and internal wounds being lost, or the tube being displaced), abscess in the mediastinum, from the tube having been inserted between the trachea and the soft parts, and so causing inflammation. Asphyxia also, from too delayed operation, the blood having become contaminated—injury to the trachea from its having been pierced or bruised—a vein in the œsophagus having been opened, or that canal injured—fistula—inflammation of the air tubes or lung substance, &c., &c., are possible results. Pericarditis, too, has been attributed to the operation.

The length of time the tube is to be worn, will, of course, mainly depend on the object for which it was introduced. From six to ten days is the average in cases of croup, but the restoration of the larynx to activity may be delayed for weeks. In any case the tube should not be withdrawn till it is loosened by suppuration. It should be replaced, if respiration continues embarrassed, after a short time, and at first it should always be reintroduced during the night. Fear, the loss of the habit, and a certain want of power in the muscles of the larynx, together with the presence of dry mucus, or some shreds of false membrane, may cause the breathing to be difficult for a time after the tube is taken out, but this will shortly disappear. It may be that the canula cannot be at once dispensed with, but must be given up by degrees. It should be disused at first, only for a short time, and that during the day, and again had recourse to till the parts are restored to their function. In taking out the tube the greatest gentleness should be employed, so as to prevent the child crying. M. Broca uses a canula which can be gradually closed, and thus the action of the glottis increased as it is capable of resuming its function. The canula can undoubtedly be borne with impunity for years if it is carefully looked to and kept clean, and occasionally removed, so as to avoid the risk of its breaking, and portions falling into the air passage. When it can with safety be dispensed with, it should, however, be discontinued. The wound will heal spontaneously, or will demand only the simplest treatment. If the canula is to be left long in place, a valved instrument should be used. The evils which may attend the prolonged use of the canula are ulceration, troublesome suppurations, hæmorrhage, necrosis of the cartilages; ossification and contraction of the windpipe. These evils are, however, more apt to attend the long use of the canula after laryngotomy than tracheotomy.

For a few days after tracheotomy (and lasting usually about a week) much annoyance is frequently occasioned by the difficulty in swallowing, and the escape of the fluid portions of the food by the tracheal wound, and into the air passages. This causes much irritation, and what is even worse, from the necessity to success of duly nourishing the patient, occasions great dislike to food. Solid food does not cause this annoyance, and should therefore be mostly used. Meat in pulp, thick soup, arrowroot, eggs, &c., suit well. A small piece of ice laid on the tongue, or swallowed entire, will quench thirst. If fluid is given at all,

it should be water, and used just before eating. Thick farinaceous food should take the place of the more liquid kinds. It may be requisite in these cases to pass a tube by the nose into the stomach for the administration of food. The paralysis of the larynx which is present will demand electricity for its removal. At other times the symptoms referred to depend on a mere loss of the habit of swallowing and breathing simultaneously, or rather of closing the glottis while deglutition is being accomplished.

During convalescence all intercurrent ailments of the lungs or other organs will require to be watched for and combated if they appear. The feeding will demand careful regulation, so as to supply the utmost nourishment of easy digestion. The sooner and better a child partakes of food the more successful will the operation be.

*Laryngotomy.*—This operation is preferable to tracheotomy in many cases, from the facility and rapidity with which it is accomplished, and the small amount of danger which attends it.

The relative value of tracheotomy and laryngotomy may be thus shortly stated. Laryngotomy is easier and quicker of performance, and attended with fewer dangers than tracheotomy, but the orifice obtained is very restricted, and is not well adapted for the continued use of a tube. In cases of disease of the upper portion of the windpipe also, the opening is not sufficiently removed in laryngotomy from the seat of the affection. If the object in opening the air tube be merely to re-establish respiration suddenly and temporarily arrested, as by spasm of the glottis, or the impaction of a foreign body, then laryngotomy is unquestionably the better operation; but if disease be the cause necessitating the operation, or if a large orifice is required, or if the opening has to be long maintained, then tracheotomy should be chosen. Experience proves the advantage of making the opening well below and beyond the focus of disease seated in the larynx or glottis.

In laryngotomy the opening is made in the crico-thyroid membrane, which in the adult is not more than half-an-inch in depth. The space is quite subcutaneous, and no obstacle exists to its safe opening if the middle line is carefully followed. Vicq-D'Azyr, in 1776, first performed this operation. (*L'Hist. de la Soc. Roy. de Méd., pour l'année 1776.*) The membrane should be opened with a slight jerk, and it can be cut either longitudinally, transversely, or crucially. If a tube is inserted it must be curved on the flat. There is very rarely any bleeding worthy of notice from the small crico-thyroid branch of the superior thyroid artery which traverses the membrane.

To gain more room in this region than is afforded by the ordinary operation, Boyer, in 1820, proposed to split the cricoid cartilage, and one or more rings of the trachea, and this operation is termed *laryngo-tracheotomy*. It is easy and safe, and the opening is large, but it is difficult to retain, from the firmness and elasticity of the cricoid cartilage.

Desault, again, suggested an operation he termed *laryngotomie thyroïdienne*, which consisted in splitting upwards the thyroid cartilage on a director, after opening the crico-thyroid space in those cases in which a free entrance was wished into the upper portion of the larynx. It could only be required in cases of foreign bodies being

impacted in the larynx, and then only in exceptional cases. The middle line must be carefully followed, so as to avoid the vocal cords. There is but little advantage to be gained in any case by such an operation, and great harm may be done.

Vidal and Malgaigne simultaneously proposed a supra-hyoid operation in cases where a foreign body was entangled in the ventricles of the larynx or in the neighbourhood of the glottis, or vocal cords, and could not otherwise be got rid of. They proposed to open the hyo-thyroid membrane by a transverse incision below the border of the hyoid bone. There appears to be very great risk of incurable fistula after such a proceeding, and no compensating advantage.]

#### SURGICAL AFFECTIONS OF THE TRACHEA.

[1. *Foreign bodies in the air passages.*—The foreign bodies which may find an entrance into the air passages are most various and heterogeneous in their character. Fluids of different sorts, such as water, milk, blood or pus may pass into some part of the respiratory passages, and be spontaneously expelled, or continue to cause uneasiness or danger, but to the effects produced by such agents or by gases the following remarks do not apply. It is the symptoms which result from the presence of solid bodies and the surgical treatment they demand that are here considered.

The enumeration of those articles which have been met with in the windpipe is both long and curious. Coins of various sizes; husks and kernels of grain and fruit; shells; fish and other bones, masses of meat; chips of wood and earthenware; shreds of cloth; tow and feathers; grains of corn, sugar, and salt; marbles, pebbles, insects, lumbrici, and other worms; pieces of laryngeal cartilage; detached bronchial glands; nails; peas and beans; leeches and pills; coffee-berries; the claw of a crab; buttons; bullets; an arrow head; pins and needles; false teeth and their setting; a pen-holder; a popgun; a whistle; calcareous concretions formed within the passage; polypi, hydatids, &c. &c.

In rare cases foreign bodies have passed into the trachea through the soft parts, as in gunshot wounds, and in the oft-quoted case of De la Martinière, in which a pin attached to a whiplash was so driven in; and in other cases extraneous matters have been admitted through ulcerated openings from the pharynx or œsophagus, or have been drawn into the larynx during the act of vomiting. At other times the intruder has come up from the lung where it has formed, or to which it has come from without as from the liver; or yet again the foreign body may consist of a portion of the walls of the windpipe itself, which having become diseased and detached has fallen in, and come to obstruct the passage. In most of the foregoing cases, however, we have to contend with a severe and dangerous ailment of which the presence of the extraneous substance in the air passages is but a comparatively insignificant part, while on the contrary, when the foreign body gains admission by the mouth it is in itself the sole cause of the evil we have to contend with. It may here be remarked that it has fallen to the writer's lot, in the prosecution of certain official duties, to find in seven instances in a period of three years, sudden death due to the impaction in



the air passage of foreign bodies brought up by vomiting during drunkenness.

The mechanism by which foreign bodies gain admission into the air passages is no longer confounded, except by the vulgar, with the act of deglutition. It frequently however occurs during eating, when the attention is diverted and an attempt made to speak or laugh. A deep inspiration is made, the epiglottis is raised, and the aperture of the larynx being thus widely open every facility exists for the easy passage of any object held in the mouth whose size is fitted to enter it. So, too, when a person holding carelessly such a foreign body as a date-stone or a nut in the mouth is startled, he may suddenly by a rapid inspiration draw it through the glottis. The exit of such an intruder is opposed by the narrowing of the glottis which takes place during expiration, especially when this is augmented by the spasm and cough which the presence of the extraneous substance occasions, and thus its spontaneous ejection becomes very difficult. If at the moment a deep inspiration is taken the head be thrown back so as to place the mouth and windpipe more in a line than usual the accident referred to will be more apt to occur, while of course, if there be either partial or entire destruction of the epiglottis or paralysis of the larynx, the danger of such a mishap will be much augmented.

After a foreign body has passed the glottis its further progress is influenced by a variety of circumstances. If pointed and sharp, it may enter the soft parts, and remain fixed at any part of the windpipe. If light, it may remain in the larynx, but if heavy, and especially if it is also round, it will probably pass downwards to a lower point, its size in a great measure determining the limit of its progress. A heavy body will probably remain at rest when it has once fallen down to the lowest level its size enables it to reach, while an object of slight specific gravity and smooth round outline may continue to move up and down the windpipe during respiration, and may even be thrown into the mouth during a violent expiratory effort. It is into the right bronchus that a foreign body is most apt to fall, because of the anatomical relationship of the parts—that tube being larger though less in a line with the trachea, and also, according to Mr. Goodall, to some extent from the presence at the point of bifurcation of the bronchial tubes of a ridge or septum to the left of the middle line which may have the effect of directing a foreign body into the right division. After entering the bronchus the extent of penetration will depend mainly on the size and form of the intruder.

The effects produced by a foreign body in the air passages will vary with its nature and the position it occupies. If it is soluble it may shortly disappear, and if a chemical it may cause much harm as it dissolves. If capable of absorbing moisture the size of the extraneous substance may undergo great augmentation. The most dangerous position a foreign body can occupy is the glottis, where instant suffocation may be caused; next the ventricles of the larynx is most hazardous, next the trachea, and lastly one of the bronchia.

Heat and moisture may so augment the bulk of substances of a vegetable and animal nature as to cause them completely to block up the passage, and grains of corn have been known to germinate within the canal. If long impacted, deposits of

lymph and carbonate of lime may equally increase the size of the extraneous agent. Sharp bodies may come to pierce the walls of the tube, and penetrate bloodvessels, as in a case related by Rokitsansky, in which fatal bleeding thus arose from the innominate artery.

The inflammation caused by the presence of a foreign body is frequently established very insidiously, and may continue limited, or it may spread far and wide, leading to disorganisation of the lung and disease of the bronchial glands, pleura, pericardium, and heart.

*Signs and Symptoms.*—In rare cases the immediate and remote indications of the presence of a foreign body in the air passages are so slight as hardly to attract attention. In the vast majority of cases, however, it is far otherwise. If death by suffocation does not immediately follow, most distressing irritation and spasm is set up, urgent dyspnoea, spasmodic cough occurring in paroxysms, pain possibly at a limited spot of the throat or at the upper part of the sternum, faintness, and it may be hæmorrhage by the mouth and nostrils. If the body is large, there is a most distressing feeling of instant dissolution. The patient puts his hand to his throat as if he would remove the impediment to his free respiration; he remains, if possible, erect; his eyeballs become prominent, and the face gets livid; tears flow over the cheeks, and the voice is altered or lost. Attempts are made to vomit, and occasionally there is involuntary discharge of feces and urine. The mental anxiety experienced is graphically depicted on the countenance. Loss of consciousness may follow and continue for some time. If there be great straining, some of the pulmonary cells may give way, and cause emphysema of the neck or pneumothorax.

Such violent symptoms as the foregoing may abate, and, being followed by an interval of calm, give rise to a delusive opinion of the danger. The formidable train of symptoms above referred to, however, too surely return, and during the intervals of their violence there is an abiding sense of anxiety and insecurity. These periods of intermission may be very short, or be considerably prolonged. The higher the position occupied by the intruder, the greater usually is the irritation, spasm, and distress it occasions, from the more sensitive character of the lining membrane of the upper as compared with the lower portion of the air passages. It is mainly when in its migration the foreign body impinges against the laryngeal surfaces that the violence of the symptoms so urgently increase, and it is often from the spasm thereby produced, more than from the mere mechanical action of the agent, that suffocation follows its passage upwards and its impaction in the neighbourhood of the glottis.

The pain caused by a foreign body will vary mainly with the rapidity and completeness of the obstruction to the respiration which it causes. Occasionally there is very slight uneasiness only; at other times it amounts to agony. A copious expectoration of purulent or bloody sputa is generally observed, and the influence of some particular posture in assuaging the more distressing symptoms is sometimes remarked, though in other instances all positions are alike attended by the most distressing discomfort. The respiration in a portion of the lungs is diminished or wholly suppressed by

the impaction of the agent, or the inflammation caused by its presence. This and other important diagnostic points can be determined by auscultation. Puerile respiration may be detected in some parts, enfeebled or suppressed murmur in others, and musical notes of various kinds may be heard, caused by the passage of air by the side of the foreign body or through it, as in Macnamara's case, in which a perforated plum-stone caused a distinct whistling. Percussion, too, adds a certain quota of information. If there be air imprisoned and at rest in a portion of the lung, a clear note will result from percussion, but if inflammation has been followed by consolidation, dullness will be elicited. If a considerable portion of the lung is inactive, the movements of the ribs, too, will be wanting. The point of impaction can thus, by auscultation and percussion, be sometimes clearly defined, by finding how much and what portion of the lung is shut off from communication with the windpipe. Further, by means of the stethoscope, the movement of the foreign body can be heard, and the hand applied to the throat during strong expiration occasionally detects its migrations, if the body be of such a size, shape, and weight, as to favour it. When impacted in the larynx, the laryngoscope may occasionally enable us to detect it.

The inflammation induced by the irritation may appear early or not till late—the period of its establishment, its extent, and its intensity depending chiefly on the amount of irritation present. Death may follow a train of symptoms in every way analogous to those of phthisis, and any of the pathological conditions arising from disease of the bronchia and lungs may be found afterwards.

The risk, then, which attends the impaction of a foreign body is at first from suffocation; afterwards from inflammation, and ultimately from pulmonary disorganisation.

The *Diagnosis* is not always easy. Children may be too young, or too ignorant, or too much afraid to give any information, or they forget that they held anything in the mouth at the moment they were startled, and thus if the first violent effects have passed off before the surgeon is called, it is apt to be concluded either that it was a false alarm altogether, or that the intruder has been spontaneously expelled. If, however, such symptoms as were before described set in suddenly in a young person, we may be almost certain that a foreign body has entered the air passages, and enquiries should be made to discern its nature, while by auscultation and percussion an attempt should be made to determine the place of its impaction. The history of the case, the previous condition of the patient, the mode of attack, and the nature and size of the extraneous object should all be carefully investigated. If the object is large it will probably be found in the gullet; if sharp and irregular it has likely got entangled in the folds of the pharynx or glottis, and if small and smooth it may have passed into the windpipe. The movements of the body may be sought for if we can expect from its form, &c., to find them, and auscultation and percussion put into practice to elicit what further information they are capable of affording. It may be remarked that the absence of the respiratory murmur from a lung or a portion of a lung, and its sudden re-establishment is very characteristic and decisive of the accident under consideration.

If the aphonia is marked, or the voice and respiration very croupy, and if the pain be severe and constant while no marked sounds can be detected in the chest, we may be pretty confident that the foreign body is impacted in the larynx, while, if its movements can be detected in the trachea, or if there be but a certain portion of a lung cut off from communication with the windpipe, we can in like manner recognise the seat of obstruction. It is, however, to be remarked that it is not alone in those cases in which impaction in the larynx has occurred that decided modifications of the voice are observed, nor yet is it always the case that the presence of a foreign body in the ventricles of the larynx gives rise to a train of very severe symptoms, still in general an opinion may be safely formed as to the position of the intruder from a consideration of these two circumstances, viz. the influence on the voice, and the severity and persistence of the effects. A few exceptional cases are recorded, in which, after the outset, no symptoms of any moment have followed the presence of a foreign body low down in the trachea.

From *croup* the presence of a foreign body is distinguished by the greater suddenness of the attack; by the irregular but pretty perfect nature of the intermissions in the progress of the affection; by the seat of the pain and obstruction shifting if the foreign body is not fixed; or the limited portion of the lung affected if it is impacted low down; by the expiratory effort, being that which in general is most embarrassed; and by the less loud and stridulous character of the breathing and the dryness of the cough. Lastly, in croup, we have the presence from the outset of inflammatory fever.

*Edema of the glottis* may be at once recognised by digital examination, together with the history of its advent and progress; while *foreign bodies in the pharynx or œsophagus* may be detected by the finger or a probang, and when they are present deglutition will be affected as well as respiration. If the body is large or sharp it will, as was before remarked, probably be found in the gullet, and the appearance of a circumscribed tumour in the neck will further confirm that opinion.

*Whooping cough* may be recognised by its history, the peculiar "whoop" and the respiratory difficulty being chiefly *inspiratory*, as also by the spasm of the glottis.

The *Prognosis* will mainly turn on the nature of the foreign body, the position it occupies and the period of its sojourn. The size, shape, and composition of the substance will manifestly greatly influence the opinion we give as to the result of the case; its chemical character, its liability to imbibe moisture, the degree of irritation it causes, its direct influence on the respiration. There is most danger of suffocation during the first four or five days, but the risk of that event continues so long as the foreign body remains. Then we have the hazard of inflammation and its effects to weigh, and the various complications which may arise if the body is not got rid of. The longer the extraneous substance is present the worse the anticipations concerning it. As to the position it occupies, it may be said generally that the worst place is at the glottis, next the ventricle of the larynx, and that the trachea (if not wholly closed) is less dangerous than a bronchus, because allowing



of more easy removal. Of course here, as in all surgical maladies, the age, strength, and individuality of the patient must be taken into account in forming an opinion of the ultimate result of the case.

*Treatment.*—When abandoned to itself a foreign body may either be expelled by the mouth, or being swallowed be evacuated by the bowel. It may, if impacted, escape from the air passages by setting up ulceration, and end by becoming encysted in the lung or cavity of the chest, or it may cause an abscess and escape from the surface, possibly at a considerable distance from its original position, or it may fall into the pleura and be the source of empyæma. The nature of the body will to some extent determine which result will follow. In fortunate cases a foreign body may thus safely be got rid of, but in most of the foregoing modes of expulsion, the risks are very great, both before, during, and after the process.

Spontaneous removal by the mouth during the act of coughing, sneezing, or vomiting, is not unfrequent, especially when the head has been at the moment dependent, as hanging over a bed. Very long periods however may elapse before this occurs, and such disorganisation may in the meantime have been produced as to render its removal a matter of comparatively little moment. Professor Gross has related 57 cases of spontaneous expulsion out of a total of 159 in which a foreign body was present. In some of these instances only a short period had elapsed since their introduction, but in many of them long intervals had passed, and all the evil influences of their presence had been fully developed.

The great object of course (and that which takes precedence of all others) in the management of these cases is to get rid of the intruder. Without this no good can be done, except perhaps the alleviation of the more severe symptoms. There should be no procrastination. The hope of spontaneous expulsion is not great, and may, by its delusive promise, fatally delay operative proceedings. Any moment may bring about a fatal end by suffocation however quiescent the foreign body may for the time appear. A cough or sudden effort may displace it, and so end the struggle. Further, though the danger of suffocation be escaped, yet the most serious disease in the air tubes and lungs will eventuate from the continued residence of the foreign body, notwithstanding the evidence to the contrary apparently furnished by such cases as those collected by M. Mondiere. Hence, to avoid both an early and late source of much evil and danger, the sooner the intruder is removed the better. Tracheotomy performed for this purpose is successful very much in proportion to its early performance when no secondary disease has established itself. Emetics and sternutatories experience has shown are powerless as means of procuring expulsion, and the former remedy has even been found injurious. Occasionally, when the specific gravity of the extraneous body was considerable, it has been removed by inverting the patient, as in the oft-quoted case of Mr. Brunel, when by means of a hinged platform he was inclined to an angle of  $86^{\circ}$  with the horizon, and after several futile attempts the coin removed. Several other successful cases are now on record in which the same method has been employed. The patient being bound firmly in a

chair, is turned head downwards, and then smartly struck between the shoulders; or after taking a full inspiration his chest is compressed suddenly either by the hands of a bystander, or by means of a bandage, or the trachea is manipulated to aid the process of expulsion. Tracheotomy should however precede such manœuvres, as otherwise suffocation may be quickly caused by the foreign body falling into the chink of the glottis, or causing by its contact spasm which will close that aperture. By first opening the air passage we avoid all risk of such danger, and we further provide a second and highly favourable (because well placed and non-sensitive), exit for the foreign body, and one which allows of instrumental aid being employed. If the seat of impaction is high, then laryngotomy may be more fitted for our purpose than tracheotomy, but as a rule the latter operation carried as low down as possible best suits these cases.

Occasionally "laryngo-tracheotomy" succeeds best. The choice will mainly depend on the case.

There are few exceptions recognised to the rule that the presence of a foreign body in the air passages demands tracheotomy. Even in those instances in which the intruder is of such a nature as to favour its spontaneous expulsion, yet the risk of fatal spasm during the act of extrusion is so great that it is highly imprudent to hazard it. If the artificial aperture is kept patent and free, expulsion may be almost surely counted on, though it may be considerably delayed. Favier's experiments demonstrate the ready manner in which this takes place. Frequently the foreign body is at once and very forcibly expelled whenever the windpipe has been opened. The operation of tracheotomy is not attended with much hazard if properly performed, and the patient afterwards carefully tended; and certainly the amount of risk that it adds to such cases as those under review is insignificant as compared to the good it is capable of doing.

After an artificial opening has been made at a fitting part, our subsequent proceedings must depend on circumstances. If the foreign body is light it may now be spontaneously expelled by the current of air admitted to the lungs; if it be heavy and movable we may by inversion bring it within reach; or if impacted instruments adapted for the purpose may be employed to assist its removal. Chloroform is of much use during such manœuvres. Great gentleness must be used, and all hæmorrhage from the lips of the wound arrested before anything further is attempted. In the case of a child with a small windpipe, when there is much restlessness, spasm and cough, and suffocation imminent, no more trying or difficult position can be supposed than the operating surgeon is then placed in, and in no operation is there a call for more careful and delicate manipulation.

If the foreign body is impacted so that little air enters the lungs, a probe should in the first instance be used to displace it, and allow of the entrance of air both for the relief of the patient, and also to provide a freer outgoing current to aid the upward passages of the body. The lips of the wound should always be kept well apart, and the head bent forward so as to facilitate expulsion. If forceps are employed, the risk of grasping and

lacerating the mucous lining of the canal must be borne in mind, and all such manipulative efforts should be desisted from if one or two fair attempts fail. Much harm may attend their continuance. If the foreign body lie above instead of below the aperture made in the windpipe, then we may be able to push it upwards into the mouth or downwards to the artificial opening.

If the intruder is not removed by one of the above-described means, the aperture should be kept open by appropriate means; no tube of course should be introduced, but a piece of wire gauze, arranged so as to form a bag, should be put over the wound, and the temperature of the apartment kept steadily at from 60° to 80° Fahr. There is very considerable danger of inflammation of the lungs and pleura arising, and this must be jealously guarded against and carefully treated, if it occur. Its progress is often very rapid after tracheotomy, and demands prompt measures to command it.

After the foreign body has been expelled, the wound must be at once closed, and an attentive supervision of the breathing apparatus long maintained.

The instruments best fitted for the removal of foreign bodies from the air passages after tracheotomy, are strong but slender silver forceps, which can be bent to a curve suited to the case, and of different lengths, so that the hinge shall be outside of the wound. A loop of wire has been sometimes found to succeed well. In all cases the utmost gentleness and patience must be exercised.

If the foreign body has been long present in the passages and the lungs have become seriously affected, there is very little ultimate good to be got from any operation, and the surgeon must then be guided in judging of the advisableness of interfering by weighing the immediate risk of the body's sojourn against the ultimate hope of success with the existing stage of the secondary disease. If the latter is so evidently the leading affection as to throw the former into the shade, then it will be a point of much niceness and difficulty to decide what alternative to choose, the patient's welfare being his first consideration, but the reputation of his art not being forgotten.

*Wounds and Fistula (see LARYNX).*

*Hernia.*—Rarely a protrusion of the lining membrane of the trachea takes place between its rings, giving rise to a tumor usually of small dimensions, of soft consistence, and augmenting when the mouth and nostrils are closed, and a strong expiratory effort is made. Pressure diminishes its size, and thus alone can we exercise any influence over its progress or hope to cause it to disappear. Such accidents are said to arise occasionally suddenly, after violent efforts of the voice, but they are more likely to occur when repeated prolonged expiratory efforts are made, as in blowing wind instruments. It is, however, a very rare accident indeed, and is very unfitly designated a hernia.

*Pneumatocele* occasionally forms on the windpipe from its perforation and the escape of air into the surrounding parts, and being thus circumscribed it forms a tumor, which is soft, easily effaced by pressure, tympanitic, and occasionally transparent (if prominent). If effaced by pressure it soon reappears on coughing.]

[*Tracheitis Infantum*; *Trachealia*; *Croup*; *Angina Trachealis*; *Angina Membranacea vel Suffo-*

*catoria*; *Cynanche Stridula vel Laryngea*; *Laryngile Stridulense*; *Diphtherite Trachéale*, &c. &c.

In this specific inflammation of the trachea in children, a whitish-grey albumino-fibrous membrane forms in the interior of the windpipe, implicating its surface more or less extensively. Sometimes this deposit takes place in patches or stripes, at other times it forms a complete cast of the inside of the tube. It may be confined to the upper part of the air-passage or penetrate deeply into its ramifications. Sometimes it extends upwards into the nasal cavity and downwards into the oesophagus. In thickness and adhesion to the underlying surface this deposit varies considerably. Its age chiefly regulates this. If fluid is effused below it, as sometimes happens, the attachment of the false membrane is much loosened.

Croup only began to be carefully studied about the middle of the eighteenth century. It belongs more to the province of the physician than the surgeon, and will only be shortly described here, and that in order to render more complete the account given of the affections of the trachea. As few details as possible will be given.

In the usual form of the affection seen abroad, the secretion does not partake of the tough adherent character it so often assumes in Great Britain, and consequently the danger attending it is not so great, in its early stages at any rate. Croup is frequently epidemic, and attacks almost exclusively children from one to seven years of age (and especially those of two and three), and kills on an average the half of those seized. It appears to prevail in some families, and in certain localities, especially those which are cold and damp. It constitutes about a twelfth part of the acute affections of childhood, and it is very apt to recur.

Croup may set in suddenly, with little or no warning, but more usually it begins with symptoms of catarrh,—feverishness,—running at the nose and eyes,—hoarseness,—wheezing respiration,—rough dry cough,—soreness in the windpipe,—some redness in the fauces, followed by spasmodic action of the laryngeal muscles.

The pyrexial symptoms may be wholly absent, or at least not attract attention for twenty-four or thirty-six hours, and then manifest themselves by hot skin and quick pulse. The violence and progress of the disease may be slight and slow, or severe and rapid. It frequently begins at night, and the interference with the respiration is its characteristic and leading feature. The inspiration becomes shrill, hissing, and crowing, and a peculiar hoarse "brassy" clanging cough is very distinctive. The voice, at first husky, at last disappears. The respiratory murmur is found to be deficient over the chest, and the expiratory sounds are prolonged. The attacks occur in paroxysms, with intervals of comparative rest, especially during the day. The dyspnoea, however, though diminished in violence, never wholly disappears. The distress during the paroxysm is very great and most heart-rending to witness. The child grasps the windpipe with the energy of despair, or inserts the fingers into the mouth in the vain hope of removing the obstruction to the breathing. The face swells and becomes oedematous and discoloured,—the veins of the neck are prominent and the eye-balls injected and staring. Occasionally thick mucus or portions of the fibrous casts from the air-passages, mixed with blood, are expector-



ated after a violent exertion. The pulse becomes feeble and irregular,—stupor, with momentary paroxysms of excitement, set in, and death takes place in from twenty-four hours to fourteen days from the outset of the attack (rarely earlier or later) in about half the patients seized. The immediate cause of death is either suffocation or exhaustion. Convulsions frequently precede dissolution; and, according to Dr. Richardson, fibrinous clots forming in the heart are the immediate cause of the fatal event.

The symptoms above shortly described are quite distinctive of this terrible malady. The age of the child, the mode of invasion, and the progress of the complaint, together with the peculiar respiration and cough, are sufficient to distinguish croup from other ailments. Laryngismus stridulus, or false croup, is differentiated by the greater suddenness of the attack as a rule; the absence of fever, the distinct and clear remissions, the unaffected voice which, though perhaps hoarse, is not suppressed, and the different character of the accompanying cough which, though loud and ringing, has not the brassy clanging sound it has in true croup. Further, there is no false membrane formed or expectorated.

For the signs by which croup is distinguished from foreign bodies in the air passages, see p. 761.

True laryngitis is an affection of adults, and is marked by fixed pain increased by pressure on the larynx. Its progress is wholly different, and there is no false membrane formed.

Œdema of the glottis can be recognised by inspection or exploration, and there is the absence of the characteristic cough and expectoration.

Post-pharyngeal abscess interferes with the deglutition, but not at all, or only in a very slight degree with the respiration and voice. The symptoms persist, and the swelling it occasions in the back of the pharynx can be seen or felt.

Growths in the larynx are very rare in children. Their progress is chronic, and the expiration is affected as well as the inspiration. The laryngoscope too will aid their recognition.

The *Prognosis* in croup is always most unfavourable if the symptoms are severe.

The *treatment* should be early and antiphlogistic. A bath of the temperature of 98°, an emetic, followed by a free action on the bowels by calomel and castor oil, a few leeches to the mastoid processes or the upper part of the sternum (where effective pressure can be used to arrest bleeding), followed by the application of hot sponges or poultices to the windpipe. Antimony if administered should only be used in the early stages of the affection, and its depressing influence sedulously avoided afterwards. Quietness should be enjoined in the apartment, and the air rendered warm (65°) and moist by the introduction of steam. This can be very effectually accomplished by surrounding the child's cot with curtains, and directing a jet of steam into the sort of tent thus made. The food should be carefully regulated and rendered as nourishing and easy of digestion as possible. The body should be comfortably but not oppressively clothed.

The use of counter-irritation, either by blisters or iodine, and the subsequent employment of mercury, either to the raw surface or given internally, is highly objectionable and in no way conducive to good.

Lowering remedies, unless to subdue the violence of the attack at its outset, must as a rule be avoided in the treatment of croup. The depression they occasion if severely pushed is most detrimental in the later stages of the disease, and serves greatly to render operative measures ineffectual. If the disease attack, as is not uncommon, a child now or lately the victim of any other depressing ailment, such as an exanthem, bronchitis, &c., or a child that is constitutionally weak, then no lowering remedies whatever can be thought of at any stage of the complaint.

The administration of an emetic or tickling the fauces, so as to induce vomiting, will aid in the expulsion of the false membrane, if loose, and so give great relief; and the inhalation of oxygen has been thought useful when asphyxia threatened. Iodide of potash alone, or with the chlorate, or combined with senega, assafetida, and ammonia, or with the tincture of the muriate of iron, have been the internal remedies which have received most favour. It is mainly, however, as regards the performance of tracheotomy that croup is here treated of. It is to the example and precepts of Trousseau that we owe most in this connection, and since he showed how desperate may be the cases saved by it, British surgeons have become less timorous about its performance. The chief point still, however, to be advocated, is the early recourse to operation before the powers of life have been exhausted, and not the looking upon it as a last resource, when to succeed would be a miracle. Much attention has been paid of late years to this question, mainly through the labours of Trousseau, Bretonneau, and Guersant, and many lives saved which there is every reason to suppose would have been lost if tracheotomy had not been undertaken. It may be remarked in passing that, though the French authors above mentioned have of late years taken the lead in this question, yet that Francis Home was the first (1765) to recommend tracheotomy in croup, and that the first successful operator was André of London, in 1782.

It is mainly the definition of the cases which demand the opening of the windpipe, and the determination of the stage in which it is best performed, that calls for remark. As to the first point, it may be said, that it is in the membranous form of croup alone that the operation is called for; and as to the stage, it is that in which the inflammation and exudation, having become decidedly established, have not as yet penetrated so deeply as to implicate the bronchial tubes, or disorganise the lungs. It is when death threatens by apnoea, caused by the obstruction of the upper part of the windpipe by morbid effusion, but before the general system has so felt the effects as to become greatly exhausted, that tracheotomy holds out the best hopes, as by its performance the immediate source of danger is at once removed, and those ulterior changes in the blood and general system, which are themselves fraught with so much hazard, obviated. Guersant thinks that inflammation of the larger bronchi does not contraindicate the operation. If death threaten by syncope, opening the windpipe below the seat of disease can be of little or no avail. When medicine has failed to arrest the disease, and suffocation is imminent, common sense, no less than actual experience, would point to tracheotomy as the re-

medy of most promise, and one which, if performed at the right time and with due precautions as regards manipulation and after treatment, is almost certain to be successful. It is most essential not to delay till the dyspnoea has become very urgent, and the puffy, discoloured, anxious face, convulsive movements, and intense agony of approaching suffocation have become manifest, as then prostration will quickly follow such abortive attempts to breathe, and the prolonged want of rest, and the circulation of impure blood, will destroy that recuperative strength on which we must depend for recovery. It is not by any means asserted that recovery may not sometimes follow tracheotomy performed in the most desperate circumstances—some cases which have fallen under the writer's own care amply prove the contrary,—yet it is exceptional for success to be then attained, while it would be the rule if operative interference were sooner resorted to. The degree of strength possessed by the patient will very manifestly and most powerfully influence the result. If the child is constitutionally delicate, or its vigour diminished by previous ailment or by the effects of the present attack, the hope of success from tracheotomy will be much diminished. It is to be remembered that a state of asphyxia does not always manifest its establishment by such obvious signs as were before described. Occasionally, on the contrary, restlessness, exhaustion, and stupor, alone mark its advent. There is no excitement.

Nothing probably affects the result of the operation so much as the strength of the patient at the time of its performance. If able to throw off the false membrane and to take food, the hope of success is very considerable. If the child is weakly, independently of the croup, from being of delicate habit, or a victim to some other depressing ailment; if lowering remedies have been energetically pursued at the outset of the disease; if the child is very young, or cannot be carefully nursed and tended after the operation; then the chance of success will be much impaired. It is probably from the difference of strength alone that the observation has been made that the older the child, other things being equal, the better the hope of success.

The more the effusion is limited to the upper part of the windpipe the better, yet cases are not wanting in which tracheotomy has apparently saved life when the exudation has penetrated far below the point opened. We must frequently operate when we cannot form any very accurate idea of the extent to which the exudation has reached, but in most cases we can form a tolerably correct opinion. Albuminous urine is always a bad sign, and one which should be inquired after. It renders the case unpromising, but by no means desperate or hopeless.

To conclude the consideration of this point then it may be said that success in the performances of tracheotomy in croup depends in a great measure on attention to—

1st. The avoidance of depressing and exhausting remedies in the early stages of the disease.

2nd. The case being one in which the danger solely or mainly arises from an obstruction in the windpipe to the entrance of air into the lungs.

3rd. Operating before exhaustion and blood contamination have appeared.

4th. Skill and care in the necessary manipulations.

#### 5th. Careful after treatment.

The operative procedure will obtain separate and detailed notice, but the after-treatment of cases of croup which have been operated on demands distinct mention, as it is most important. The most strenuous endeavours should be made to support the strength by the administration of concentrated and easily assimilated food, of which meat soups, milk, eggs, chocolate, jelly, &c., are the most useful. If the general health require the use of drugs, they must of course be employed, but not otherwise. No specific remedy is of any avail. Calomel, antimony, potash, &c., are useless after the windpipe has been opened. Food and carefully regulated stimulants (good claret and brandy) are the real remedies. It is by such means and the admission of air into the lungs that the disease is to be combated.

Tracheotomy in croup removes the great source of danger in the early stages of the affection,—it provides an opening by which air gains admittance and false membranes are ejected—it allows of the application of local remedies, and prevents exhaustion and collapse, while the effect of drugs may be developed if they are capable of controlling the disease, and it at least helps to uphold life while the malady exhausts itself, and lastly it gives rest and comparative comfort to the sufferer, and imparts consolation and hope to relatives whose distress is often almost as poignant as those of the patient.

The advantages which attend the operation then are sufficiently obvious, the drawbacks which have been alleged to it are that it renders attacks of bronchitis and pneumonia frequent, and that unless skilfully performed it may be attended with much danger. Adroitness in operating is not to be attained by all, but judicious after treatment as regards protection from cold air and careful feeding is.

Trousseau strongly advises the free application of nitrate of silver to the interior of the windpipe, after it has been opened, and this to be repeated daily till a healthy action is established. Cases may arise in which this practice is desirable, but as a rule the avoidance of all irritation must be aimed at.

After tracheotomy has been performed in croup, death may occur from accidental circumstances, such as obstruction of the canula, hæmorrhage, &c., but it is chiefly from exhaustion, the extension of the disease, and the implication of the bronchial tubes and lungs that a fatal result is to be feared. The rapid sinking which occasionally takes place a few hours after the operation, and when everything appears to be favourable, has been attributed to nervous exhaustion and pulmonary collapse.

*Diphtheria* (διφθερα, a skin) is a specific disease of great fatality, occurring epidemically and being possibly contagious. It consists in inflammation of the mucous membrane of the throat, followed by lymphic exudation, and this may come to cover the tonsils, pharynx, larynx, and œsophagus. It may invade the nares and penetrate into the stomach and bronchial tubes. It is attended with great feebleness and prostration, and an enlargement of the cervical glands, which usually accompanies it, adds considerably to the swelling of the throat and the embarrassment of respiration.

This disease may become rapidly developed, or, on the contrary, establish itself most insidiously.



A state which may be described as that of a feverish cold is its usual early manifestation. There is, however, early and marked prostration, and not unfrequently considerable gastro-enteric disturbance. The inflammation usually begins in the uvula, and a mere feeling of stiffness and discomfort may alone be complained of, though more frequently severe pain attracts the attention to the part. Dysphagia soon appears, and in from twelve to forty-eight hours the exudation, which is so characteristic of the disease, shows itself at many centres on the tonsils and back of the throat and spreads therefrom far and wide. The false membrane which forms may be quite soft, like glue, and easily detached; or, on the contrary, it may resemble wash-leather, and be tenacious and adherent. If detached, it is reproduced with great speed. The surface beneath the membrane is often ulcerated and gangrenous, and may bleed profusely and even fatally. Respiration becomes embarrassed, as well as deglutition, and as the blood becomes contaminated and the inability to take food increases, the patient's strength is undermined, and the greatest weakness is established. Death may occur in from twelve hours to fourteen days, and be due to suffocation (as is common in children), or prostration, or septic poisoning, or uremia. If recovery take place, the convalescence is protracted, and liable to serious intercurrent ailments. Albuminuria is common, and frequently very aggravated, and that early in the disease; partial paralysis of a most distressing kind, affecting both sensation and motion, appears in about one-fourth of the cases, and various other maladies are liable to defer and render the recovery difficult and incomplete. The paralysis referred to commonly appears in the muscles of the pharynx and tongue, as well as in those of the limbs.

The treatment varies somewhat, according to whether the disease manifests itself mainly by general or local symptoms. Generous support and pure air are required in all cases. If the swallowing of food is impossible, nutrient enemata must be employed. Soup, milk, wine, or brandy, and everything likely to support the vital powers, must be administered. The age, habits, and powers of assimilation of the patient, together with the necessities of the case, must regulate such administrations. A purgative of calomel and jalap at the outset is useful in clearing the bowels, but afterwards enemata should be used. After the clearance of the intestinal canal, the tincture of the muriate of iron, in half-drachm doses every three hours, forms perhaps the best remedy; or chlorate and iodide of potash in free doses, or a combination of quinine and iron. If there is sleeplessness, morphia may in the early stages of the disease be given, and chips of ice allowed to dissolve in the mouth will allay thirst and afford relief. Emetics have been found useful in disengaging the exudation, which, if loose (not otherwise), should be mechanically removed. Poultices to the loins are good if the urine is scanty.

The inhalation of warm, moist air is beneficial, and gargles of limewater or perchloride of iron, or permanganate of potash, help to correct the condition of the throat. If caustic is applied to the patches of disease, it should be done once and for all, and not repeated. A strong solution of nitrate of silver (3j. to the ounce of water) brushed freely over, or nitric acid half diluted with

water, freely applied, answers best. Hydrochloric acid, with honey, has been much recommended. It may be requisite to syringe the nostrils with a weak caustic or disinfectant solution (Condy's fluid is best for this purpose), and fomentations and poultices to the neck give much relief. If the respiration is seriously compromised, the windpipe must be opened; by so doing death by asphyxia is prevented, and the effects of non-aerated blood avoided. If death threaten by asthenia, or from the establishment of blood poisoning, then tracheotomy is too late; but if the strength is good, and the obstacle to the respiration be apparently the chief source of danger, then tracheotomy is most hopeful. In more than half the cases the danger during the first week is from laryngeal obstruction, especially in the young, and against this, operative interference is most efficient. It has succeeded, even in the most desperate cases, in a considerable number of instances; and in France, where early operation is more practised than in Great Britain, tracheotomy has been crowned with much success. If it fail to cure, it certainly tends much to soothe the last hours of the patient. Its success will be in proportion to the source of danger being solely seated in the trachea. The less the constitution is implicated the better, and in any given case our discrimination will be called for to determine the relative preponderance of the local and the constitutional elements in the affection. The chances of success are very considerable indeed when the windpipe is opened just when the respiration is becoming seriously impaired, but before evidence of true asphyxia has manifested itself.

During the convalescence from diphtheria, country air, nourishing food, cod liver oil, wine and malt liquor, tonics (iron, quinine, strychnine), and galvanism should be used to restore the functional energies.] *G. H. B. Macleod.*

[TRANSFUSION. This operation, which at one time excited the most extravagant expectations, has hitherto held a fitful and insecure place in surgery. Often revived, and as often falling into desuetude, it has never failed to arrest the attention of some thoughtful and enterprising men. If success alone could command recognition, transfusion ought by this time to be an operation in frequent use. Many lives have undoubtedly been saved by it; and if there have been also many failures, it must be remembered that the transfusion has almost always been performed in very desperate cases, and that it is not a sound objection to an operation that it sometimes fails, since all operations are liable to fail. We ought to seek for the causes of failure, to see if they cannot be removed, and thus to diminish the proportion of failures. This is one of the instances in which a single success should encourage to persevere in the face of any number of failures. Of late years material accessions to our knowledge of the subject have greatly increased the probability of rendering the operation more practicable and successful.

There are two distinct proceedings to be considered under "transfusion." This word properly means the translation of the blood of one animal into the circulation of another. But we may also inject into the circulation of an animal other substances besides blood, such as saline or alcoholic fluids, or medicinal substances. This is called

venous injection or infusion simply. A detailed history of the subject would here be out of place. I refer for the best account to Dr. Little's Oration before the Hunterian Society, 1852, and to the monographs indicated in the bibliography at the end of this article. Infusion of wine and opium was first practised on dogs by the great architect, Wren, in 1656. Lower amongst others followed, and was the first who successfully practised transfusion in an animal. He connected the cervical artery of one dog with the jugular vein of another.

It was next taken up in France by Denis, who first effected transfusion in the human subject in 1667. He successfully introduced small quantities of the blood of calves and lambs into the veins of five persons, who experienced no injurious consequences. Experiments by other observers proved that the blood of the lower animals might be injected into the human circulation without bad result. Garman suggested that asphyxiated newborn infants might be restored by the injection of a few drops of wine by the umbilical vein. In 1776, Kohler illustrated, in a remarkable manner, the value of venous injections of emetic substances. He was called to a man in whose œsophagus a large piece of gristly flesh had become impacted. The man was speechless, with fluttering pulse and cold sweat. He injected six grains of tartar emetic into a vein. Half an hour afterwards the piece of flesh was ejected with great violence. The man recovered. Balck, in 1784, performed a like operation under like circumstances, and with the like success. It was not then clearly known that the mere subcutaneous injection of medicinal substances might have answered the same purposes. Hennman, a German, injected into a vein of a person apparently dying of typhus an infusion of bark and harts-horn: the patient recovered.

After being practically laid aside, transfusion was again examined and placed upon a better footing by Dr. Blundell, at Guy's hospital. The modern revival of the operation is due to him. Dr. O'Shaughnessy proposed the injection of saline fluids in cholera. Dr. Latta, of Edinburgh, put the proposal into practice; of fifteen cases of cholera-collapse, one-third recovered. Many practitioners, and amongst them Dr. Tweedie, Dr. Craigie, Dr. Murphy, Dr. Girdwood, Mr. Arthur, Dr. Little and his son, Mr. L. S. Little, followed this example. All had cases of recovery.

The practical questions are these:—1st, what is the best fluid to inject? 2ndly, what is the best apparatus and mode of operating? 3rdly, what are the conditions indicating or justifying transfusion or infusion?

1. Transfusion of course implies that blood shall be used. But blood in different states, and from alien animals, has been used. It appeared to result from the experiments of Dieffenbach and others that to obtain success it is necessary to take blood from an animal of the same species. But the annals of transfusion contain many proofs that this conclusion is erroneous. It has, however, been generally agreed that for human transfusion human blood shall be used. In selecting a giver, it is not necessary to regard the sex, but only the state of health. In many of the experiments on animals, the blood was drawn from an artery; but in human transfusions the blood is drawn from a

vein. Dr. Gesellus, of St. Petersburg, obtained the blood by scarifying the skin and suction, the blood collecting in a tube connected with a pneumatic pump. (*Practitioner*, 1869.) It is quite clear that venous blood answers the purpose. Then the question arises as to the best mode of dealing with this blood. The practical difficulty which, perhaps more than any other, has retarded the extensive use of the operation, has been the tendency of the blood to coagulate rapidly after being withdrawn from the veins. This has frequently baffled the operation, the blood clotting in the apparatus, in the veins of the patient, or perhaps in his heart. Various inquiries and expedients, suggested by the hope of averting this difficulty, have arisen. In many of the experiments on animals *immediate transfusion*, that is, transmission direct from vein to vein, was practised. Dr. Aveling, Oré, and others advised this, in the expectation that the blood, being secured from contact with air, and never being at rest, it could not coagulate. But even under these conditions, the difficulty is not certainly overcome. At one time great stress was laid on keeping the blood, received in a funnel or other reservoir, at the same temperature as that of the body. But this is undoubtedly a physiological mistake. Cold retards coagulation, and there is no inconvenience from injecting blood a few degrees below the normal standard. The operation, then, may be simplified by disregarding care as to temperature. It was thought that the object might be attained by depriving the blood of its coagulating constituent. This led to defibrination, by whipping the fibrin out, and then injecting the serum and globules. Experiments were made to ascertain what were the constituents of the blood which were capable of restoring life. It is proved by two cases, those of Polli and Nussbaum, that defibrinated blood is efficient. Dr. Albanese reports (*Centralbl.* 1869) seven cases in which he used warm defibrinated filtered blood. He introduced the injection-syringe into the radial artery. Four recovered. In about fifteen other cases the use of defibrinated blood was unsuccessful. Oré proved that the blood-globules were efficient. Panum contends that the serum contains vivifying elements. In the case of cholera patients, again, it is quite proved that the simple infusion of saline fluids is enough. It results that the fibrin may be taken out, but this involves a loss of time; also that it certainly does no harm if it can be got into the circulation of the patient in its fluid state. The large number of recoveries from the transfusion of whole blood renders it probable that it is better to use it as nearly as possible in the natural state. We come back, then, upon the question, how to prevent it from coagulating? Dr. Richardson, eighteen years ago, in his admirable work on "the causes of the coagulation of the blood," proposed the addition of a few drops of ammonia to every ounce of blood for this purpose. This, he says, effectually preserves fluidity. Dr. Braxton Hicks, pursuing the same idea, in *Guy's Reports*, 1869, proposed a solution of phosphate of soda. He used it in several cases; and although the patients did not recover, the special purpose was attained.

2. What is the best form of apparatus? The answer depends greatly upon the fluid employed. Those who contend for immediate transfusion use a caoutchouc tube, armed at each end



with a suitable canula to insert into the veins of the giver and the receiver. Dr. Aveling (*Obstet. Trans.*, 1865) recommends a tube having a dilatation in the middle like a Higginson's syringe, to enable the operator to propel the blood; it has no valves. Dr. Richardson objects that even thus coagulation may mar the operation. Most of those who have used whole blood have used some form of injecting syringe. Some have first collected the blood in a vessel, and have then taken it up into a syringe. Dr. Blundell set the type of a number of instruments by collecting the blood in a funnel-receiver, which was attached to the pipe of the syringe, so that the blood might gravitate at once into the syringe. Mr. Samuel Lane used an apparatus of this kind in a case where he performed the operation on a boy dying of bleeding; he was entirely successful, but he had to leave off and clean the apparatus several times on account of obstruction by clots. Probably the addition of ammonia or phosphate of soda might make this apparatus quite efficient. A good modification of it is figured by Mr. Higginson (*Liverpl. Med. Chir. Trans.* 1857), who by it treated successfully two cases out of six. The receiving-funnel admits the blood into an elastic barrel which has no piston. Squeezing the barrel propels its contents. The best syringe, however, appears to be Dr. Richardson's. It consists of a glass barrel holding six or eight ounces; attached to the pipe is an elastic delivery-tube, a foot long, having at its end a canula, conveniently curved, with a long oblique mouth smoothed for insertion into the vein, and tapering so that when inserted it is pushed on till its calibre fills the vessel. The piston-rod works on a joint so that it can be placed out of the way when the blood of the giver is received direct into the barrel; the plug of the piston is perforated so that when the rod is lifted up an opening is made through which the blood received above it may run into the lower compartment of the barrel. In this lower compartment is placed ready a small quantity of water, so that when the barrel is charged with blood, this water is thrown out first through the elastic tube expelling air—a little water going into the vein is of no consequence. A few drops of ammonia added to the blood in the barrel from time to time preserves its fluidity and enables the operator to proceed leisurely. When the first charge is exhausted, more can be received in the barrel without displacing the apparatus from the patient's arm, or admitting air. This apparatus will answer equally well for injection of saline or other fluids. As to the operation, the apparatus being tested as to its working order, the patient's arm should be prepared. A vein is selected at the bend of the elbow; a fold of skin is raised transversely to the vessel; the base of the fold is pierced with a sharp-pointed bistoury, and the skin divided by cutting towards the surface; this gives an incision an inch in length, over and parallel with the vein. A probe is now passed under the vein at the lower part of the incision, which serves to raise and steady the vessel, and to prevent the escape of any blood after the opening is made in it. This opening is made with a common lancet. A vein at the bend of the elbow of the giver is then opened in the ordinary way as for bleeding; taking care that the opening will allow the blood to flow *pleno rivo*. The supply of blood should be controlled by an assistant, who should be ready to charge the syringe when wanted. The connection then being

made with the patient's arm, the contents of the syringe are gently propelled into the vein. When the syringe is nearly empty a fresh charge may be taken, and in like manner injected. The quantity need not be great. In many successful cases the quantity injected did not exceed three ounces. Mr. Lane injected about six ounces, and this is the quantity which has, perhaps, been most frequently thrown in. If the patient takes it well, we may go on till eight or ten ounces have been injected. It is doubtful whether more would be beneficial. The object of the operation is not all at once to make good what has been lost, but to rouse the heart and nervous centres from collapse, and to give opportunity to the system to rally. If Aveling's tube be used, it has occurred to me that coagulation might be prevented by driving a drop or two of ammonia into the barrel from time to time by means of Anel's syringe.

The immediate indications in the case of hæmorrhage, as commonly recognised, are sinking to extent of collapse, extinction of pulse at the wrist, very feeble heart action, coldness of surface, gasping for air, jactitation, perhaps convulsions. These conditions are the forerunners of dissolution. That recovery under transfusion should only occasionally follow, is more calculated to excite astonishment than frequent failure. But that many such recoveries have taken place cannot be doubted. Greater success would be achieved if the operation were resorted to before these extreme symptoms supervened. On the other hand, there is a natural reluctance to resort to what appears to be a desperate remedy except in a desperate case.

3. What are the *applications of the operation*? Of late years it has been almost restricted to cases of extreme exhaustion from hæmorrhage, and this most frequently to cases occurring in obstetric practice. This application seems the most obvious and the least questionable. A fair amount of success has attended—so much indeed, that no one should be suffered to bleed to death without an attempt being made to restore him by transfusion. This will apply to all cases of threatening death from bleeding from whatever cause. We shall not probably again fall into the enthusiastic excesses formerly indulged in; we shall not expect by transfusion or infusion to rescue patients dying of phthisis or malignant disease, or to make the old young; but we may reasonably hope to save patients sinking under various acute diseases, attended with poisoned blood. In the beginning of this article instances of recovery from fever are given. I anticipate good results from transfusion or infusion in some cases of puerperal convulsions after taking away a portion of the poisoned blood. It is especially indicated in the exhaustion following obstinate vomiting. It might be employed with advantage, in conjunction with artificial respiration, in cases of suspended animation from chloroform and similar conditions.

The applications of infusion seem to admit of far greater extension beyond those at present recorded. Nothing appears more hopeful in cholera-collapse than the infusion of salines. Dr. Little's fluid was designed to supply the salts lost, and to give a fluid of specific gravity nearly equal to that of blood. Plain water, it is known, causes the blood globules to swell. Dr. Woodman tells me he found the blood-globules preserved their natural appearance after saline injection. The following

is the composition of the fluid Mr. Little employed : chloride of sodium, 60 grs.; chloride of potassium, 6 grs.; phosphate of soda, 3 grs.; carbonate of soda, 20 grs.; distilled water 20 ounces. Two drachms of pure alcohol were added to every pint. This was injected at a temperature of 110° F. The apparatus used was a funnel, having an elastic tube attached, so that the fluid ran in by gravitation. In the more successful cases 80 ounces were introduced at a time. Dr. Woodman and Mr. Heckford, who in the cholera epidemic of 1866 carried out Dr. Little's precepts, used an ordinary Higginson's syringe, which they tell me answered very well. The funnel with a stop-cock, however, seems to give better security against the admission of air. In several cases the infusion was repeated two or three times. Might we not hope for similar success in other forms of malignant fever? It appears to me extremely probable that, in cases of sinking from rapid loss of blood, where transfusion cannot be practised, the infusion of saline alcoholic fluid might be successful. I am inclined to share in the hope entertained by Dr. Richardson that he will one day succeed in the discovery of an artificial chyle which, by injection into the veins, will restore and maintain life under circumstances otherwise beyond medical skill. Nothing seems more certain to practised transfusionists and infusionists than that the injection of saline fluids into the veins is a harmless proceeding, provided air be excluded. In cases of pyæmic fever, in various forms of puerperal fever, at a stage when the ordinary forms of administering remedies are unavailable, why should we not give the patient a chance by injecting medicated saline or alcoholic fluids? Who is there that has not turned away from a dying bed dejected by the sight of a person sinking from mere blood-exhaustion or perversion, with a sickening feeling that his art is a mockery, failing at the very critical point? Where also can we look with better hope than in the study of transfusion? Dr. Hatford injected liquor ammoniac diluted with two parts of water into the superficial veins of dogs that had been bitten by venomous snakes. The results as regards the saving of life seemed so conclusive that he proposed this treatment for snake-poisoning in the human subject. (*Med. Times and Gaz.* 1869.) Dr. Tyler Smith has applied this suggestion successfully in a case of puerperal fever (*Obstetr. Trans.* 1870); and Mr. B. Wills Richardson has by it been rewarded with success in a case of poisoning by aconite. (*Med. Times and Gaz.* 1869.) As a guide to this study, and for abundant grounds of encouragement to pursue the practice, the following works should be referred to: Dr. Little, *Hunterian Oration to the Hunterian Society*, 1852, and *London Hospital Reports*, 1866; Panum, *Embolie, Transfusion und Blutmenge*, Berlin, 1864; P. Martin, *Transfusion*, Berlin, 1859; Oré, *Études historiques et physiologiques sur la Transfusion du Sang*, Paris, 1868; S. A. Lane, *Lancet*, 1810 (refers to cases of *Hæmorrhagic Diathesis*); Blundell, *Med. Chir. Trans.* 1818; Waller, *Obstetrical Trans.* 1860.]

Robert Barnes.

TREPAN. (From *τρύπω*, to perforate.) *Trepandum*; *Terebellum*; *Modiolus*. A circular saw, by means of which the skull is perforated in the operation called *trepanning*, or a circular por-

tion of any bone may be sawed out. It bears a considerable resemblance to the well-known instrument named a wimble, and is worked in the same manner. Formerly the saw was sometimes made of a conical shape; but this construction rendered the action of the instrument difficult. In this country, the trepan is now superseded by the instrument called a *trephine*, which has a different handle, and is not worked in the same way. On the continent, however, the trepan still has the preference.

TREPHINE. The instrument now commonly preferred for perforating the cranium, for purposes which I shall presently explain. It consists of a simple cylindrical saw, with a handle placed transversely like that of a gimlet; and, from the centre of the circle, which the teeth of the saw describe, a sharp little perforator projects, named the centre-pin. The upper part of the centre-pin is made to screw in a corresponding hole at the inside of the top of the saw, and is capable of being taken out or put in, at the surgeon's option, by means of a little key for the purpose. Its use is to fix the trephine when it is first applied, that is, before the teeth of the instrument have made a sufficient circular groove, in which they can steadily work. When this has been accomplished, the centre-pin must always be removed; because now it is not only unnecessary, but, if left, would retard the progress of the operation, and inevitably wound the dura mater and brain, when the teeth of the saw had cut to a certain depth through the cranium. Many trephines have centre pins which slide up or down, and are fixed in either position by turning a little screw.

The cylindrical part of the trephine is termed the *crown* of the instrument. The surgeon should have at least two or three cylindrical saws of various sizes; for it is always a commendable rule never to saw away any more of the cranium than is absolutely requisite for the accomplishment of some rational object. There is no occasion, however, for having more than one handle, which may be made to fit any of the saws.

Trephines are also occasionally applied to other bones, besides those of the cranium. In the articles, ANTRUM, BONES, CARIES, EXOSTOSIS, FRACTURES OF THE STERNUM, NECROSIS, SPINA VENTOSA, other cases are mentioned, in which the employment of these instruments sometimes becomes proper.

It is not always desirable to remove a complete circular portion of the cranium, the taking away of a piece of smaller size, and of a different shape, bringing frequently much more advantageous. Some surgeons, who object to removing any unnecessary quantity of the cranium, occasionally employ a trephine, terminating only in a semicircular, instead of a circular saw, by which means they can often cut across the base of a depressed portion of the skull, and take it away, without any occasion for removing also a circular piece of bone. An instrument of the latter kind may be sometimes useful.

The saws, however, which Mr. Hey has described, should constantly be kept in every case of trephining instruments. This practical writer remarks, that "the purposes for which any portion of the cranium is removed are, to enable the surgeon to extract broken fragments of bone, to elevate what is depressed, and to afford a proper issue to blood or matter that is or may be confined, &c.

"When a broken fragment of bone is driven



beneath the sound contiguous part of the cranium, it frequently happens, that the extraction cannot be executed without removing some of the unbroken part, under which the fragment is depressed. This might generally be effected with very little loss of sound bone, if a narrow portion of that which lies over the broken fragment could be removed. But such a portion cannot be removed with the trephine. This instrument can only saw out a circular piece. And, as in executing this, the central pin of the saw must be placed upon the uninjured bone, it is evident, that a portion of the sound bone, greater than half the area of the trephine, must be removed at every operation. When the broken and depressed fragment is large, a repeated application of the trephine is often necessary, and a great destruction of sound bone must be the consequence.

"When the injury consists merely of a fissure with depression, a small enlargement of the fissure would enable the surgeon to introduce the point of the elevator, so as to raise the depressed bone. But a small enlargement of the fissure cannot be made with the trephine. When it is necessary to apply the elevator to different parts of the depressed bone, a great deal of the sound cranium must be removed, where a very narrow aperture would have been sufficient.

"The same reasoning will apply to the case of openings made for the purpose of giving a discharge to extravasated blood or matter.

"If a saw could be contrived which might be worked with safety in a straight or gently curvilinear direction, it would be a great acquisition to the practical surgeon. Such a saw I can now with confidence recommend, after a trial of twenty years, during which time I have rarely used the trephine in fractures of the skull. Its use has been adopted by my colleagues at the General Infirmary in Leeds; and will be adopted, I hope, by every surgeon who has once made trial of it." Mr. Hey next informs us, that the instrument was first shown to him by Dr. Cockell of Pontefract; but that there is a saw, formed on the same principle, in Scultetus's *Armamentarium Chirurgicum*. The saws alluded to are very short ones, fixed at the end of a longish straight handle; their edges are made either straight or semicircular. The latter construction qualifies the instrument for cutting in a curvilinear direction, which is often proper. The edge of the saw should always be made a little thicker than the rest of the blade, by which means it will work in the groove, which is cut, with more facility. The semicircular saws do not, however, answer so well as the straight; and Mr. Liston declares them to be utterly useless. (*On Practical Surgery*, p. 46.)

Saws made on the principle just described, are also of infinite use in cutting away diseased portions of other bones, besides the skull, exostoses, &c. In necrosis, when a dead part of a bone is quite wedged in the substance of the surrounding new bony matter, Mr. Hey's saws may often be advantageously employed for cutting away the parts which mechanically prevent the detachment of the dead pieces. The saws invented by Mr. Machell and Professor Graefe are also highly ingenious, and particularly merit attention, when there is very little room for the working of the instrument, and the bone to be cut lies deep. They are wheel-like saws, turned by machinery.

Besides trephines of various sizes, and the saws just now noticed, the surgeon should also take care to have in his case of trephining instruments a little brush for occasionally cleansing away the particles of bone from the teeth of the saw, in the progress of the operation; a pair of forceps for extracting the round piece of bone after it has been detached by the saw; a lenticular knife for removing any inequalities which may present themselves round the sawn edge of the cranium, after the circular piece has been taken out; a raspatory for scraping the bone, in order to see whether it will bleed, which is a circumstance deemed by Abernethy in some cases important to be attended to (see *HEAD, INJURIES OF*); a largish common scalpel for dividing the scalp, &c.; and some elevators for raising depressed pieces of bone.

The raspatory and the lenticular knife are disapproved of by Mr. Liston; the requisite denudation of the bone to a small extent, he accomplishes with the point of the knife and the dissecting forceps; the lenticular he does not employ, because it cannot be used without unnecessarily detaching the dura mater. "Any sharp spine in the opening (he says) can be easily removed by the careful employment of the elevator." (*On Practical Surgery*, p. 45.)

The common elevator is now generally used: but several others have been proposed, as, for instance, the tripod elevator; and another invented by J. L. Petit, and afterwards improved by M. Louis.

Before beginning the description of the operation, I think it highly proper to remind the reader of what has been so forcibly dwelt upon in the article *HEAD, INJURIES OF*,—that, generally, the removal of pressure from the brain, which pressure must also actually occasion dangerous symptoms, can form the only true and vindicable reason for employing the trephine, or sawing away any portion of the skull. There are but few exceptions to this remark: it may, indeed, be now and then proper to saw away the bony edges around some fungous excrescences, which grow from the dura mater and make their way outward by occasioning an absorption of the part of the skull immediately over them. (See *DURA MATER*.) It may also be necessary to saw out a necrosis involving both tables, if it were the occasion of irritation of the dura mater and much cerebral disturbance: under other circumstances, it may generally be more prudent to leave the detachment of the dead bone to be completed by the process of exfoliation; though M. Velpeau is inclined to maintain that a necrosis of both tables of the skull is of itself, whether attended or not with symptoms of compression, a well-founded indication for the trepan: and he relates three cases in support of this view. (See *M. Velpeau, de l'Opération du Trépan*, p. 23.) A mere necrosis of the outer table, abstractedly considered, can never be an adequate reason for the application of the trephine. Loose splinters should generally be removed. But though this is the common rule, there are exceptions to it. If the bone were broken into several loose pieces, but not exposed by any wound of the scalp, and the case not accompanied by any urgent symptoms of compression, an operation for the removal of the fragments of bone would, in my opinion, be unadvisable. A very interesting case has been published by Mr. Crampton, proving that, even though such injuries of the bone may be attended

with a wound, and depression of some of the fragments into the substance of the brain, the case will not invariably require the immediate extraction of the pieces of bone. In the instance alluded to, Mr. Crampton had scarcely touched with the forceps a large fragment of bone which was buried in the brain, when the whole body was shaken by a convulsive movement, and the patient (a nephew of Lord Brougham's) moaned deeply. Mr. Crampton desisted from all further attempts to extract the splinters; antiphlogistic treatment was pursued, and, at the end of twenty-two days, the small fragments of bone were removed as they became detached by the process of nature. (See *Ph. Crampton in Dublin Journ. of Med. Science*, vol. ii. p. 42.) I know of some other similar cases; yet these may be regarded as exceptions to the general maxim. If the depressed portion of bone be denuded by a wound of the scalp, a trial to raise it with the elevator may sometimes be proper, even though urgent symptoms of pressure may not exist. In such a case Sir A. Cooper sanctions the application of the trephine. (*Lectures*, vol. i. p. 343.) Yet, my own experience and reflections would here incline me to abstain from the operation, and to follow the example of Dease, Desault, Abernethy, and Crampton. "In Dublin (observes the latter distinguished surgeon) we conform in general with the rule of practice as originally laid down by Mr. Dease (who preceded Desault by many years), namely, in fractures of the skull with depressed bone, *whether complicated with wound of the scalp, or otherwise*, no attempt should be made to raise the depressed bone, *unless very decided symptoms be present of compressed or irritated brain.*" (*Op. cit.* p. 34.) I have seen many cases which have terminated very favourably without the trephine, though the scalp was wounded, and the bone depressed. A boy has just now (July, 1838) been discharged from University College Hospital, who was brought to it for a wound of the forehead, and considerable depression of the frontal bone, above five weeks ago. The accident was occasioned by the blow of the handle of a pump. As he was perfectly sensible, I recommended bleeding, calomel, cold lotions, and other antiphlogistic means; and the patient recovered without any serious indisposition, the depression of the bone, however, still continuing.

An argument urged in favour of elevating the bone by an operation, is that, though the patient may not at present labour under bad symptoms, he will become liable to them afterwards, if the bone be left depressed; a consideration upon which Sir Astley Cooper, M. Velpeau, and others, lay much stress. It is indeed a truth, that, in a certain number of cases, inconveniences and danger do subsequently come on. But, with this fact before us, the questions may yet be asked, ought we then to trephine in the first instance, without taking the chance of there being any occasion for the operation? Or, ought we to take such chance, and avoid trephining till the inconveniences of the continuance of the depression show themselves? Thus, if a patient were to become subject to epileptic attacks, manifestly dependent upon the depression of a part of the skull, it might be time enough to trephine when the patient became thus afflicted. Professor Dudley has inserted a valuable paper On Injuries of the Head, in the first No. of the

*Transylvania Journal of Medicine*. He reports several cases of epilepsy from injuries of the skull, which he cured by trephining; and another instance of this has been published by Dr. D. L. Rogers, of New York. (See *New York Med. and Physical Journ.* vol. v.) A person might meet with a compound and depressed fracture of the skull, yet experience at first no symptoms requiring the trephine; but, in about a week, signs of irritated and compressed brain might come on, and the removal of a portion of the skull become indispensable. The reader will find this observation well exemplified in a case recited by Mr. Crampton, where both tables of the skull, the membranes of the brain, and the brain itself, had been divided with a sabre, and the inner table had been driven in upon the brain, so as to form an acute angle with the outer table. (See *Ph. Crampton, in Dublin Journ. of Med. Science*, vol. ii. p. 37.) The subject of this case, after having been discharged, lived irregularly and returned to the hospital with severe headache, paralysis of the right arm and hand, and right side of the face, followed by convulsions, stupor, &c. A small opening was made in the prominent part of the cicatrix, and two drachms of healthy pus were let out; "the pulse immediately rose to 68°; he sat up in bed; answered questions rationally, and said he was quite free from pain." (*Crampton, Op. cit.* vol. cit. p. 206.) I once attended, with Mr. Walne, of Bloomsbury-square, and Mr. Bainbridge, of Tooting, a young gentleman who fractured the frontal bone, and was trephined on account of urgent symptoms, which were thus relieved; but febrile symptoms and attacks like those of epilepsy afterwards came on, and the case ended fatally from abscess in the substance of the brain.

In a case of depressed fracture, unaccompanied at first by any urgent symptoms, suppuration may follow between the skull and dura mater, or even more deeply; still it may be questionable whether trephining would be the most likely means to prevent such mischief, though, undoubtedly, the best calculated to afford relief, if the matter were directly under the skull. Here I should say that the right treatment consists in antiphlogistic measures; and that we should only proceed to remove bone when the symptoms indicate the confinement of matter under it, or injurious effects from the continuance of a depression which, in the first instance, perhaps, produced no unfavourable symptoms. On the question, however, whether we should trephine for a depressed fracture exposed by a wound, though not attended with urgent symptoms of pressure, I deem it fair to mention, that Sir Benjamin Brodie coincides with Sir Astley Cooper; and lays down the following general rule: that if the depression be exposed, in consequence of a wound of the scalp, let the surgeon apply the trephine, and elevate the depression; but if there be a depression, without a wound of the scalp, in consequence of the accident, let him not make such a wound by an operation. (See *Med. Chir. Trans.* vol. xiv. p. 403.) M. Velpeau is another high authority also in favour of not suffering a depressed fracture to continue. (See HEAD, INJURIES OF.) The punctured or stellated fracture, on account of its being invariably accompanied with splintering and depression of the inner table, I join in believing a proper exception to the general rule of not trephining, unless urgent symptoms of pressure exist.



In the records of surgery, innumerable facts may be consulted, where the prudent and judicious employment of the trephine has effected wonderful cures, and been the only thing by which the patients' lives could possibly have been saved. The benefit which the operation brings about is also sometimes so sudden and astonishing, that in no instance does the interposition of the surgical art display itself to greater advantage. The immediate restoration of sight by the depression, or extraction of an opaque substance from the eye, is not more beautiful and striking than the instantaneous communication of the intellectual faculties, and of the powers of speech, of feeling, &c., together with voluntary motion, to a person lying in an apparently lifeless state from an injury of the head. The utility of the trepan is occasionally manifested even in this degree. In the valuable essay of Mr. Abernethy, "On Injuries of the Head," a case may be seen, in which the patient, who had been in a condition almost bereft of animation, rose up and spoke the instant the extravasated blood had been removed from the surface of the brain: and amongst the wounded at the battle of Waterloo, there was a soldier of the 44th regiment, whose case is of equal interest. He had been struck by a musket-ball on the right parietal bone, which was exposed, but had no appearance of being fractured. As however the symptoms of compression were urgent, and the patient was in nearly a lifeless state, I conceived it right to apply the trephine to the part on which the violence had acted. I had not sawn long before the external table came away in the hollow of the trephine, leaving the inner table behind, which was not only splintered, but driven at one point more than half an inch into the membranes and substance of the brain. No sooner were the fragments taken out with a pair of forceps, than the man instantly sat up in his bed, looked around, and began to speak with the utmost rationality. It is a most extraordinary fact, that this patient got up and dressed himself the same day, without leave from the medical officers, and never had a bad symptom afterwards. Immediately the operation was finished, the temporal arteries were opened, and some purgative medicines exhibited.

Sir Benjamin Brodie has seen a case in which there was a fracture with distinct depression of the inner table, while there was a simple fissure, which was scarcely perceptible, and that without the smallest depression of the outer table. He also adverts to the example recorded by Tulp, in which there were extensive fissures of the inner table, although the outer one remained uninjured; and to another, mentioned by Paré, in which, while the outer table was entire, the inner table was broken into splinters, some of which were actually driven into the substance of the brain. In all fractures of the cranium with depression, it is remarked that the inner table is always broken to a greater extent than the outer one; and the actual depression greater than would appear from the mere inspection of the external fracture. These circumstances are imputed to the greater elasticity of the outer table, and more considerable brittleness of the inner. (See *Med. Chir. Trans.* vol. xiv. p. 380.)

In a case of fungus of the dura mater, with diseased bone, mentioned by Schmucker, the trepan was applied eleven times in less than a month, and

the operation used to cause so little indisposition that the patient hardly ever required to go to bed afterwards; and, on one occasion, actually went to market an hour after its performance. (*Wahrnehmungen*, b. i. p. 456.)

Let not the young surgeon, however, imbibe from a few dazzling examples of success an immoderate solicitude to perform the operation; for it should scarcely ever be undertaken but in the most pressing circumstances, and when symptoms unequivocally show that a dangerous degree of pressure on the brain exists. I recollect an unfortunate example, in which the late Mr. Ramsden, of St. Bartholomew's Hospital, ventured to saw out a portion of the frontal bone for a mere long-continued pain in the part: the patient was attacked with inflammation of the dura mater, and perished in three or four days. Two analogous cases of the needless use of the trephine, with similarly tragical results, are also mentioned by Sir Benjamin Brodie. (See *Med. Chir. Trans.* vol. xiv. p. 394.) That the removal of bone creates some risk of subsequent ulceration, and sloughing of the dura mater, and protrusion of the brain, is now a fact universally admitted. We may therefore conclude that the operation is not itself exempt from danger; and it is certain that it ought never to be resolved on without deep consideration, "*Gravis tamen satis est operatio, ut nunquam, nisi indicationes sufficientes adsint, institui debet.*" (*Callisen, Syst. Chir. Hodiern.* tom. i. p. 658.)

In cases of injuries of the head, the trepan or trephine is hardly ever justifiable, except for the purpose of relieving the brain from pressure. Such pressure may be caused by a depressed portion of the cranium, or it may be produced by an extravasation of blood, or the lodgment of matter, betwixt the skull and the dura mater. The chief danger of concussion, when the accident is not directly or soon fatal from the disorganisation and mischief done to the brain, depends upon the consequent inflammation of this organ, and therefore cannot be likely to be benefited by the trephine. If the operation become proper in such a case, it is when an abscess has formed under the cranium, and when the confined matter itself creates bad symptoms by its pressure on the brain. This state, however, cannot come on till after the inflammation of the brain and its membranes has prevailed a certain time, and it is always accompanied with a detachment of the pericranium and a puffy tumor of the scalp; or if there be a wound of the latter part immediately over the abscess, the lips of the injury suddenly acquire an unfavourable appearance, and lose their vermilion colour. The patient has also had much preceding febrile disorder, pain and tension over the whole head, redness and turgescence of the eyes, and generally more or less delirium. When the matter is forming, there are usually rigors, and as soon as it is formed, the patient falls into a comatose state, and paralytic symptoms show themselves. Here the urgency for the prompt application of the trephine is very great, and the patient's only chance of living is almost essentially connected with the immediate performance of the operation. This important case has been particularly dwelt upon in the writings of Pott.

In the article HEAD, INJURIES OF, I have enumerated the most remarkable symptoms of con-

cussion and compression of the brain; a subject, which every surgeon should study with earnest attention, before he ever presumes to employ the trephine. For sometimes these cases are extremely difficult to be discriminated; sometimes they exist together in the same individual, a complication which is peculiarly embarrassing; and, in every instance, where the symptoms are those of concussion, the operation so far from being indicated, would be a step of all others the most likely to do harm, by increasing the irritation and the risk of inflammation of the brain and its membranes. A fall upon the back, or upon the head, occasions a direct concussion of the brain; and the shock, not being materially weakened by the intervention of any yielding elastic structure, is the more dangerous. When a person has fallen from a certain height, and pitched on his head, his back, the buttocks, the knees, or even the soles of the feet; when he has been instantly deprived of his senses, and then by degrees recovered them and come to himself again: the fact of his having suffered concussion of the brain is clear and indisputable. Concussion has likewise taken place, though in a slighter degree, when the patient has been only stunned by the fall, and experienced a sensation of sparks. But, a multitude of degrees separate this feeble concussion from that in which the substance of the brain is instantaneously disorganised, so that there is not the possibility of recovery.

The symptoms of concussion of the brain are attended with coma, and the compression of this organ by an extravasation is also accompanied with lethargic heaviness. How then is the surgeon to ascertain, whether the comatose disorder arises from one or the other of these affections?

Here, in order to avoid repetitions, I beg leave to refer to the observations already made in another article. (See *HEAD, INJURIES OF*.) But there is one criterion of such importance, that it may prevent innumerable fatal mistakes, and, indeed, without the continual recollection of it, no man ought to interfere with this dark and abstruse part of surgery. On this account, I shall mention it here, notwithstanding it has been already noticed elsewhere. If the patient has been knocked down and stunned directly by the blow and remains in a state of insensibility, these primary symptoms are ascribable to the concussion. On the contrary, when the coma and loss of sense do not take place till an hour or two after the blow, they are to be imputed to an extravasation.

The shock given to the brain by concussion, must, like every other impulse communicated, continue to diminish, until it ceases altogether. If, at the very time of the blow, the shock has not been forcible enough to produce alarming symptoms, such symptoms will not afterwards come on when their cause is weakened. Hence, the reason why compression can be distinguished from concussion of the brain when there has been an interval of sense between the receipt of the blow and the occurrence of the bad symptoms. But, the distinction of the symptoms into primary and consecutive, cannot be made when concussion and extravasation exist together.

Having made these few remarks on concussion and compression of the brain, I shall next introduce a few observations on contusions of the head and

fractures of the skull, cases on which the most erroneous opinions have been entertained.

Contusions of the head not unfrequently occasion a small kind of tumor, which is soft in the centre, but hard and resisting at the circumference, especially when the violence has been considerable. Now the ease with which the centre or seat of the extravasated fluid admits of being depressed, while the circumference remains hard and elevated, is extremely apt to give rise to the belief, that a fracture with depression has happened. The true nature of this accident was first clearly explained by J. L. Petit; and, since his time, the proper cautions not to fall into a mistake concerning it have been laid down by the generality of surgical writers.

Often nothing is more obscure than the diagnosis of fractures of the cranium; their existence, indeed, can only be made out with certainty when they can be felt or seen. Thus a fracture of the skull, attended with a wound of the scalp, and exposure of the bone, shows itself in the form of a fissure more or less wide and extensive, and taking various directions. The accident may also be known by the touch, even when the soft parts continue entire, particularly if the fracture is accompanied with splinters, or the edges of the fissure are materially separated. When there are many splinters, entirely detached, a crepitus will likewise serve to explain the nature of the accident; but, unassisted by these symptoms, imparted to him by the sight, the hearing, or the touch, the practitioner cannot at once offer a decided opinion as to whether a fracture exists, or not.

In order to procure more positive information, would it be right and judicious to make several incisions and uncover the bone? But, here the surgeon would be embarrassed in the very commencement of his proceedings; for, how would he be able to judge where the knife should be applied? Why also should he resort to a useless and painful operation, which (to say the best of it) would only render the patient's cure more distant?

The symptoms, indicating compression of the brain, can alone justify an examination of the fracture. These symptoms also must be urgent and alarming; for, when they prevail in a slight degree, bleeding and evacuations promise more benefit than any operation on the skull; and consequently all examination of the part, supposed to be broken, must be unnecessary.

Even when the cranium has been denuded, so that the sight can convey due information respecting the solution of continuity in the bone, care must be taken not to be deceived by a suture, or by the groove of a vessel. In cases of doubt, a modern surgical author advises us to scrape the outside of the bone; and he tells us, that, if after the removal of the external scale, the fissure yet appear, and a thread of blood be seen at its outer part, no doubt exists of its being a real fissure. As however making this examination can answer no purpose, except with the view to determine the place where the trephine should be applied, I cannot recommend the plan except where the symptoms positively render this information desirable. On the contrary, it appears to me, that all examinations of the bone, made seemingly from mere curiosity, and without any true surgical object, should be deprecated as rash and hurtful.



The danger of fractures of the skull does not depend upon the simple solution of continuity: but is in relation to the degree of concussion and compression of the brain, with which the injury of the bone may be complicated. The pressure, caused by depressed splinters of bone, is less alarming, inasmuch as the cause of the compression is easy of removal. The pressure of extravasated fluid is far more serious, in consequence of the difficulty of ascertaining positively its existence and precise situation.

Its seat is sometimes between the skull and the dura mater, which is detached from the bone. More frequently, it occurs either between the dura mater and tunica arachnoides; in the substance of the brain; or else in the ventricles. The quantity of extravasated fluid is generally less in those extravasations which are situated between the dura mater and the skull, unless they lie in the course of the middle meningeal artery, where they are frequently copious. Extravasations, formed in the substance of the brain itself, are not only more considerable, but also, as they mostly depend upon concussion, are more alarming, than effusions on the surface of the dura mater. It is indeed extremely difficult, if not impossible, to ascertain the situation of the extravasated fluid. In such cases, the trepan is likewise of no use; while concussion, when so violent as to produce external extravasation, is perhaps invariably fatal. In extravasations between the dura mater and the skull, which are almost the only cases of the kind to which surgery can administer relief, when the effused fluid lies under a part of the skull, accessible to the trephine, the extravasated fluid is generally, except in the instance just now specified, small in quantity. The danger, however, is not the less: ten or twelve drops of fluid are sometimes enough to produce a fatal compression. When the extravasation has happened in the substance of the brain, the compression is far more perilous: in short, it may be said to prove, with very few exceptions, certainly mortal.

The lethargy, the degrees of which increase from mere drowsiness into the most perfect coma; and the paralysis of the opposite side of the body to the seat of the extravasation; are the most common symptoms of this accident. Having explained elsewhere (see *HEAD, INJURIES OF*) some other symptoms, such as stertorous respiration, dilated pupils, &c., which usually indicate pressure on the brain, it is unnecessary here to dwell upon them. The subsequent increase of the coma, and paralytic affections, and the gradual augmentation of their intensity, serve to render these symptoms distinguishable from others, which are suddenly brought on by concussion. But there are instances, as every man of experience knows, where concussion ruptures the blood-vessels and produces an extravasation of blood. In this circumstance, it is obvious that the symptoms of compression are blended with those of concussion. The symptoms proceeding from the latter cause always diminish in proportion to the time which has elapsed from the moment of the injury; while those of compression succeed, and on the contrary increase in intensity, in proportion as the quantity of extravasated fluid becomes more considerable. Notwithstanding these distinctions,

however, it must be acknowledged, that there are many cases in which the surgeon is obliged to remain in doubt with regard to the particular cause of the symptoms. This indecision is the more embarrassing, because the operation of trephining is necessary in cases of extravasation, but useless in those of concussion. Even when extravasation is known to exist, the practitioner requires more information; for he ought to know the precise situation of the effused fluid. It is true, indeed, that paralysis of one side of the body generally indicates the pressure to be upon the opposite hemisphere of the brain. But, what surgeon would venture to follow the practice advised by Van Swieten and apply to the suspected side of the head three crowns of the trepan? Possibly, not one of them might fall on the situation of the extravasated fluid. When the skull is broken, the extravasation is almost always on the same side of the fracture. When it is the effect of concussion, or when the breach of continuity in the skull is what is termed a counter-fissure, the effusion is generally on the side of the head most remote from the blow. If the pressure is caused by a detachment of the internal table of the skull, the nature of the case cannot be ascertained before the operation of trephining has been performed on the part of the skull upon which the violence has acted. When there are two extravasations, one depending upon a fracture, and situated immediately under it between the dura mater and the skull; the other arising from concussion, and situated at some point directly opposite, either between the dura mater and tunica arachnoides or within the substance of the brain itself; paralysis may occur on the same side as the fracture; and hence, it may be inferred, that the palsy does not always take place on the side opposite to the extravasation. But, says Richerand, an examination of the body quickly proves, that the case does not deviate from the common rule. The extravasation, produced by concussion, being almost invariably more considerable than that caused by a fracture, accounts for the extension of the palsy to the same side of the body. Sometimes, the side which is not paralytic is affected with convulsions; the pulse is full and hard; and the respiration stertorous; in short, the symptoms are analogous to those caused by apoplexy.

The following observations and advice fully accord with the doctrines, which I have always inculcated in my writings upon this part of surgery, and they also agree with the practice, which was so successfully adopted by me in the case of the soldier of the 44th regiment, wounded at the battle of Waterloo, as already mentioned: it is therefore with much pleasure that I quote the authority of Sir Benjamin Brodie on a point, about which practitioners have been so much perplexed:—"Blood (says he) is seldom poured out in any considerable quantity between the dura mater and the bone; except in consequence of a laceration of the middle meningeal artery, or one of its principal branches; and it is very rare for this accident to occur, except as a consequence of fracture. If, therefore, we find the patient lying in a state of stupor, and, on examining the head, we discover a fracture with or without depression, extending in the direction of the middle meningeal artery, although the existence of an extravasation on the

surface of the dura mater is not thereby reduced to an absolute certainty, it is rendered highly probable, and the surgeon, under these circumstances, would neglect his duty if he omitted to apply the trephine; and, where no fracture is discoverable, yet, *if there is other evidence of the injury having fallen on that part of the cranium in which the middle meningeal artery is situated, the use of the trephine may be resorted to on speculation, rather than that the patient should be left to die without an attempt being made for his preservation.* I cannot, indeed, adduce any particular experience of my own in favour of what is here recommended; but, I conceive, that the instances which have been recorded, in which the middle meningeal artery has been ruptured without any fracture of the bone; and the known fact, that there is sometimes a fracture of the inner table of the skull, while there is none of the outer table; sufficiently justify such an experiment in desperate cases. (*Med. Chir. Trans.* vol. xiv. p. 385.)

With the foregoing exception, in which indeed the ground for suspecting the seat of the effused blood is the knowledge of the exact part on which the violence has operated, the plan of depletion, recommended for concussions (see HEAD, INJURIES OF) is all that can be done, when everything is uncertain relative to the situation of the extravasation. It is all that can be done in those frequent instances where the effusion has taken place in the substance of the brain, so that it cannot possibly be voided. The trephine then is indicated only when there is an extravasation between the dura mater and the bone, the fracture being situated at a part of the skull accessible to instruments, and not at the base. We shall not here dwell upon the doubtful example, where the fluid lies between the dura mater and the arachnoides. I believe that the operation should be limited to a small number of cases, in which not only the existence and situation of the pressure are known, or may be suspected on the ground above explained, but in which the symptoms, arising from this cause, are urgent and dangerous, and the pressure can be removed by no other means.

Desault in the last years of his practice abandoned the operation of the trepan altogether, its ill success at the Hôtel-Dieu having become notorious. Surgeons of the present day trephine with more caution and discrimination, and sometimes with striking success.

When the case is a simple fissure, the trephine ought to be applied upon the solution of continuity, *if the symptoms indicate a dangerous degree of pressure of the brain.*

When the detached portions of bone are depressed, so as to compress the brain, and cause urgent symptoms, the operation is still requisite, if they cannot be elevated by other means. But Richerand maintains, that a positive indication for trephining is not frequent, either because it is difficult to judge of the existence and situation of extravasations, or because extravasated fluids readily escape through the interspaces of the fragments, when there is a splintered fracture. Such facility is also increased when one of the portions of broken bone is totally detached, so that it can be removed, leaving an aperture equivalent to what would be produced by the application of the trepan.

When the operation is determined on, the head should be shaved: indeed, this is often done im-

mediately the surgeon is called, in order that he may have a better opportunity of seeing what parts of the scalp have been struck; for it is in such situations, that he has most reason to apprehend fractures of the bone, or extravasations beneath it. If, however, the violence has occasioned a large wound, or laceration of the scalp, the practitioner, knowing where the force has been applied, is frequently content with having a little of the hair shaved off the parts surrounding the injury. All that need be said on this subject is, that it is always better to have enough of the hair taken away, to afford the surgeon an uninterrupted opportunity of examining the scalp freely, and doing whatever may be necessary. The loss of a little hair is of very little consequence, while the concealment of the seat of a depressed fracture, or extravasation, may lead to fatal consequences.

When the propriety and necessity of trephining are fully indicated, provided the wound, or laceration of the scalp, should not have exposed a sufficient surface of the bone for the application of the crown of the trephine, an adequate dilatation of such wound ought immediately to be made. If, in the situation of the blow, there should only be a contusion, or a bump, unattended with any wound, a division of this part of the scalp is to be made by carrying the knife quite down to the bone. In those cases in which the swelling occasioned by the violence is considerable, and attended with the sensation of a crepitus, as well as in other instances in which there is only a contusion, under which a fracture and displaced pieces of bone may be felt, the scalp must be divided in the same manner, only with greater caution, lest the point of the knife should insinuate itself through the fracture, and do mischief to the dura mater and brain.

Authors recommend the shape of the incision to be different according to the kind of fracture, and the parts of the head, on which the violence has operated. When the whole extent of the injury can be brought into view, by means of an incision, having the form of the letter T, the surgeon should be content with such a division; but if this be not sufficient, he may give it a crucial shape. When the trephine is to be applied to the squamous part of the temporal bone, we are recommended to make the incision as much as possible in the shape of the letter V, the branches of which are to be upward, and the angle downward, in order that as little as possible of the temporal muscle may be cut, and that the division of its fibres may be avoided as far as it is in our power.

Having divided the scalp and aponeurosis of the occipito-frontalis, the next object is to reflect the flaps; but no man would be warranted in cutting any part of them away, although such practice is advised by Pott. The purposes of the operation do not require any removal of this kind; and the method would leave a wound, which would be long in healing, and, when healed, never exempt from deformity. In short, the reflected flaps of the scalp are capable of adhering to the parts, on which they are laid, after the operation, and, consequently, ought never to be wantonly cut away.

The scalp, being reflected, some authors next advise us to scrape away the pericranium, either with a knife, or raspator. Perhaps this measure may be considered as one which does neither much harm nor much good. The design is to facilitate the application of the trephine to the



bone. However, the teeth of a proper instrument, in good order, will not be impeded by the slender periosteum; and scraping this membrane away from parts of the skull, which are not to be removed, may conduce to exfoliations.

Sometimes, the bleeding from branches of the temporal, or occipital artery, is so copious, that the bone cannot be conveniently perforated until the hæmorrhage is suppressed. If it be prudent to wait a little, and the case (as it generally does) should be likely to be benefited by the evacuation of blood, it is as well to let the bleeding continue for a certain time. The surgeon may then just direct an assistant to put the end of one of his fingers on the mouth of the vessel, and proceed in the operation. In some cases, the bleeding might be so troublesome, that it would be better to tie the artery.

All parts of the cranium do not admit of being trephined with equal convenience and safety. It has usually been set down by surgical authors, that the trephine cannot be applied below the transverse ridge of the os occipitis. There are some cases, however, which prove that such an operation is practicable, and that we ought not, in urgent circumstances, to be afraid of dividing the trapezius and complexus muscles, in order to be enabled to apply the trephine to the bone. (See *A. C. Hutchison's Case in Med. Chir. Trans.* vol. ii. p. 104, &c.) Additional instances of similar practice are quoted by M. Velpeau. (*De l'Opér. du Trépan*, p. 139.)

Many writers forbid the application of the trephine to the frontal sinuses, in consequence of the indeterminate depth of these cavities, and the apprehension of incurable fistulæ. However, Larrey deviated from this precept in several instances; and his practice confirms the statement of Sir Charles Bell, that, by opening the frontal sinus with a large trephine, and then using a small one, the internal parietes of this cavity may be trephined with perfect safety, and without injuring the dura mater with the saw. (See *Larrey, Mém. de Chirurgie militaire*, t. ii. p. 136-138, t. iv.)

Writers also caution us not to apply the trephine to the posterior inferior angle of the parietal bone, on account of the situation of the lateral sinus under it; nor to its anterior inferior angle, in consequence of the middle artery of the dura mater lying under it, generally in a groove of the bone, but occasionally in a canal in its very substance. In the latter circumstance, this portion of the parietal bone could not possibly be taken away, without wounding the vessel. However, notwithstanding this advice, which has been transmitted from generation to generation, I much question the soundness of the doctrine. We undoubtedly ought to avoid trephining this part of the cranium, when we can prudently do so. But the causes demanding this operation are always so urgent, that the patient's sole chance of existence depends on their quick removal. Hence were there pressure on the brain, either from a depressed portion of bone, from blood, or matter, and such pressure could not be removed without trephining the anterior inferior angle of the parietal bone, what operator would be afraid of doing so? Besides the peril, hæmorrhage has been greatly exaggerated; for, the lodgment of the artery in a bony furrow, or canal, which authors have pointed out as rendering the suppression of the hæmorrhage

difficult, has no such effect, a little plug of lint or a bit of a small bougie pushed into the orifice of the vessel, so situated, will mostly stop the bleeding with ease.

The foregoing suggestion was made in the early editions of my works, and I now see the safety of the practice has been confirmed. "I have applied the trepan (says Larrey) over the track of the spheno-spinous artery, at the inferior anterior angle of the parietal bone. The artery was divided; but I stopped the hæmorrhage almost immediately, by applying an iron probe red hot. (*Mém. de Chir. militaire*, t. ii. p. 138.) Dr. Dorsey, of the United States, once succeeded in tying this vessel.

Formerly, surgeons were cautioned not to trephine on the temple, because the temporal muscle and middle meningeal artery would thereby be injured. Had there been sufficient reason for this advice, as M. Velpeau observes, it would have been unfortunate, inasmuch as the temporal region is precisely one of those in which the trepanning or trephining is most frequently useful. Luckily (he adds) the prohibition has scarcely ever been attended to; and he refers to various works in proof of this statement. (*Velpeau, de l'Opér. du Trépan*, p. 134.) In many persons, the bleeding from the middle artery of the dura mater is but trivial, and, when it is more copious, it may easily be stopped. Thus, in addition to cases already mentioned in proof of this observation, I may state, that Bérard and M. P. Dubois experienced no difficulty in checking the hæmorrhage. (*Arch. gén. de Méd.* t. iii. p. 377.)

The occipital protuberance, by reason of its thickness and inequalities, would render the safe application of the trephine difficult. The conflux of the sinuses at that point would also be another objection. Yet, if the case were urgent, M. Velpeau sees no insurmountable obstacle to trephining on the occipital protuberance; and he cites a case, in which Bourrienne expresses regret, that an extravasation of blood, under the occipital protuberance, had not been recognised during the patient's life, as it might have been discharged by trepanning. (*Journ. de Delorme*, t. iii. p. 246.) It seems to me that, in an urgent case, a surgeon would, at all events, be warranted in trephining over one or both the fossæ for the posterior lobes of the brain, or even the manner adopted by Mr. A. C. Hutchison below the transverse ridge of the occiput.

Writers, until lately, prohibited us from trephining over any of the sutures, and especially over the sagittal suture, beneath which the longitudinal sinus is situated. The fear of the dura mater being injured and of this vessel being wounded was the reason for the advice. With regard to the sutures in general, the trephine may be applied to them if circumstances call for it, as well as to any other part; and as for the sagittal suture, many facts confirm the propriety of not being deterred even by it, though situated immediately over the longitudinal sinus. It is to be remembered, also, that the dura mater, in cases of extravasated blood and pus, beneath the cranium, is detached by the intervention of such fluids from the inner table.

Amatus Lusitanus trepanned on the sutures and on the occipital bone (*Portal*, t. i. p. 500); and Thiriot on the squamous suture. (*Journ. de Desault*, t. iv. p. 105.) Morand followed the same

practice (*Op. Chir.* part 2, p. 192); and Warner applied the trepan to the lambdoidal suture. (*Obs.* 2.) See also *Velpeau, de l'Opér. du Trépan*, p. 126.

By means of a perforation practised over the sagittal suture, Garengeot successfully elevated a portion of bone, which pressed upon the longitudinal sinus. The depressed piece of the cranium could not have been so advantageously raised had the trepan been applied in any other situation. But a still stronger argument in favour of this practice, when the case at all requires it, is the fact that wounds of the longitudinal sinus, and the hæmorrhage resulting from them, are not attended with any serious danger. Sharp mentions his having twice seen a bleeding of this kind. Another instance is also recorded in Warner's Cases. A child received a wound on its forehead: the two parietal bones were fractured, and a portion of each was depressed on the dura mater. The child lived a month, without any operation being performed; but, at the end of this time, Warner applied the trepan. He found a splinter of bone sticking in such a way into the longitudinal sinus, that it could not easily be got out; consequently, he enlarged with a lancet the opening in which the splinter was entangled. The hæmorrhage, which was copious, was easily suppressed by the application of a little dry lint, and the child was relieved, though it died at the end of two months, after suffering a variety of symptoms, which had no connection with the wound of the sinus, the opening of which soon healed. The fourth case, related by Marchettis, also proves that wounds of the longitudinal sinus are not fatal. Pott and Calisen have recorded other facts tending to the same conclusion. (See *Syst. Chir. Hodiernæ*, pars i. p. 659, ed. 1798.)

The following case was communicated to M. Velpeau by M. Champion. "I removed (says the latter) the two upper thirds of the occipital bone, which had been broken in pieces in a boy twelve years old. In taking away one fragment opposite the torcular Herophili, the blood from this point gushed out to the distance of more than two feet, and extinguished the candle. I placed some charpie over the part, and held it there with the little finger of my left hand, and by the time that all the pieces of bone had been removed and raised, there was no more bleeding." (See *Velpeau, de l'Opér. du Trépan*, p. 129.) If a vein is so placed that it will admit of compression, the bleeding from it, however large the vessel may be, may generally be commanded with facility.

Whenever a depressed fracture can be elevated to its proper level without applying the trephine, and with the mere aid of a pair of forceps or an elevator, trephining should never be performed unless there be strong reason to apprehend that blood or matter, lodged on the surface of the dura mater, contributes to the production of the bad symptoms, and cannot otherwise be discharged.

"In order to gain space for the disentanglement of the depressed bone, and for the efficient application of the elevator, it is in many cases necessary to remove a circular piece of bone. This is generally done, so as to attain the desired object most readily as near as possible to the point where the force has been applied. In very bad and extensive fractures, large portions may be found entirely detached and loose, but very frequently the

depressed portion is not separated. On one side, the bone is cracked and bent down; that part which has been struck is generally driven more deeply towards the cavity, and is wedged under the sound portion. By removing part of the latter the elevator can be introduced with advantage under the depressed piece. The crown of the trephine is therefore applied so as to overlap slightly the injured part, and to remove the broken edge." (See *Liston on Practical Surgery*, p. 47.)

The scalp and aponeurosis of the occipito-frontalis, having been divided, if necessary, and the pericranium scraped from the bone, according to the common precepts, the next thing is the application of the crown of the trephine.

The surgeon is first to make a little impression with the point of the centre-pin, for the purpose of marking the place where it will work, when the crown of the trephine is applied in the proper situation; for where such impression is made, the operator must make a small hole with a perforator, in order to fix the point of the centre-pin, on which the crown of the instrument turns backwards and forward, as on an axis, during the first stage of the operation. However, the generality of centre-pins make a perforation without need of any particular instrument for the purpose, and in this respect are advantageous.

The point of the centre-pin having been fixed, the trephine is to be turned by regular semi-circular motions, alternately to the right and left, which object is effected by steady pronations and supinations of the operator's hand, the pressure being only made in turning the instrument from the left to the right. (*Liston, Op. cit.* p. 47.) The teeth of the saw having made a manifest circular groove in which they can steadily work, the centre-pin becomes useless; and, as it would, if not withdrawn or removed, certainly injure the dura mater and brain, by reason of its projecting further than any other part of the instrument, it would be an unpardonable blunder to let it remain after a proper circular groove had been formed by the teeth of the saw.

The beginning of the sawing may be executed boldly and quickly; for the operator runs no hazard of doing mischief. It is necessary occasionally, with the view of facilitating the action of the instrument, to clean away the particles of bony matter with a little brush, usually kept for the purpose in every box of trephining instruments. Were this plan neglected, the action of the cylindrical saw would be very much clogged.

The operator, however, must increase his caution when the sawing has made greater progress; for, were he to be too bold, he might sometimes lacerate the membranes of the brain with the teeth of the instrument, particularly as the thickness of the cranium is subject to infinite variety, both in different parts of the same head, and in different subjects. Let the surgeon, therefore, never forget to examine frequently, with the point of a quill, or thin end of a probe, whether any part of the circular groove is cut through or nearly so; for when this is the case, the instrument must only be worked in such a way as to make pressure upon, and cut, the part of the circle which yet remains to be divided. In some few cases, it is said that the surgeon can distinctly feel when the teeth of the saw reach the diploe, or medullary structure, between the two tables of the cranium; and some



writers have rashly directed us to saw with boldness till the sensation of this occurrence is communicated to our hand and fingers. However, I believe this possibility of discriminating the arrival of the teeth of the saw at the diploe is so uncommon and so fallacious, that it should never be expected or relied on. Nor ought the surgeon to saw with incautious force and rapidity till he sees the teeth of the trephine bloody, which appearance has been set down as another criterion of their having reached the diploe. I have already stated that a great many skulls have hardly any space between several parts of the two tables. This is well known to be the case in old persons and in children.

A prudent man will always prefer exerting a little force for the purpose of breaking some of the bony connexion, retaining the circular piece of bone, to running any hazard of injuring the dura mater by sawing too deeply. After a certain time, therefore, it is better to lay down the trephine, and endeavour to elevate the portion of bone, with the aid of a pair of forceps, constructed for the purpose, and kept in most cases of trephining instruments, or else by means of an elevator, which is still more calculated for the purpose.

When the circular piece of bone has been taken out, and the edges of the perforation are unequal and splintered, the irregularities are to be cut off with the lenticular knife. When there is extravasated blood underneath the opening that has been formed, it sometimes spontaneously makes its escape, and if it should not do so, the surgeon must remove it himself. If one perforation of the skull should not suffice for letting out the blood, as much more of the cranium ought to be removed with the trephine as circumstances may require; there being no comparison between the danger of repeating the application of the instrument, and that of leaving a quantity of undischarged compressing fluid, on the surface of the brain. Certainly many facts on record evince that the dura mater may be very extensively uncovered without dangerous consequences. Sarrau saw a whole parietal bone exfoliate, in consequence of a blow on the head. Blegny relates a similar case; and Saviard makes mention of a woman who had lost the upper part of the os frontis, both the parietal bones, and a large portion of the os occipitis, all of which had come away at the same time; yet she recovered. Vaugion, however, who seems also to refer to this identical case, describes the exfoliation as not being quite so extensive.

I am of opinion, notwithstanding these facts, that exposing a large part of the dura mater with the trephine is by no means an operation exempt from serious danger. And, what I conceive confirms this statement, is my having known instances in which persons who had been rashly advised to submit to being trephined, for the cure of violent pains in the head, &c., died in consequence of the operation. I make this observation, well aware of the successful instance of the practice recorded by Schmucker. (*Wahrnehm.* b. i. p. 434.)

However, I perfectly coincide with writers who direct the removal of as much bone as is necessary, in order to be able to remove the whole of the pressure from the surface of the dura mater.

The application of the trephine, in cases of copious extravasations, must in particular be made several times, when the situation of the fluid does

not favour its escape. But, in this circumstance, Sabatier says that we should not make numerous perforations all along the extent of the extravasation; but only a counter-opening, as is done on the soft parts. This author expresses his surprise at there not being on record many examples of counter-openings made in the cranium, since analogy demonstrates their utility. I cannot help remarking, on this part of the subject, that one very obvious objection to making openings of this kind in the cranium, is the impossibility of knowing with certainty whether blood lies under any particular part of the skull; whereas, in abscesses of the soft parts, the surgeon feels the fluctuation of the matter, and knows that his counter-opening will be made in the cavity containing it. One may sometimes have occasion to make more than one perforation, in order to discharge blood extravasated beneath the skull, when the blow has happened near a suture, to which the dura mater continues adherent; for a single opening, made only on one side of the suture, might only give vent to a part of the extravasation.

When the trephine is applied on account of a fracture with depression, Sir Benjamin Brodie considers the removal of a small portion of bone as generally sufficient; but when the case is an extravasation of blood on the surface of the dura mater, he recommends a freer removal of the skull. He was led to adopt this rule by having seen a case in which, after two triangular portions of bone had been taken away with a straight saw, and a large quantity of blood discharged, to the great relief of the patient, suppuration afterwards took place on the surface of the dura mater wherever this membrane had been separated by the extravasation from the bone. The matter was hindered by the granulations from escaping by the aperture already made, and though another portion of bone was removed, the practice was too late to save the man's life. (*See Méd. Chir. Trans.* vol. xiv. p. 387.) Whether an extensive removal of the cranium ought to be generally made in anticipation of suppuration of the dura mater in such a case—whether such a measure might not rather tend to make the event more likely to happen—and whether the practice which Sir Benjamin Brodie actually adopted, might not have been the best, though, in the instance brought forward, unsuccessful—are questions, I think, on which the most judicious surgeons may entertain differences of opinion. As my principles lead me to disapprove of the old custom of trephining for the purpose of preventing inflammation and suppuration of the dura mater, they would incline me to be content with rigorous antiphlogistic treatment, and discharging the confined matter as soon as the ill effects of its pressure began to show themselves.

If we should not find blood lodged under the cranium, but the dura mater should seem elevated, tense, dark-coloured, forming a prominent fluctuating tumour, it may be cautiously opened with a lancet, or bistoury, with the view of letting out any collection of blood underneath. In the article HEAD, INJURIES OF, I have stated the result of Mr. Abernethy's experience, in regard to the operation of opening the dura mater. This gentleman found, that the method never effectually discharged all the blood, but only the serous part of it. However, the evacuation of any of the compressing fluid must certainly be desirable;

and, if the surgeon cannot do more, yet he has fulfilled his professional duty.

Although Sir Benjamin Brodie admits, that wounds of the dura mater are attended with great danger, he approves of the practice here recommended (see *Med. Chir. Trans.* vol. xiv. p. 389), and supports his opinion by reference to an interesting case under the late Mr. Chevalier. This gentleman was called to a child, a year and a half old, which had received a severe blow on the head, and lay insensible and convulsed. There was no wound of the scalp; but the fontanel appeared somewhat elevated. It was therefore exposed by an incision, and raised so as to uncover the subjacent dura mater, beneath which the purple colour of extravasated blood was plainly discernible. A puncture having been made with a lancet, three or four ounces of blood issued out with considerable force; the symptoms were immediately relieved, and the child recovered. (See *Med. Phys. Journ.* vol. viii. p. 505.) An example, furnishing an equally convincing proof of the practice here advised, is also adduced by Sir Benjamin Brodie, from the practice of my friend and neighbour, the late Mr. Ogle.

The utility of trephining is not limited to discharging extravasated blood, or matter, lodged underneath the skull. This operation frequently enable us to elevate depressed portions of bone. The latter object can often be accomplished by merely making one perforation. Sometimes, several perforations are requisite, to be made near each other. Authors even state that it may also become necessary to remove the intervening portions of bone with a pair of cutting forceps. The depressed part may then be easily raised by means of an elevator. Occasionally, indeed I may say very often, the best practice is to remove the depressed portion entirely, when its total separation from the rest of the skull can be accomplished by cutting across the base of the depressed piece.

According to some writers, if, after dividing the dura mater, the surface of the brain appears smooth and flabby, with a fluctuation, we may conclude there is an abscess in its substance; and these authors, more enterprising with their pens, it is to be hoped, than with their scalpels, sanction the method of carrying the point of the bistoury to the depth of an inch, if circumstances render so deep a puncture necessary. "But," says Richerand, "prudence forbids us to go further. Cutting the surface of the brain causes no pain, and it produces less danger than one might apprehend; experience and observation prove (in opposition to phrenological theories), that the essential parts of this organ are situated near its base, and that its surface may be removed without danger or pain." (*Nosogr. Chir.* t. ii. p. 301. ed. 3.)

A case, in which Dupuytren plunged a bistoury to the depth of more than an inch into the brain, and thus let out an ounce and a half of pus, is recorded in a valuable periodical work. (See *Journ. of Foreign Med.* No. 18. p. 298.) Some temporary amendment followed; but the case had a fatal termination.

After the operation of trephining, the divided scalp is to be placed as nearly as possible in its natural situation, and lightly dressed with a pledget of simple ointment, or covered with the water dressing and a piece of oil silk. In applying the dressings, the surgeon should invariably keep in

view these objects; namely, to let whatever is put on the wound be as light as possible, not apt to make pressure on the brain, and of a nature which cannot excite irritation. All stimulants are to be strictly prohibited. A bandage, which would only heat the patient, should be avoided; and, if any further covering be required, a thin linen cap should be preferred.

The practitioner should not now conceive that he has done all that he ought to do. Let him remember the urgent necessity of keeping off, or diminishing, inflammation of the dura mater and brain, which is still to be feared. Let him bleed the patient largely and repeatedly; exhibit calomel, saline purges, clysters, and antimonials; and if the symptoms continue, let him apply a blister to the head. I shall avoid, however, any repetitions on this subject, by referring to HEAD, INJURIES OF.

The aperture in the skull becomes closed with granulations, which slowly acquire a hard consistence. While the cicatrix is soft, it should be protected from external injury with a thin piece of horn or metal. Exfoliations from the margin of the perforation sometimes retard the healing of the wound; but, now that the practice of dressing with drying spirituous applications has been exploded, and the removal of any part of the scalp is condemned by all the best surgeons, these unpleasant consequences are rendered much less frequent than in former days.

The reproduction of bone to fill up the perforation made by the trephine, does not usually advance beyond a certain point, and takes place very slowly and only from the margin of the aperture. Even when the soft parts unite by the first intention, the deficiency of bone is never completely obviated (See NECROSIS); first, because, as M. Velpeau observes, the pericranium has been destroyed; secondly, because the dura mater (which, however, does not appear to him to be capable of contributing to the process) is for the most part also involved; and thirdly, because the concentric reproduction is hindered by the contact of the soft parts. If the wound heal by the suppurative process, M. Velpeau adverts to the following changes as taking place. Between the 15th and 20th days, a preliminary inflammation begins to detach the sharp edges of the perforation, which afterwards exfoliate. The osseous texture itself becomes the seat of a very curious healing process, which has been accurately investigated by Baron Larrey. It becomes exceedingly vascular, and its minute vessels, by extending themselves, and producing ossification, may even in time close with an osseous plate the greater portion of the opening in the skull. In the Museum of M. Larrey at the Invalides, M. Velpeau saw various preparations, and one patient in which this process was manifest; and, in proof of the accuracy of this statement, the latter surgeon adverts to instances in which the perforation is reduced to a mere canal. In University College Museum, there is a skull in which very extensive reproductions of bone have taken place after the operation of trephining, the patient having survived it forty years. That the bone may live and enlarge, without the intervention of the pericranium and dura mater, seems evident to M. Velpeau from the circular osseous ridge, which sometimes takes place around the perforation, so as either to form a perceptible protuberance under the scalp, or a swelling within



the skull. Larrey showed him one example of this; and another specimen is referred to, as being in Dr. Physick's Museum, at Philadelphia. (See *Vulpeau, de l'Opér. du Trépan*, p. 262—264.) I will conclude this article with the following extract from Dr. Reese's *American ed. of this DICTIONARY*.

"It is a high source of gratification to be able to record, that in this country (the United States), the trephine is now much more seldom used than formerly. But a few years ago, on a man being stunned by a blow or a fall, to any considerable extent, almost any neighbouring physician would apply the trephine without hesitation, and the facility with which this operation can be performed offers no small temptation to the mere operator, especially as there is seldom any risk of life, and always a gain in reputation among the multitude. It is now very generally viewed as it ought to be, as a *dernier ressort* in such cases, and the use of it is not countenanced, unless the symptoms of compression by depressed bone, or extravasated blood, are altogether unequivocal; and a consultation with the best surgeons is always premised.

"I have seen scores of persons, who would have formerly been trephined, without even a 'trial by jury,' recovered from coma, paralysis, and convulsions, justly attributable to compression on the brain, by very large and copious bleedings, aided by cathartics and stimulating frictions and cataplasms to the extremities.

"Still, however, there will be a sufficiency of instances, imperiously requiring the use of the trephine, to render it necessary that every practitioner should be conversant with the instrument and all the circumstances connected with its use. Indeed, some of the most deplorable cases to which surgical assistance is ever rendered, are occasionally met with among the examples in which the trephine becomes indispensable.

"In the year 1819, I assisted Dr. Henry William Ducachet, then a practitioner in the city of Baltimore, in the performance of this operation on a woman who had received several blows on the head with an axe, from a brutal husband. We could discover no depression of bone, and yet the coma, stertor, hemiplegia, and other evidences of compression, resisted all our depletion, and, on the third day after the violence, we determined to apply the trephine, being sustained by judicious counsel in our opinion, that there must be extensive extravasation of blood beneath the cranium. On removing the circular piece of bone, with the largest crown of the instrument, a coagulum was found extending over the left hemisphere of the brain, exterior to the dura mater. This being removed, and only a mitigation of the symptoms following, the obvious distension of the dura mater itself pointed out the existence of still more extended mischief. We therefore divided the dura mater with a probe-pointed bistoury, for the space of half an inch, when coagulated blood to an immense extent forced itself through the opening. After washing out the cavity with warm water thrown in with a syringe, we were delighted to find the entire removal of the symptoms instantaneously result. Our patient spoke for the first time, asked for water, seemed as though awoke from an ordinary sleep, the stertor ceased, the dilatation of the pupil and hemiplegia were removed, and the most sanguine hopes were entertained of her recovery.

"I shall never forget the painful acuteness of our disappointment, when in a few hours we found all these dangerous symptoms return in a still more aggravated form, discovering to us the mortifying truth, that *though the operation had succeeded, yet our patient would die*; for, although we had removed the coagula, we could not stop the bleeding vessel.

"In the *post mortem* examination, the temporal bone was found fractured, and a spiculum of bone had pierced the meningeal artery, which had not ceased to pour out its blood, and hence coagula were found to fill the whole space of the hemi-cranium, above and below the dura mater. I have preserved the skull in my cabinet of morbid preparations, and the point at which the fracture of the internal table pierced the great artery of the dura mater, is distinctly visible in the depression which marks its course, which is in this case deeper than ordinary. It was exhibited on the trial of the murderer, and was highly important in a medico-legal point of view, since it fully satisfied the court, council, and jury, that her death was occasioned by the blows, and that the injury was altogether irreparable. This was clear from the fact, that the only blows which had wounded the scalp were on the top of the head, and on the middle of the os parietale. The fracture and consequent rupture of the vessel was low down on the temple, where no external wound was found, and two inches from the point at which the trephine was applied, guided as it was by the external injury.

"Since that time, I have applied the trephine and Hey's saw for the removal of a large portion of the frontal bone, which had become carious from syphilis involving nearly the whole forehead. The extensive suppuration which had entered the frontal sinus, and even passed into the cavity of the skull, rendered this operation necessary, in the opinion of the consultation; the man having become idiotic from the disturbance of the cerebrum, and being a burden to himself and family, from frequent epilepsy.

"I applied the crown of the instrument four times, removing all the diseased portion of the bone, and only once entering through the skull, the caries being in the other parts confined to the external table, and the diploe filled with a fetid pus which had not sufficient egress, and by consequence was involving the bone still more extensively in the specific morbid action. A large number of smaller pieces of the cranium were removed with Hey's saw, and by the forceps. A very considerable quantity of pus was found upon the dura mater, at the point at which the caries had entered the cavity, which was discharged through the opening made by the trephine, and the cavity of the head washed out with warm water. Notwithstanding the specific character of the disease, the almost hopeless extent to which it had progressed, and the extreme emaciation which had been superinduced by neglect and mismanagement, this patient entirely recovered, and has ever since the time of the operation (1822) been actively employed as a mechanic; never having had epilepsy since, nor any intellectual deficiency, although this had become apparent for months before. I saw him when last in Baltimore in perfect health."

The reader may find an account of the operation of trepanning or trephining in every system of surgery; but he should particularly consult the writings

of Sharp, *Le Dran*, *Dionis*, *Bertrandi*, *Pott*, *Sabatier*, *Schmucker*, *Richter*, *Dease*, *Abernetby*, *Desault*, *Calisen*, *Richerand*, *Sir C. Bell*; the *Mém. de l'Acad. de Chirurgie*; *Sir R. C. Brodie*, on Injuries of the Brain, in *Med. Chir. Trans.* vol. xiv. *A. A. M. L. Velpeau*, *De l'Opération du Trépan*, &c. 8vo. Paris, 1831; and in *Nouv. Elém. de Méd. opér.* t. i. *J. F. Malgaigne*, *Manuel de Méd. opér.* p. 217. 12mo. Paris, 1837. *Ph. Crampton*, in *Dublin Journ. of Med. and Chemical Science*, vol. ii.; 8vo. 1832. *Professor Dudley*, in *Transylvania Journ. of Medicine*, No. i. *Dr. David L. Rogers*, in *N. Y. Med. and Phys. Journ.* vol. v. p. 79. *R. Liston*, on *Pract. Surgery*, p. 44. 8vo. Lond. 1837.

TRICHIASIS (derived from *Sp̄l̄x*, the hair) denotes a faulty inclination of the eyelashes inwards against the globe of the eye. The disease presents itself under two distinct forms: the first is where the hairs turn inwards, without the natural position and direction of the tarsus being at all changed; the second consists in a morbid inclination of the tarsus inwards (*Entropium*), and consequently of the eyelash towards the eyeball (*Trichiasis*).

The first form of this disease is uncommon. The second species or form of trichiasis, or that which consists in a folding inwards of the tarsus and cilia at the same time, is the case which is commonly met with in practice. It may be either complete, affecting the whole of the tarsus; or incomplete, occupying only a certain portion of the edge of the eyelid, most frequently near the external angle of the eye. Sometimes the disease is confined to one eyelid; at other times it affects both; and occasionally the patient is afflicted with it in both eyes.

Some writers admit a case, which they call *districhiasis*, and which they suppose to be produced by a double and unusual row of hairs. It may be that although the roots of the cilia appear to be disposed in one line only, they form two, three, and in the upper eyelid even four rows of hairs, unequally situated, and, as it were, confused. Whenever, therefore, in consequence of disease, a certain number of hairs are separated from each other in a contrary direction and disorderly manner, the eyelash will appear to be composed of a new and unusual row of them, while, in fact, there is no change, either with respect to their number or natural implantation.

It is not an easy matter to determine precisely, what are the causes which sometimes make a few of the hairs deviate from their natural direction, while the tarsus continues in its right position. They are commonly referred to cicatrices in consequence of previous ulceration, whereby the cilia fall off, and those which are growing are hindered from taking their proper direction. There must, however, be other causes sometimes concerned; for, in the case seen by Scarpa, two or three hairs were turned inwards against the eyeball, although there had been no preceding ulceration, nor cicatrices, of any part of the tarsus. Indeed, Scarpa is inclined to believe, that the small ulcers and scars, which are sometimes formed upon the internal margin of the tarsus, are more likely to cause the second form of the disease, or the inversion of the edge of the eyelid, and, consequently of the cilia, towards the globe of the eye. As these ulcers, when neglected, destroy the internal membrane of the eyelids near the tarsus, it necessarily follows, that in proportion as they heal and diminish, they draw along with them and turn inwards the tarsus

and hairs inserted into it. And since they do not always occupy the whole extent of the internal margin of the eyelid, but are sometimes confined to a few lines in the middle, or extremity, near the external angle of the eyelid, so, after the cicatrices are formed, the whole of the hairs are not invariably turned inwards, but only a certain number of them, which correspond to the extent of the ulcers previously situated along the internal edge of the tarsus. Indeed, in every case of imperfect trichiasis from a cicatrix of the inner margin of the eyelid, the tarsus and cilia are everywhere in their natural situation, except opposite the part where the ulcers formerly existed. Also, if the eyelid be everted, its internal membrane, near that part of the margin corresponding to the seat of the trichiasis, will be found pale, rigid, and hardened, the inversion of the cartilaginous border and of the cilia being plainly the effect of the contraction of the cicatrised point.

Granular ophthalmies of long continuance sometimes bring on the complaint, in consequence of the skin of the eyelids being kept for a long time in a state of distension and œdema, terminating in a considerable relaxation of it. The cartilaginous margin of the eyelid then loses the proper support of the integuments, inclines towards the eyeball, and afterwards turns inwards, drawing the eyelashes along with it in the same improper direction. Long-continued puriform discharges from the glands of the eyelashes likewise spoil the shape and consistence of the cartilage of the eyelid, and therefore not unfrequently occasion trichiasis.

The annoyance, which must necessarily result from the hairs perpetually pressing upon the cornea and white of the eye may be easily imagined. The evil is rendered still greater by the hairs, which are turned inwards, becoming much longer and thicker than those which retain their natural direction. And although the trichiasis be confined to one eye, both the eyes usually suffer from the effects of the disease. Indeed, generally, the eye on the sound side cannot be moved without occasioning pain in that which is exposed to the irritation and friction of the inflected hairs. In almost all cases, both the eyes are very irritable, and incapable of bearing the light. As, in cases of incomplete trichiasis, the patient retains some little power of opening the eyelids for the purpose of seeing, and that most frequently towards the internal angle of the eye, the head and neck are often inclined in an awkward manner, so that in children a distortion of the neck and shoulders is at last produced, which cannot be rectified without difficulty even after the trichiasis has been cured. Unfortunately, also, children are impatient of the uneasiness arising from the inflected hairs, and therefore are continually rubbing the eyelids, whereby all the ill effects of the complaint are much increased.

*Treatment*.—[The eyelashes, if displaced, should be drawn out gently with a cilia forceps without breaking them off. Atrophy of the hair-papilla may thus be produced by drawing them out, at first every third day, then every week, and so on for months. Some recommend the removal of the hair-papilla by operation.

The growth of fresh eyelashes may be prevented for months by applying some sulph-hydrate of cal-



cium to the portion of the margin of the eyelid which surrounds the orifices for the eyelashes. The calcium, after five minutes, is washed away with a sponge, and the eyelashes left to themselves. During the application, a spatula is placed between the lid and the eyeball to protect the latter. The growth of eyelashes has been prevented by destroying their papillæ with pure liquor-potassæ. A needle, moistened with it, is thrust along the eyelashes in the direction of and a little beyond the papilla. Slight inflammation follows. The eyelashes, after a few days, are drawn out with the forceps.]

The cure of the second species of trichiasis, or that which is commonly met with in practice, is accomplished by artificially everting the eyelid, and fixing it permanently in its natural position, together with the eyelashes which irritate the globe of the eye. This indication is perfectly fulfilled by the excision of a piece of skin close to the edge of the eyelid, of such a breadth and extent that, when the cicatrix is formed, the tarsus and margin of the eyelid may be turned outwards and sufficiently separated from the eyeball, the cicatrix of the integuments affording a point of support fully adequate to keep the parts in their natural position and direction.

The following is the mode of proceeding. The patient being seated in a chair, if an adult, or, if a child, laid upon a table, with the head raised, and firmly held by an assistant, who must stand behind the patient, the surgeon is to push outward, with the end of a probe, the hairs which irritate the eye. Then, with a pair of dissecting forceps, or the ends of his forefinger and thumb, he should lift up a fold of the skin of the eyelid, taking great care that the piece which is taken hold of corresponds exactly to the middle of the whole extent of the trichiasis; for, sometimes the whole, sometimes half, and in other instances only a third of the extent of the tarsus is inverted. The surgeon, with his left hand, must raise the fold of the skin, more or less, according as the relaxation of the integuments, and the inversion of the tarsus, are more or less considerable. The reason of this is evident, viz. the greater the quantity of skin is, which is raised, the greater is the quantity which will be cut away. Supposing the patient to be an adult, as soon as the fold of skin has been raised in a certain degree, the surgeon must request him to open his eye; and if, in this act, the tarsus and eyelashes resume their natural place and direction, the portion of skin already raised will be sufficient for the purpose. When the integuments are elevated, by means of a pair of dissecting forceps, and care is taken to lay hold of the skin precisely at the middle point of the whole extent of the trichiasis, it necessarily follows, that the consequent section of the skin will form an oval, and that the greatest width of the wound will correspond exactly, or nearly so, to the middle of the eyelid, and its narrowest parts to the angles, or commissures of the same.

This contributes very materially to make the cicatrix correspond to the natural fold of the eyelid, and hinder the origin of a disease of an opposite nature to the one about to be remedied, toward the angles of the eye, viz. a turning out of the commissures of the eyelids. See ECTROPION.

Besides this caution, relative to the situation

and figure of the fold of the integuments to be cut off, the surgeon must be careful that the division of the skin be made very near the inverted tarsus. Were this circumstance neglected, the operator might have the mortification of finding, after the wound has been healed, that although the eyelid is shortened on the whole, from the eyebrow to the place of the recision, yet it is not equally so at the space which is between the edge of the eyelid and the cicatrix of the skin. Hence the tarsus would not be turned outward sufficiently to keep the eyelashes from rubbing against the eye.

The surgeon holding up the fold of skin by means of the forceps, in his left hand, is, with a pair of probe-pointed sharp-curved scissors, to cut off the whole of the duplicature, being first sure that one of the blades of the instrument is applied close to the edge of the eyelid. If the two eyelids should be affected, the same operation must immediately be done upon both of them, with such cautions and in such proportion, as the extent of the disease, and the degree of inversion of each eyelid, may require.

No suture to unite the wound is required, it is sufficient to keep the eyebrow as much downward as possible, if the operation had been done on the upper eyelid, or, if on the lower, to support it against the inferior arch of the orbit, by pressing it from below upwards, so as to keep the edges of the wound from becoming separated. Then the lips of the wound are to be brought exactly together, by means of strips of adhesive plaster, extending from the superior arch of the orbit to the zygoma; and the maintenance of this state of the wound will be still more securely effected by placing two compresses, one on the eyebrow and another on the zygoma, together with a bandage.

On taking off the first dressings, the third day after the operation, the surgeon will find, says Scarpa, that the patient can open his eye with ease, and that the inverted tarsus and eyelashes have resumed their natural position and direction. In the partial, or incomplete trichiasis, or that which only occupies a half, or a third, of the whole length of the tarsus, and in subjects who have had the skin of the eyelids very loose, Scarpa has often found the wound perfectly united on removing the first dressing.

When, however, only a part of the incision has healed, while the rest seems disposed to heal by suppuration and granulation, the surgeon is to cover the wound with a small piece of lint, spread with the unguentum cerussæ; and if the sore should become flabby, it must be occasionally touched with the argentum nitratum until the cure is finished.

With regard to the first form of this disease, or that in which the eyelashes project against the eyeball, without the natural position of the tarsus being at all altered (a case which is fortunately rare), the accomplishment of a cure is difficult, since neither the pulling out of the hairs, nor burning the situation of their roots, are means at all to be depended upon for producing a complete cure of the disorder; and turning the tarsus out of its natural position would make the patient liable to an irremediable dropping of the tears over the cheek, attended with a chronic thickening of the lining of the eyelid. It has only been in young h.

individuals that Beer has ever seen the repeated and careful extraction of the cilia effect a radical cure. (See *Lehre von den Augenkr.* b. ii. p. 121.) In the instance of this form of the disease, which Scarpa met with, only two or three of the eyelashes inclined against the eyeball. He found, on turning the eyelid a little out, opposite to the situation of the faulty hairs, that he could not, indeed, completely put them in their natural position; but he saw that he could thus remove them so far from the cornea, that they would not rub against it, without altering the position of the eyelids so much as to occasion a perpetual discharge of the tears over the cheek. And as, in the patient alluded to, the skin about the eyelid was very tense, Scarpa made an incision with the back of the lancet, near the tarsus, three lines long, and took away a small piece of skin of the same length, but very little more than one line broad. When the cut healed, the operation was found to answer as well as the nature of the case would allow, though the cure was not complete.

According to Mr. Guthrie, when chronic inflammation prevails, and there is a commencing but incomplete general inversion of the cilia, the cure of the inflammation will restore the conjunctiva to its natural state, and the cilia to their original direction, without any especial means being employed for the cure of the beginning inversion; but, when these changes proceed too slowly, the nitric acid should be applied, and will always be found effectual. Indeed, in cases where the incurvation of the cartilage is slight, and the contraction of the angles moderate, Mr. Guthrie finds that such treatment will render another operation unnecessary. It should be applied as follows: 1st. A small quantity of concentrated nitric acid is to be applied, by means of a piece of smooth solid wood, to the centre of the affected part of the lid, and rubbed along on an oval space, a little exceeding in length the part on which the inverted hairs are situated, and from three to four or six lines in width, according to the inveteracy of the disease. The part ought to be wiped dry, after the acid has been applied about ten seconds, in order to prevent any of it from getting into the eye. 2nd. The application of the acid is now to be repeated, care being taken that it approach the edge of the eyelid, and touch the parts immediately over the inverted eyelashes; and it is to be continued, or repeated a third, or a fourth time, until the contraction of the parts draws the hair from within outwards, or to their natural situation; then the operation is completed, and the part ought to be again perfectly dried.

[If the turned-in eyelashes are scattered over the entire margin of the lid, and if for this or other reasons we determine upon their entire removal; we must take great care to spare the margin of the tarsus so as to preserve its width as much as possible and to keep its inner edge intact, otherwise obliteration and atrophy of the Meibomian glands, or thickening and distortion of the tarsus with accumulation of the secretions of these glands, beneath the skin along the margin of the lid, or eversion of the conjunctiva with irritating cicatrices or epiphora, if the lower lid was operated upon, may follow the operation.]

*The Operation.*—In this and other operations on the eyelids, to avoid troublesome bleeding a compressorium forceps is applied. It should not be

tightened more than will suffice to stop bleeding, otherwise much inflammation or even sloughing of the lid may follow. This forceps being applied, the margin of the lid is split with a cataract-knife, so as to separate the skin, orbicularis muscle and eyelashes, their hair-follicles included, from the tarsus; taking care not to wound the lachrymal canaliculi, nor to leave behind any eyelashes or their roots, which latter appear as little black dots on the surface of the tarsus. The separation is carried to about a quarter of an inch from the margin of the lid, so as to remove all hair-bulbs. An incision, a quarter of an inch from the margin of the lid, and parallel to the first one, is then carried through the skin &c. down upon the tarsus, and the parts including the hair-bulbs and eyelashes removed. No suture need be applied.

The profuse bleeding is arrested by means of wet lint tied over the closed lids. The lint should be changed three times daily. The patient may go about. The wound will have united after two or three days.

Eyelashes that may have been left behind, must, if irritating the eye, be extracted with the forceps.]

Some new methods of performing the operation for the cure of trichiasis have been proposed by Mr. Crampton, Mr. Saunders, Dr. Jaeger, Schreger, and Mr. Guthrie. With respect to that of Mr. Saunders, however, its novelty is denied by Graefe, who states that the practice is as old as the time of *Ætius*.

The following is the account which Mr. Crampton gives of his plan, which he tried in one instance with complete success. "Let the eyelid be well turned outwards by an assistant; let the operator then, with a lancet, divide the broad margin of the tarsus completely through, by two perpendicular incisions, one on each side of the inverted hair, or hairs; let him then, by a transverse section of the conjunctiva of the eyelid, unite the extremities of the perpendicular incisions. The portion of cartilage, contained within the incisions, can then, if inverted, with ease be restored to its original situation, and retained there by small strips of adhesive plaster, or perhaps, what is better, by a suspensorium palpebræ, adapted to the length of the portion of the tarsus which it is intended to sustain, should one or two hairs be displaced without inversion of the tarsus." (*Essay on the Entropion*, p. 55.)

Mr. Travers informs us, that, in cases of a circumscribed inversion, "produced by cicatrix from burn or wound," he has found Mr. Crampton's method an effectual remedy. It is added, that the complete division of the conjunctiva and tarsal cartilage, including the inverted portion, and parallel to its border, with the aid of sticking-plaster, sometimes proved sufficient. Mr. Travers also sees no objection to the entire removal of that portion of the tarsal edge which is incorrigibly inverted from such a cause, especially when combined with a preternatural growth of cilia from the Meibomian border of the tarsus. (*Synopsis*, &c. p. 356.) In one inveterate case, which was not effectually relieved by the frequent extraction of the cilia, cauterising the edge of the tarsus, the excision of a slit of skin, and smearing the eyelid with concentrated sulphuric acid, as proposed by Helling (*Hufeland's Journ.* st. 4, p. 115), Schreger, with a pair of curved scissors, cut out a triangular piece of the cartilage of the eyelid at the



place where the cilia were most troublesome. The great benefit derived from the operation then led the same practitioner to suggest the removal of the whole of the inverted edge of the tarsus, towards the inner canthus, where some irritation was yet maintained. The plan, though followed by severe pain, appears to have succeeded. (*Chir. Versuche*, b. ii. p. 253.)

Mr. Saunders entertained a favourable opinion of Mr. Crampton's operation for the cure of the disease in its early stage; but he contended, that such a vicious bending of the tarsus inward was often the consequence of repeated ophthalmia, attended with ulceration of the conjunctiva and inside of the eyelid, so that every endeavour to rectify the wrong position of the tarsus, and restore its original direction, would be fruitless. Hence, he believed that its excision was decidedly indicated; an operation which is said to be followed by no pain or uneasiness, and which is sure in its effect. No particular shortening of the eyelid ensues; the deformity is materially lessened; and, unless the cornea be already too opaque, perfect vision is re-established. Mr. Saunders directs a piece of thin horn, or a plate of silver, having a curvature corresponding to that of the eyelid, to be introduced under this part, with its concavity towards the eyeball. On this instrument the eyelid is to be stretched. An incision is to be made through the integuments and orbicularis palpebrarum, down to the tarsus, immediately behind the roots of the cilia. The cut should extend from the punctum lachrymale to the external angle. The exterior surface of the tarsus is then to be dissected, until the orbital margin is exposed, when the conjunctiva is to be cut through directly by the side of the tarsus, which must now be disengaged at each extremity. The punctum lachrymale must be left uninjured. The operation is described as being simple, and if any embarrassment arises, it is from the hæmorrhage of the ciliary artery, the blood sometimes obscuring the punctum lachrymale, just when the operator is about to divide the tarsus by the side of it. No dressings are required, it being merely necessary to keep the eye covered for a few days. The skin will continue to be elevated, just as the perfect eyelid was; and, though less completely, yet enough to leave the pupil clear, when the eye is moderately directed upward. In all the cases in which Mr. Saunders operated, a fungus grew from the wound. He recommends the excrescence to be destroyed with caustic, or the knife.

Respecting this operation, I shall merely observe that it is more severe than that advised by Scarpa, and even than the method of Schreger, and must leave greater disfigurement. Unless, therefore, the latter methods prove ineffectual, I should consider the practice unjustifiable. Mr. Guthrie has seen three persons on whom this operation had been performed, and on two of them by Mr. Saunders himself: in all, the deformity was considerable, and the relief only partial. (*Operative Surgery of the Eye*, p. 25.) Nor is Schreger's method allowable, except in cases which resist the milder plan sanctioned by Beer and Scarpa.

Mr. Guthrie recommends the following operation, as adequate to the cure of the worst cases. A small narrow knife, or one blade of a blunt-pointed scissors, is to be introduced close to the

external angle, and a perpendicular incision made, from a quarter to half an inch in extent, or of sufficient length to render the eyelid quite free. Another incision is then to be made, in a similar way, at the inner angle, without including the punctum lachrymale. "The length to which the perpendicular incisions at both angles ought to extend must now be decided upon by the appearance of the part: they must be continued, if necessary, by repeated touches with the scissors, until that part of the eyelid containing the tarsal cartilage, is perfectly free, and is evidently not acted upon by the fibres of the orbicularis muscle." The part included in the incisions is now to be completely everted, and retained by the forefinger of the operator's left hand against the patient's brow; when, if any lateral attachment be observed, confining the lid, it is to be divided. "On letting the eyelid fall on the eye, the edge of the tarsus and the hairs will frequently appear in the natural situation, in consequence of the relaxation of the angles which bound them down; but, if the tarsal cartilage has become altered in its curvature, this will be immediately perceived; it will turn inwards at its ciliary edge, and be completely bent at its extremities, more especially at the inner one, where it is more powerfully acted upon by the orbicularis muscle. On desiring the patient to raise the lid, he readily attempts it, but the action of the levator, in such cases of vicious curvature, causes the cartilage to resume its situation; and, on examination, the curve will be observed to be so permanently vicious, for about an eighth of an inch at each extremity, and especially at the inner, that it cannot be induced to resume its actual situation. When this is the case, the cartilage is to be divided exactly at the place where it is bent in its length, and in a direction at a right angle with the perpendicular incision: the portion thus slit is only connected with the common integuments of the eyelid; and although this incision scarcely exceeds one, and never two-eighths of an inch at both extremities, and in general is only necessary at the inner, it enables the surgeon to remove the altered curvature of the part." The next proceeding in Mr. Guthrie's operation consists in cutting away a fold of skin from the part of the eyelid between the incisions. Three or four ligatures are then to be introduced, and the divided parts, from which the fold has been removed, are to be brought together by the ligatures, each of which is to be twisted and fastened to the forehead with several short strips of sticking-plaster. The fold of skin should be raised regularly with the fingers, and as near as possible to the margin of the eyelid. It may then be taken hold of with Beer's forceps, the grasping pieces of which are transverse, slightly curved, and shut with a spring. The skin, thus taken hold of, which need not be large, may now be cut away with a large pair of curved or straight scissors. The ligatures are first inserted at each angle, and when the vicious curvature is considerable, Mr. Guthrie not only passes them through the skin, but takes care to make the *internal* one include, at its lower part, the *outer edge* of the margin of the eyelid. The ligatures, thus placed, are to be equally drawn up on the forehead, until the eyelid is *completely everted*, when they are to be fastened in the manner above specified. In order to prevent union by the first intention, and make the granulating

process necessary, the edges are slightly touched with the sulphate of copper. The eye and eyelids are now to be carefully cleansed; a piece of lint, spread with the ung. cetacei, is to be placed upon them; a small compress under the edge of the orbit; and a retaining bandage over the whole. The next morning, the bandage and lint are to be removed, the eye fomented and cleansed, and the dressings replaced. On the second day, great care must be taken that the ligatures keep the lid sufficiently raised; and, if any union has taken place by adhesion at the angles of the incisions, it must be broken through with the probe. On the third day, the plasters on the forehead should generally be changed. The ligatures themselves must be supported by strips of plaster, placed vertically between them; and the edges of the incisions should be touched again with the sulphate of copper, or separated with a probe. In a few days more, the ligatures cut their way out; and by the time the parts are healed, the eyelid will have resumed its natural situation. (*Operative Surgery of the Eye*, p. 31, &c.) Operations on the same principle are also recommended by Mr. Guthrie for the lower eyelid.

When a surgeon chooses to try the foregoing operation, he ought to be certain that the cartilage of the tarsus is so altered in its shape, as not to afford much chance of effectual relief from milder plans.

Inversion of the lower eyelid is much less common than that of the upper one. An inversion of the inferior palpebra is sometimes produced by inflammation and swelling of that part of the conjunctiva which connects the eyelid with the eyeball. In cases of ophthalmia, this membrane often forms between the latter parts a distinct fold, which is situated just on the inside of the orbital edge of the tarsus, and pushes it outward; while the contraction of the orbicular muscle turns the ciliary edge inwards, and inclines it between the swelling of the conjunctiva and the eye. In this particular case, Mr. Saunders assures us, that replacing the eyelid in the early stage of the disease, and maintaining it so, until the ophthalmia has been lessened by proper means, will be found effectual. But when the conjunctiva is much thickened and indurated, Mr. Saunders recommends cutting such diseased part of it away, and the application of compresses to keep the orbital margin of the tarsus inward. (See also *Travers's Synopsis*, p. 234 and 355.)

Albinus has recorded a species of trichiasis, which originated from the growth and inversion of one of the hairs upon the caruncula lachrymalis. The plan of relief consisted in plucking out the irritating hair; but it is not mentioned whether it grew again.

C. Bader.

*J. Scultetus*, Trichiasis Admiranda, sive Morbus Pilaris Mirabilis, 12mo. Norib. 1658. *Scarpa* sulle principali Malattie degli Occhi. *R. Crampton*, Essay on the Entropion. Lond. 1805. *Saunders's* Obs. on several practical Points relative to the Diseases of the Eye, ed. 3. *Richter's* Anfangsgründe der Wundarzneikunst, B. iii. *G. J. Beer*, Lehre von den Augenkrankheiten, B. ii. pp. 111-117. 8vo. Wien, 1817. *Schreger*, Chirurgische Versuche, B. ii. Neue Methode die Trichiasis zu operiren, p. 253. 8vo. Nürnberg, 1818. *B. Travers*, Synopsis of the Diseases of the Eye, pp. 232-354, &c. 8vo. Lond. 1820. *Jaeger*, Diss. sistens Diagnosin et Curam Radicalem Trichiasis, Distichiasis, necnon Entropii. Viennæ. This method is said by Mr. Guthrie to be similar to that

proposed by Saunders. *G. J. Guthrie*, Operative Surgery of the Eye, 8vo. Lond. 1823. *Delpsch*, Clinique de Chirurgie, t. ii. 4to. 1828; and the *Traité* on Dis. of the Eye, by *Laurence*, *Mackenzie*, and *Middlemore*, *Desmarres*, *Traité*, &c. 1847, p. 47. *Riberi*, Trattato di Bieforotalmia, terapia operativa, 1838. *Furnari*, Ann. d'Ocul. vol. xi. p. 229. *Mackenzie*, On the Diseases of the Eye, 4th edit. 1854. Consult also *Voisin*, Himly. Bd. i. 217. *J. Vogel*, *Wedel*, Grundzüge der pathol. Histologie, 1854, S. 467. *Annales d'Oculistique*, vol. xxxiv. p. 265. *Pauli*, Ann. d'Ocul. vol. i. suppl. p. 26. *H. Rodriguez*, Ann. d'Ocul. vol. xvi. p. 25. *Lisfrank*, L'Institut, 1836, No. 158. *Cunier*, Annales d'Oculistique, vol. ii. p. 163. *Wedel*, Grundzüge der pathol. Histologie. Vienna, 1854, p. 469.

TRISMUS. (from *τρίζω*, to gnash the teeth.) The locked jaw. See TETANUS.

TROCHAR, or TROCAR. (from the French, *trois-quart*, three-fourths, from its point being always formerly of a triangular form.) An instrument used for discharging serous fluids from different cavities in the body, particularly those of the peritoneum and tunica vaginalis, in cases of ascites and hydrocele. Trocars are also employed for tapping the bladder, dropsical ovaries, &c., and sometimes large chronic abscesses. One, for bronchotomy, was invented by the late Mr. Wood. (See TRACHEOTOMY.)

A trocar consists of a perforator, or stilet, and of a canula, which is so adapted to the first piece of the instrument, that, when the puncture is made, they both enter the part together, with perfect ease, after which, the stilet being withdrawn, the canula remains in the wound, and gives a ready passage for the fluid outward.

Such are the uses of a trocar, and the principles on which it should be constructed. It would be unnecessary in this work to detail every little particularity in the instrument: I shall merely observe, that the triangular-pointed, and especially the round pointed, trocars seem to retain the greatest share of approbation; for, although those of a flat, lancet-pointed shape enter parts with more ease, their canulæ are not large enough for the ready escape of fluids which are at all thick, gelatinous, or blended with hydatids and flaky substances.

The trocar for puncturing the bladder from the rectum should be longer than a common trocar, and of a curved form.

Surgeons ought always to have, at least, three trocars; one of full size, another of middling width, and a third of small dimensions. In hydrocele, the latter is often preferable. [Since Mr. Cooper's time, trocars of smaller size have been in common use, diminishing from the size of the ordinary hydrocele trocar to that of an exploring needle. These are fitted to an ivory handle and case, containing the canula. The smallest are used for tapping in hydrocephalus, and have superseded the grooved needle for exploring doubtful cases of tumor, and of collections of fluid of various characters. Minute portions of malignant growths may be obtained for microscopic examination by thrusting the canula further into the tumor after the stilet has been removed. In this way diagnosis may be materially aided. Trocars are also affixed to glass syringes, with double valvular action. These are of great service in drawing off fluids where it is considered of great importance not to permit atmospheric air to enter the cavity containing them, as in tapping the chest for empyema, or in opening a large Psoas abscess. Very large trocars, half-an-inch in diameter, have been lately



introduced by Mr. Spencer Wells and others, to draw off the fluid rapidly during the operation of ovariectomy. (See OVARIOTOMY.) India-rubber tubing is adjusted to the canula for the purpose of conveying the fluid into a convenient receptacle, and a contrivance is connected to the proximal end of the large canula, by means of which the cyst is held securely to it.]

**TRUSS.** (*trousse*, French.) *Bracherium*. A bandage, or apparatus, for keeping a hernia reduced. A truss, which fulfils its intention properly, should compress the neck of the hernial sac, and the ring, or external opening of the hernia, in such a manner, that a protrusion of any of the contents of the abdomen will be prevented with complete security. Hence, it is the indispensable quality of a good truss, first to make effectual and equal pressure on the parts indicated, without causing pain or inconvenience to the patient; secondly, not easily to slip out of its right situation, in the varying motions and positions of the body.

Trusses are either of an elastic or non-elastic kind. The latter are composed of leather, fustian, dimity, or similar materials. These cannot be at all depended on, and should, therefore, be entirely banished from surgery. Since (as Mr. Lawrence has remarked) the size of the abdomen varies, according to the different states of the viscera and to the motions of its parietes in respiration, a non-elastic bandage must vary constantly in its degree of tightness, and keep up either too great or too little pressure. The omentum, or intestine, easily slips out when the opening is not exactly closed, and the patient who wears such a bandage must be in a state of constant insecurity. Those who lead an active life, or are obliged to use laborious exertions, will be more particularly exposed to risk. If the patient, after experiencing these defects, endeavours to remedy them by drawing the bandage tighter, he may confine the viscera in position, but he produces other inconveniences. The increased pressure injures the spermatic cord, and may affect the testicle; the integuments become red, painful, and excoriated, and the bandage must be entirely laid aside until the parts have recovered. Richter has often seen painful tumefaction of the testicle, hydrocele, and even cirsocele, produced from this cause, and entirely dissipated by the employment of a proper truss. (*Traité des Hernies*, p. 24.) He also saw the pad of a non-elastic bandage excite, in the region of the abdominal ring, a considerable inflammation, which terminated after a few days in suppuration. The hernia never appeared again after the cure of the abscess. The inflammation had extended to the neck of the sac, and obliterated that part. (*On Ruptures*, ed. 3. pp. 69, 70.) The *spring* is a very essential part of every elastic truss, and it consists of a flat, long piece of steel, which is adapted to the side of the body on which the hernia is situated. It is not a great many years since the spring used to be made of common iron, and Arnaud and Richter express their preference to a mixture of malleable iron and steel, so that the instrument may be moulded by the hand to any particular shape; but, as Mr. Lawrence well observes, a truss which admits of such management, must be more or less liable to the objections which apply to inelastic bandages, and the only material which possesses the requisite qualities of firmness and elasticity is well-tempered steel. The front part of the steel spring has

an expanded form, and, when the truss is properly applied, ought to be situated over the mouth of the hernial sac. The spring of a truss has commonly been a semicircle, with the posterior end resting on the spine. Camper proposed to carry it round to the anterior superior spine of the ilium on the sound side; a plan of which Scarpa highly approves. Trusses of this form fit with a degree of steadiness which cannot be given to others by tightening the strap. They keep up the rupture better than even a stronger spring of the common kind. Under the back surface of the anterior end of the spring is placed the pad, which should be adapted in shape and size to the passage which is intended to be shut up. The steel spring is usually covered with leather, is lined with soft materials, and, after being put on the patient, is fastened in its situation by means of a strap, which extends from the two ends of the spring, round the side of the body on which the hernia is not situated. Hare-skin, with the fur outwards, is sometimes considered the best covering for preserving the spring from the ill effects of perspiration.

When it is necessary to make strong compression, as in large old ruptures, and in persons who cannot avoid labour and exercise, the elastic spring should be made accordingly thicker and broader. But, an object of first-rate importance is to make the spring press equally upon every point of the body which it touches. This is what demands the earnest attention both of the surgeon and the instrument-maker, especially as the hips of some individuals are flat and narrow, while those of other persons are broad and prominent. A thick, flexible metallic wire, accurately applied round the pelvis, will serve to take the measure and proper shape of the spring, which may afterwards be altered a little if found necessary. The wire, however, should be somewhat longer, on account of the length of the spring.

The springs of trusses, intended for children and persons who do not undergo much labour and exertion, need not be made so strong as those designed for hard-working, active people.

The idea that children cannot wear steel trusses, is as erroneous as it is dangerous in its practical consequences; a point on which Mr. Pott has strongly insisted.

Trusses are sometimes fabricated with a pad moveable on a spring, instead of being riveted to it. This may be inclined upwards or downwards, according to the form of the abdomen; and it is retained at the desired point by a spring fitting into the teeth of a rack. In others, the plate contains a screw, by which the cushion is pushed further inward, or allowed to recede at pleasure. Although there cannot be a doubt that some of these inventions possess considerable merit, and are in certain instances eminently useful, it must be confessed that, in general, their utility is not so much greater than that of common pads, as to make amends for the want of simplicity and the increase of expense. I should be sorry, however, to say anything that would unfairly discourage all such ingenious endeavours to improve an instrument so difficult to bring to perfection as a truss; especially as I believe there are particular cases in which pads, with racks, screws, springs, pivots, &c., may be employed with great advantage.

Notwithstanding every care, sometimes even elastic trusses cannot be hindered from slipping

away from the part which they are designed to compress. Sometimes they slip downwards, and this, in fat subjects, is generally caused by the projection of the abdomen. Occasionally the fault consists in the instrument becoming displaced in the direction upwards, which mostly happens in thin persons, and is produced by the flatness of the abdomen. In the first case, the displacement is to be prevented by the use of an elastic scapulary; in the second, the slipping of the pad upwards is to be prevented by the employment of a thigh strap.

When a patient is afflicted with a rupture on each side, the two protrusions may be very well kept up by means of a single truss, made with two pads, which are joined together, at the exact distance of the rings from each other, by a piece of steel, applied over the convexity of the symphysis of the pubes, and proportioned in length to the space between the two openings through which the viscera descend. In such cases, however, it is absolutely necessary to have the spring stronger than if there were only one rupture. The truss should also be put on that side of the body upon which the hernia most difficult to retain is situated. Some practitioners, however, give the preference to the use of two single trusses joined together in front and behind with suitable straps.

[The truss invented by Mr. Coles, which in addition to the usual steel spring has also a spring in the pad, may fairly be considered as an improvement on the ordinary truss. M. Bourjeaud has succeeded in combining with his elastic webbing, fitted exactly to the thighs and around the pelvis, india-rubber air-pads, which are placed and fixed over the site of the hernial protrusions, and in some cases this method may be found preferable to a spring truss.]

The following remarks are contained in the American edition of this work.

"Our profession is very largely indebted to Dr. Amos G. Hull, of New York, for the valuable service he has rendered the cause of humanity, as well as the science of surgery, by the indefatigable labours and persevering ingenuity which he has devoted to this interesting department of chirurgery. After experiencing in his own practice the defects of the various kinds of trusses ordinarily employed, and suffering the inconveniences of which surgeons and patients have so long complained, he was induced to attempt the construction of an instrument which should fulfil the surgical indications in the treatment of reducible hernia; an object which seemed to have been overlooked by previous inventors, and to accomplish which a knowledge of the anatomy of the parts and the mechanical operation of the truss was alike indispensable.

"Dr. Hull brought to this subject a mechanical genius of more than ordinary acuteness, and, at the same time, an intimate and accurate knowledge of the intricate subject of hernia itself, and succeeded in constructing an instrument which is not only applicable to every species of rupture to which a truss is adapted; but, in recent cases, and young children, is fully adequate to effect a radical cure, as proved by experience and attested by the leading surgeons of the present day.

"Dr. Hull claims for himself the merit of accomplishing the true indications in the surgical treatment of reducible hernia, by the four following distinctive peculiarities embraced in the truss, viz.

"1st. The *concave* internal surface of the *rupture pad*, from its pressure being greatest at the *circumference*, tends constantly to approximate the hernial parietes, affording them rest and mechanical support.

"2d. The combined hinge and pivot mode of connection between the *spring* and *pad*, by means of a *tenon* and *mortice*, so constructed as to preserve a *double hinge* and *limited joint* acting in every direction, thereby securing the uniform pressure of the spring on the *pad*, and sustaining the same nice coaptation of the pad and rupture opening, as well under the varied ordinary muscular actions as when the body is in a recumbent posture.

"3d. The graduating power and fixture of the pad to the spring, rendering, as will be readily perceived, the condition of the pad perfectly controllable, even to nameless minuteness. Also resulting from this mechanism is the advantage of accommodating a large truss to a small person; hence the facility of supplying, without disappointment, persons at a distance.

4th. The double inguinal truss, being simply the addition of another pad attached to a short elastic metallic plate: this plate with its pad move on the main spring by the same power of adjustment and fixture as the first pad, the pressure of the pads being graduated at pleasure by an intervening cork wedge.

"In the article HERNIA I have hinted at the importance of a *concave* rupture pad, instead of a convex one, so universal, and once thought indispensable. It is no marvel that so few radical cures were ever known by the truss, when the *convex* pad of the instrument was fitted to the mouth of the rupture, thus enlarging the hernia opening. By this instrument the elevated circular margin of the concave pad is made to approximate the sides of the hernial opening, closes the aperture, and hence results in a permanent cure of the disease. I have known many instances of radical cures by this instrument, and in some of them, the truss has been laid aside for several years without the smallest return of the disease. It is to the interest of the profession universally to become acquainted with this instrument, and to profit by its superiority."—*Reese.*

With respect to the application and use of trusses, the following instructions merit attention.

1. A truss should never be first applied or changed except when the patient is in the horizontal posture, and unless it is known with certainty that all the contents of the rupture are completely reduced.

2. The first applications of a truss should be made under the superintendence of the surgeon himself; and care should be taken to put on the instrument in such a manner that the pad will compress the neck of the hernia sac; and with this view, if the hernia be of the oblique inguinal kind, the chief pressure should be made over the situation of the internal ring and the course of the inguinal canal; when, on the other hand, the case is a direct inguinal hernia, the pad should make pressure exactly on the external abdominal ring. The patient should be made acquainted with the right manner of applying the truss; the principles on which it keeps up the bowels, and affords a chance of a radical cure; the requisite cautions to be observed, &c. When he begins to wear a truss, he should be particularly careful not to be guilty of imprudent exertions, and he ought to observe most attentively that the instrument does not slip from.



its proper situation. It will also be necessary for him to pay attention to the instrument being neither too tight nor too loose.

3. The patient ought to be provided with at least two trusses, which fit him well, so that if one stand in need of repair, he may always be provided with one that will answer. In order to save the truss, especially in fat persons, who perspire a great deal, it is a good plan to lay a soft piece of calico under the pad.

4. An uneasiness about the ring, which always gives rise to a suspicion that a portion of intestine or omentum is protruded, makes it proper to take off the truss, carefully examine the parts, and reduce them if they have descended.

5. When the skin is excoriated by the truss, the part may be cured by sprinkling upon it the powder of acetate of lead, Fullers' earth, lapis calaminaris, &c., or bathing the part with an astringent lotion. It will also be right to protect the excoriated place with a piece of linen put under the truss.

6. When the pressure of the truss excites pain and swelling of the spermatic cord and testicle, either the thigh-strap must be relaxed, or the lower part of the pad made less prominent. And when strong pressure is absolutely necessary to keep the hernia reduced, the pad should have an excavation in it over the spermatic cord. Whoever wears a truss should be careful to employ it day and night without interruption, so that there may be no opportunity for the hernia to protrude again. If, under the employment of a truss, the rupture once descends again, either a strangulation happens from the narrowness of the neck of the sac, or at all events, the hope of a radical cure, which may have been entertained for years and months, is destroyed in a moment; for experience has put it beyond all doubt, that by the continual unremitted use of a truss, and the steady retention of the contents of the hernia, the neck of the hernial sac, and the ring, may be gradually lessened in diameter until they are entirely closed, and a radical cure of the rupture effected. This is more frequently observed in young subjects, seldom in adults, and scarcely ever in persons of advanced years. But trusses must be worn a long while; nor should the patient venture to lay aside their use till after many cautious attempts; beginning the experiment at first only in the night-time, and not making it in the day till after a considerable period from the time when he first thinks himself safe. The longer and more attentively a truss is worn, the greater is the hope of a radical cure. (*Cullisen, Syst. Chir. Hod. t. ii.*)

England's truss for naval ruptures was preferred by Hey. In the article *HERNIA*, an account is given of the truss for umbilical hernia, invented by Mr. Marrison, of Leeds. There may also be found additional observations on the place against which the pressure of the pads of trusses should be directed.

**TUMOR.** [The definition, as quoted by Richard Wiseman from Galen, is "a disease in which the parts of the body depart from their natural state by an undue increase of their size." And, doubtless, the word is employed by the public generally to convey this idea. For the word is commonly used to express *local increase of size* in any region of the body, produced by some adventitious formation at any period of life. It is the object of morbid anatomy to investigate the

elementary structure of tumors, and by knowledge thus acquired to form a classification of them based thereupon.

Thus M. Broca, in his admirable work, arranges tumors, or, as he terms them, "accidental productions" (p. 140), into four classes: 1st, Homœomorphic productions; 2nd, Heteromorphic; 3rd, Amorphic; 4th, Encysted parasitic animals. The first class he subdivides into two sub-classes—the first, homologous productions, the second heterologous. In the first sub-class he arranges: A, accidental productions formed by the hypertrophic development of organs or their elements; and B, accidental productions of new formation.

Under A he arranges—1, single hypertrophy; 2, partial hypertrophy. The first, as it occurs either diffused or circumscribed; the second, as affecting the skin, the mucous membranes, the glands (adenoma).

B consists of two groups, according as their autogenous elements are compound or simple. In the compound group he places erectile tumors, arterial and venous; hysteronoma, cysts, odontoma. In the group composed of simple elements he includes productions formed of fat, lipoma; bone, osteoma; cartilage, chondroma; fibrous tissue, fibroma; epidermic elements, as corns.

In the second sub-class he places keloid; warty tumors of cicatrices; anatomical tubercle; certain fungus of the dura mater; fibroid; epithelioma; myeloid; simple melanosis; pseudadenoma.

In the second class, which consists of heterologous productions only, he divides into A, accidental productions forming part of the economy; and B, such as do not.

A, includes cancers and tubercle; B, pus.

The third class, amorphous productions, includes simple colloid; syphilitic gum (gommes); fibrinous clots of arteries or aneurisms; cretaceous deposits, atheromatous, calcareous, tephaceous, &c.

The fourth class includes all encysted parasitic animals; hydatids.

The terms "morbid growths," "pseudoplasms," or "neoplasms," have been frequently employed, of late, to denote that division of the class of tumors to which the author of this work refers in this article.]

It is unnecessary to travel over the whole of this extensive subject, because numerous forms of disease ranking as tumors, according to the foregoing definition, have been described in other articles of this work. (See *CANCER*; *EXOSTOSIS*; *NEVUS*; *FUNGUS HÆMATODES*; *MAMMA, DISEASES OF THE*; *TESTICLE, DISEASES OF THE*, &c. &c.)

In this place will be noticed only some parts of the subject, and certain questions, which have not yet been particularly entered into in other articles. In considering all the various tumors and inductions which occur in inflammation and disease, we have reason to suspect that the processes by which they are formed must be attended with considerable diversity. Yet Dr. Armstrong believes that the general principles of morbid changes of structure may admit of being reduced to a small number. Thus, says he, if we take the acknowledged products of inflammation, and to them add tubercle, scirrhus, fungus, and melanosis, we have at once a bird's-eye view of the most important changes which occur in the solids. (See *Morbid Anat. of the Bowels*, &c. p. 1.) Though there is

some truth in this observation, it is far from being sufficiently accurate to bring within its scope a multitude of diseases which are classed as tumors; it seems to me to have proceeded perhaps from an immoderate desire to generalise. Mr. Abernethy thinks that the manner in which tumors are formed is best illustrated by those which hang pendulous from the membranous lining of different cavities. This gentleman adverts to an example noticed by Mr. Hunter, in which, on the cavity of the abdomen being opened, there appeared lying upon the peritoneum a small portion of red blood recently coagulated. This, on examination, was found to be connected with the surface, upon which it had been deposited, by means of an attachment, half an inch long; and this neck had been formed before the coagulum had lost its red colour. (See *Trans. for the Improvement of Med. and Chir. Knowledge*, vol. i. p. 231.) Mr. Abernethy observes, that if vessels had shot through the slender neck, and organised the clot of blood, this would then have become a living part: it might have grown to an indefinite magnitude, and its nature and progress would probably have depended on the organisation which it had assumed. He mentions his possession of a pendulous tumor, found growing from the surface of the peritoneum, and which was undoubtedly formed in the same manner as the tumor noticed by Mr. Hunter, viz. by vessels shooting into a piece of extravasated blood, or lymph, and rendering it a living organised substance (p. 9). Tumors, in every situation, and of every description, are probably formed in the same way. The coagulating lymph being effused, either accidentally or in consequence of disease, is afterwards converted into a living part by the growth of the adjacent vessels, if not the nerves, into it. Mr. Abernethy remarks that "when the deposited substance has its attachment by a single thread, all its vascular supply must proceed through that part; but, in other cases, the vessels shoot into it irregularly at various parts of its surface. Thus, an unorganised concrete becomes a living tumor, which has at first no perceptible peculiarity as to its nature; although it derives a supply of nourishment from the surrounding parts, it seems to live and grow by its own independent powers; and the future structure which it may acquire seems to depend on the operation of its own vessels." Mr. Abernethy conceives that the altered structure of an enlarged gland affords no contradiction to the above account, as, in this latter case, the substance of the gland is the matrix, in which the matter forming the tumor, or enlargement, is deposited.

The structure of a tumor, Mr. Abernethy observes (p. 10), is sometimes like that of the parts near which it grows. Such as are pendulous in joints are cartilaginous, or osseous. Fatty tumors frequently form in the midst of the adipose substance, and he has seen some tumors growing from the palate, which had a slender attachment, and resembled the palate in structure. However, this resemblance of the structure of a tumor to that of the neighbouring part, is not always observable. I had in my own possession a completely cartilaginous tumor, which I found in the midst of the fat near the kidneys. The pendulous portion of fat, growing from the peritoneum, and mentioned by Mr. Abernethy, serves as another instance of the fact. He had seen

bony tumors which were unconnected with bone, or the periosteum; and he observes, that the structure of a tumor is, in general, unlike that of the part in which it is produced. Therefore, he felt warranted in concluding, that in many cases the nature of the tumor depended on its own actions and organisation; and that, like the embryo, it merely receives nourishment from the surrounding parts (p. 11).

Mr. Abernethy suspects, that the irritation of the tumor itself, when once the swelling has been produced, keeps up an increased action in the surrounding vessels, so as to become a sufficient cause of the disease continuing to grow larger. As the tumor becomes of greater magnitude, it condenses the surrounding cellular substance, and thus makes for itself a sort of capsule. The close, or loose, manner in which tumors become connected with the surrounding parts, seems to depend very much on the degree of irritation and inflammation excited in the circumjacent parts. When a tumor has been at all tender, painful, and inflamed, it is generally found intimately adherent to all the neighbouring parts. Mr. Abernethy also believes, that the increased irritation which a tumor creates when it has exceeded a certain size, may explain why some tumors, which are at first slow in their progress, afterwards begin to grow with great rapidity (p. 13, 14).

It appears, then, from the preceding observations, that a tumor is a new growth, or the deposit of an adventitious substance upon, amongst, or within, the textures of the body; the addition being in the latter case made to them in the way of a molecular deposit, whereby these textures or organs acquire increased magnitude, so as themselves at once to constitute swellings, and undergo changes or obliteration of original structure. As an illustration, fungus hæmatodes, or medullary cancer, may be cited, which is a new growth, or deposit, met with in three distinct forms; sometimes as a new product enclosed in a cyst; sometimes as a new formation unprovided with any cyst; and, in other instances, as an infiltration in the substance of an organ. But whoever wishes to pursue this part of the inquiry further, should carefully study *Carswell's Illustrations of the Elementary Forms of Disease*, in which it is most ably considered, as well as works of more recent date.

The process by which tumors are formed has sometimes been thought to be attended with an increased action of the vessels which supply them with blood. It has been compared to the process which forms all the thickenings and indurations met with, under various circumstances, in different parts of the human body; and has often been referred to *chronic* inflammation. This subject of chronic or passive inflammation is one about which, so far as particular forms of it are concerned, very little certain is known; and even the name itself has commonly been admitted only on the supposition that some kind of increased action exists in the vessels, though of a slower and less evident kind than what prevails in acute inflammation. According to Dr. Wilson Philip, the difference between what is called active and passive inflammation seems to depend upon "the degree in which the arteries, supplying the *vis à tergo* to the debilitated vessels, are excited."—(*Laws of the Vital Functions*, p. 202, edit. 2.) If this position be



satisfactorily established, one important step will be made to a knowledge of the differences between acute and chronic inflammation, but much would yet remain for explanation, before our ideas of the latter process would be at all complete.

On this part of the inquiry, different pathologists entertain very different views. Three explanations have been offered of the mode in which tumors originate and grow. "First, the effusion of blood and its coagulation, and the subsequent organisation of the coagulum; secondly, the effusion and organisation of coagulating lymph; thirdly, chronic inflammation." (*Lawrence, Med. Chir. Trans.* vol. xvii. p. 6.) According to these explanations it seems to Mr. Lawrence that tumors ought to pass through successive stages, and to present different appearances at different periods of their development. For instance, we ought to find them at first, as masses of coagulated blood, or coagulating lymph, and then to observe various degrees of transition from those substances to the textures which characterise the perfect growth. But, says he, observation discloses nothing of this kind: tumors, in their earliest state and smallest size, have their peculiar structure as well marked as in their subsequent progress and full development. A fatty tumor, not exceeding the bulk of a pea, differs only in size from one as large as the head. Effusions of blood into the cellular texture from external violence are of daily occurrence: if such extravasations could become organised, and then form tumors, it appears to Mr. Lawrence, that the latter should prevail almost universally. "We see, however, that the blood, thus poured out, either disappears by absorption, or irritates the surrounding parts, and causes suppuration, by which it is expelled." The explanation of the origin of tumors from the organisation of effused blood, seems to Mr. Lawrence to have been suggested by the statements of Mr. Hunter, respecting the production of vessels in coagulated blood, the agency of this process in effecting the union of wounds, and its occurrence in effusions of blood into serous cavities. Mr. Lawrence has never seen any satisfactory proof of blood becoming organised, when effused in wounds, bruises, or into serous cavities, or when deposited in aneurismal sacs. Nothing, he observes, is more frequent than the interstitial effusion of lymph, in consequence of inflammation; the substance "thus poured out is not formed into tumors; it is absorbed as the inflammation subsides, or its partial organisation causes the enlargement and condensation of the affected structure. None of the phenomena usually considered as characteristic of inflammation are observed to precede the formation of tumors. These growths occur insensibly, and often arrive at considerable size before persons are aware of their existence. If the preceding views respecting the origin and growth of tumors were correct, the attempts to check their production and increase by leeches, cold applications, and the antiphlogistic treatment generally, would be rational; we find, however, that such means exert no influence over accidental productions, although they may be employed with advantage in some of the swellings caused by changes of structure; and this marked difference in the effects of treatment is a further reason against confounding together the two kinds of disease." (*Lawrence*, vol. cit. p. 8.)

It would appear, however, that coagula of blood and fibrine are capable of becoming organised under particular circumstances, though, perhaps never, or very rarely, under those adverted to by Mr. Lawrence. Even in the production of some kinds of tumors and new formations, little doubt, I think, can be entertained, that the organisation of these substances, and especially of coagulable lymph, or fibrine, is an essential part of the process. Thus Dr. Carswell, who adopts the expression *analogous tissues*, to signify all *solid, morbid products which resemble the natural elementary tissues* of the body, remarks that they present two important differences in regard to their origin. "The plastic element of the blood, the spontaneously coagulable part of this fluid, or the fibrine, is by far the most frequent source, and furnishes the materials for the formation of the most perfect examples of the analogous tissues. It is to those which have this origin that the term *analogous, accidental, adventitious, or pseudo-formations*, is correctly applied. Another and entirely different origin of many of these tissues, is a change taking place in the primary or existing elementary tissues, and even in organs, by means of which they are converted into tissues of a different kind, as, for example, when cartilage is converted into bone, or cellular into serous or fibrous tissue. The analogous tissues which have this mode of origin, are, in order to distinguish them from the former, called *analogous transformations*." The analogous tissues are subdivided by Dr. Carswell; for he observes, that "although originating in the plastic element of the blood, they may be formed out of this substance, whether it be separated from the blood, and effused on the surface of organs in the state of coagulable lymph, in consequence of inflammation; or whether it be separated from this fluid, which had ceased to circulate in the vessels, or had escaped from them in consequence of mere physical causes. The evidence (says this distinguished pathologist) in support of the doctrine, which maintains that analogous formations may originate in the fibrine of the blood, is derived from the changes which are observed to take place in the blood which has ceased to circulate in the heart or blood-vessels, or which has been effused into the substance of an organ. The cessation of the circulation, which precedes these changes in the blood, may be effected by the operation of mechanical, physical, and vital agents, which act either on the blood itself, or on the vessels in which it is contained. The most obvious examples of the operation of the first kind of agents, are those in which the circulation is at once arrested either in an artery, or a vein, or both, by the application of a ligature; or those in which the blood stagnates in the veins, for example, of the inferior extremities, from a mechanical obstacle to its return situated in a remote part, or in the heart. The first change, which the blood is observed to undergo in these circumstances, is coagulation, the extent of which in an artery is almost always determined by the situation of the first branch of considerable size sent off from the obstructed vessel between the ligature and heart, but which, in the veins, varies with the situation of the obstacle, and the greater or less facilities afforded for the development of a collateral circulation. Whatever may be the extent of the coagulation, the subsequent changes which take place in the blood are

as follow: The coagulum acquires gradually an increase of density, which is accompanied by the removal of the red colouring matter of the blood. The fibrine becomes thus more and more apparent, and is recognised by its pale straw colour, and more especially by the manifestation of its plastic properties, whereby it assumes, almost from the commencement, a laminated or fibriform arrangement. In this, the early stage of what may be called the process of organisation of the fibrine, there is one circumstance, which is peculiarly interesting, not only because it enables us to explain the origin and mode of formation of some analogous tissues, but because it shows that the vital endowments, or plastic properties of fibrine, under the circumstances in which we are now considering it, are of the same kind as those of coagulable lymph, however much they may vary in degree. The circumstance to which I allude, is, the tendency of the fibrine from the commencement to escape towards, and to accumulate at, the circumference of the coagulum, or to place itself in contact with the living tissues which surround the coagulum. It is not only in a blood-vessel that this is observed; it is seen to take place in the cavity of the heart in the formation of what are called polypi, whatever may be their mode of attachment, as well when they occupy the greater part of one of the cavities of this organ, as when they are small, and connected only by a narrow pedicle; and sometimes in large serous cavities in the case of hæmorrhage, when the patient has survived that accident for a certain length of time." (See *Curswell's Illustrations of the Elementary Forms of Disease, Fasc. on Analogous Tissues.*)

In a work of considerable merit, Dr. Baron, of Gloucester, offers many considerations against the correctness of the ordinary doctrines, respecting the formation of tubercles and tumours. By *tubercles*, he means disorganisations composed of one cyst, "whatever be its magnitude or the nature of its contents," and by *tumors* he would understand "morbid structures, that appear to be composed of more than one tubercle." (*On Tuberculated Accretions of Serous Membranes, &c.* p. 213.)

The late Dr. Adams, as is well known, referred cancer to the living state, growth, and multiplication of the hydatid. (*On the Cancerous Breast*, p. 77.) In order to account for the various appearances of the disease, he divided hydatids into a number of species, as *lymphatica*, *cruenta*, and *carcinomatosa*, and suspects that there may be others. These, he affirms, are lodged in different cavities, or enclosed in a fungus, which is occasioned by any individual, or numbers, stimulating the surrounding parts to generate it, for the purpose of dividing the dead from the living. This fungus is a nidus, formed altogether for the protection of another generation; by means of it, the living families are separated from the dead, and their preservation is secured. They die, he says, without otherwise affecting the body in which they existed, but by their local stimulus; and he declares, that his object is to prove the *animalcular existence* of carcinoma. Now, according to Dr. Baron, this main position is the fundamental error of Dr. Adams's book; for, "in no rational nor legitimate point of view may cancer be said to have an *animalcular existence*;

because admitting, for the sake of argument, that hydatids are animalcules, it has, I trust, been shown (says Dr. Baron), that *it is to the loss of the hydatical character altogether, and the transformations of these bodies, that the morbid appearances in this and many other diseases are to be referred.*"—(P. 276.)

Although I consider the evidence and remarks which Dr. Baron has adduced, in support of his opinions, in many respects interesting, the facts brought forward do not appear to me to justify the conclusion, that the formation of tubercles and tumors originally depends upon hydatids and their transformation. That hydatids are sometimes found within diseased structures, and that cells, cysts, granulated and tuberculated appearances, are often noticed in tumors of different kinds, are facts universally received. But, the presence of hydatids in the *unchanged* state is only an occasional circumstance; whereas, if they were generally a cause of tumors by undergoing some unexplained transformation, it is impossible to suppose that some of them, at least, would not be more commonly found in a distinct, unaltered form within or around all swellings, imagined to proceed from clusters of them. As the growth of tumors formed on these principles could not, I imagine, be accounted for, without supposing a continual multiplication and transformation of hydatids, either within or around the swellings, one would expect that some visible hydatids, previously to their transfiguration, would certainly be apparent on minutely examining the interior and the circumference of the diseased structure. Yet I am not aware that such fact has been proved to be generally the case, either with the aid of the scalpel or the microscope. The observation of cavities, cells, and tuberculated appearances, in some kinds of tumors, is no proof that such modifications of structure are transformed hydatids. Besides, if my limits would allow me to consider this topic further, many reasons might be urged against the hydatid doctrine, arising from the consideration of the changes evident in the blood-vessels, supplying parts in which a considerable tumor is situated. Thus, we often see the trunks of the arteries, running towards such parts, doubled in size (as is noticed with respect to the carotid, in the natural growth of the stag's horn), and indicating, at least, that the formation and increase of swellings are effected through the medium of the blood-vessels. The sudden effect of tying the arteries, by which a tumor is supplied with blood, would also be difficult to explain, if the growth of the swelling really depended upon some undefined transformation of hydatids.

[In a paper read before the *Roy. Med. Chir. Society* in 1829, Dr. Hodgkin added to our knowledge of the anatomical characters of some adventitious structures, and in a volume of *Lectures on Morbid Anatomy*, published in 1836, he gives a full description of "adventitious serous cysts," and their mode of development. In the eighth lecture, he carefully discriminates between them and hydatid cysts, tegumentary encysted tumors, cysts formed by the walls of obstructed canals, those formed by the distension of natural cells, and those developed in the thyroid body. He divides them into two classes, the simple, and the compound.

But during the years 1825 and 1827, Raspail



had been working with the microscope, and the results of his observations were the enunciation of the following principle, which we quote in his own words: "Donnez-moi une vésicule dans le sein de laquelle puissent s'élaborer à mon gré d'autres vésicules, et je vous rendrai le monde organisé." (*Répert. gén. d'Anat. et de Phys. path. et de Clin. chir.* t. iii. p. 174.)

The improvements in the achromatic microscope, by the aid of which pathologists were enabled to examine the elementary structure of animal tissues, established an epoch in the science of morbid anatomy.

The observations of Schleiden on the development of vegetable tissues, published in 1838, and the application of the principle he enunciated to that of animal tissues, by Schwann, in 1839, led to the proposal of the so-called "cell-theory." Schwann writes: "One may assert this—that there is one common principle of development for the most diverse elementary parts of organisms, and that the formation of cells is this principle."

He states the process to be as follows: "There is at first a structureless substance, which lies either inside the cells already existing, or between them. In this substance the cells form themselves, according to fixed laws, and these cells develop themselves, in different ways, into the elementary parts of organisms." (*Original*, p. 196.) The substance in which the cells are developed, he terms "cytoblastema," and next considers the laws according to which new cells are generated in it; the process of formation of the cells themselves; and the different ways in which the cells are developed into the elementary parts of organisms. The cell itself is a compound body, and consists of a delicate membrane, enclosing a nucleus, within which are seen the nucleoli.

Genze, in 1837, and John Müller, in 1838, after the examination of morbid growths with the microscope, opened a new path in pathological anatomy.

The elementary structures of some new growths were found to resemble closely those of some of the structures in the body, and besides those perfectly formed, were seen capillary vessels; fibres; granules; cells, with nuclei and without; corpuscles, candate and spindle shaped; vessels; and crystals. Hence Müller writes: "It is evident that no division of pathological structures into homologous and heterologous can be established. The structure of the innocent growths, in respect of their most minute elements and genesis, does not differ absolutely from cancer" (p. 8).

Vogel, in 1842 (*Handwörterb. d. Phys.* b. i. p. 812), appears to agree with this statement of Müller; but, in his *Handb. d. path. Anat.*, published in 1845, where he brings tumors into two grand divisions, from an histological point of view, it is stated otherwise. He considers the homologous tumors innocent, the elements of which correspond histologically with those of the normal body; the heterologous, malignant, the elements of which depart more or less from those of the normal body. (*Bruch*, p. 220.)

It seems to be generally admitted, that the growth of tumors may often be retarded, and that sometimes they may even be diminished, by means of topical bleeding with leeches, and keeping the parts in a continually cool state, by the incessant application of cold sedative washes.

Afterwards, when the increased action of the vessels seems checked, and the tumor ceases to enlarge, discutients are indicated, such as frictions with mercurial ointment, pressure, electricity, rubefacient plasters, solutions of salts, blisters, and issues. Few sarcomatous or encysted tumors, however, are ever completely removed by these local means. The swelling, on the contrary, generally increases, notwithstanding them; and the irritation of the disease by stimulants is not altogether unattended with danger of the affection becoming changed by them into very malignant and dangerous cases, sometimes to all appearances cancerous. The most advisable plan is to recommend the removal of sarcomatous tumors with the knife, while they are small, and in an incipient state; for, thus they may be got rid of by an operation, which is certainly trivial, compared with what might afterwards become requisite, if the disease were allowed to proceed and attain an enormous magnitude.

[More extended experience enables the surgeon of the present day to endorse some of the statements here made. Local applications to *really* new growths are absolutely useless. Various methods of treatment by injections, ligature, escharotics, and local pressure, are described in other articles. A method, recently brought again into notice, of destroying new growths by galvanism, seems likely to be attended with good results.]

**TUMORS, SARCOMATOUS.** These have been so named for their firm, fleshy feel. [The term "histoid growths" is now used instead of sarcomatous.] They are of many kinds, some of which are simple, while others are complicated with a malignant tendency. Mr. Abernethy attempted to form a classification of them, and proposed names for them, deduced from the structure which they exhibit on dissection. Under the title of *Common Vascular, or Organised Sarcoma*, he includes all those tumors which appear to be composed of the gelatinous part of the blood, rendered more or less vascular by the growth of vessels through it. The vessels which pervade this substance are, in different instances, either larger or smaller, and more or less numerous, being distributed in their usual arborescent manner, without any describable peculiarity of arrangement. The structure under consideration is met with not only in distinct tumors, but also in the testis, mamma, and absorbent glands. When a common vascular, or organised sarcoma, has attained a certain magnitude, the veins of the skin seem remarkably large, and their winding course under the integuments excites notice. This kind of sarcoma is not at all tender, so that it may be freely handled and also electrified, without giving pain. The tumor sometimes grows to such a size, that the skin bursts, the substance of the swelling sloughs out, and the disease is got rid of. However, this mode of cure is attended with local effects of so formidable a nature, and so much fever, &c., that the removal of the disease with the knife is to be preferred.

The second kind of tumor, noticed in Abernethy's classification, is the *Adipose Sarcoma* [Lipoma]. Every one in the habit of observing surgical disease, must know that fatty tumors are exceedingly common. Mr. Abernethy believes that these swellings are formed in the same manner as others; viz., in the first instance, they were

coagulable lymph, rendered vascular by the growth of vessels into it; and that their future structure depended on the particular power and action of the vessels. According to Sir Astley Cooper, "they are not composed of fatty matter only; but the adipose membrane is increased, and their structure is similar, only somewhat more compact, to that of the fatty membrane in other parts of the body." (*Med. Chir. Trans.* vol. xi. p. 440.) This fact is entirely opposed to the doctrine which ascribes the origin of tumors to hydatids and their transformation. Adipose tumors always have a thin capsule, formed by the simple condensation of the surrounding cellular substance. It adheres very slightly to the swellings, and, chiefly by means of vessels, which pass through this membranous covering in order to enter the tumor. The vessels are so small, and the connection so slight, that, in removing the tumor, no dissection is requisite, as the operator may easily put his fingers between the swelling and its capsule, so as to break the little vascular connections, and entirely detach the disease. Some individuals seem to have a disposition to the formation of fatty tumors upon various parts of their bodies; a memorable example of which is recorded in the *Revue médicale*. The patient was a young woman, aged 18, whose constitution was not in any way remarkable. Although very lean, and of the middle stature, she weighed 169 French pounds. Between her shoulders were two tumors, eight inches long, and three broad. A third, of less size, was situated near the right arm-pit. A fourth arose from the inferior angle of the shoulder-blade, and was 15 inches long, and six broad. A fifth, lower down, was six inches long, and five broad. The sixth, which was larger than a man's head, was situated upon the right hip. The seventh, a small one, was below the right trochanter major. The eighth, a prodigious one, arose from the left hypochondrium, and hung down as low as the middle of the calf of the leg, being two feet long, and three feet one inch in circumference at its base. All these tumors were of a fatty nature, soft, uneven, and quite unconnected with internal organs, or the muscles. (See *Quarterly Journ. of Foreign Medicine*, vol. iv. p. 618.)

As the substance of adipose tumors is never furnished with very large blood-vessels, the fear of hæmorrhage, which frequently deters surgeons from operating, is quite unfounded. It is an undoubted fact, that there is no species of tumor that can be removed with so much celerity, with such apparent dexterity, or with such complete security against future consequences, as those of an adipose nature. However, now and then, when the tumor has been previously in an inflammatory state, the capsule becomes thickened, and intimately adherent to the surface of the swelling, so that the separation of the disease is more difficult, and requires the knife to be more freely employed. The tumor also sometimes becomes, after inflammation, closely adherent to the contiguous parts. Adipose tumors often acquire an enormous magnitude. Indeed, there can be no doubt of the fact stated by Sir Astley Cooper, that they acquire a greater magnitude than any other swelling ever reaches. Mr. Abernethy relates an example of one, removed by Mr. Cline, which weighed between 14 lbs. and 15 lbs., and which I saw myself previously to the operation. Sir Astley Cooper also mentions the

successful extirpation of several adipose tumors of immense size: one weighing 14 lbs. 10 oz., removed by himself; and another weighing 22 lbs., removed from a lady's thigh by Mr. Copeland. But a still more remarkable case is one in which Sir Astley Cooper removed a fatty swelling, which weighed, independently of the blood in it, 37 lbs. 10 oz., and was situated on the abdomen of a man, aged 57. (See *Med. Chir. Trans.* vol. xi. p. 440.) In the case above quoted from the *Revue médicale*, and recorded by M. Dagorn, of Morlaix, the largest of the swellings weighed, after its removal, 46 French pounds. (See *Quarterly Journ. of Foreign Med.* vol. iv. p. 618.) Although, when adipose swellings attain an enormous bulk, the immense size of the wound requisite for their removal must be dangerous, and is a strong argument in favour of having recourse to the operation at an earlier period; yet it is equally true, that large fatty swellings may be taken out with a greater prospect of success than any other kind of tumor of equal size.

The next species of sarcoma, noticed in Abernethy's classification, is what he names *pancreatic*, from the resemblance of its structure to that of the pancreas. [ADENOMA.] This kind of disease is occasionally formed in the cellular substance; but, more frequently, in the female breast, on that side of the nipple which is next to the arm. Mr. Lawrence has seen many instances of tumors of this kind situated close to the parotid gland, and near the angle of the jaw; and one close to the submaxillary gland. Abernethy likewise mentions one example situated on the mylohyoides. (See *Lawrence*, in *Med. Chir. Trans.* vol. xvii. p. 18.)

[The new growth here described is now more commonly known by the terms adenoid, adenocoele, mammary glandular, or the chronic mammary tumor of Sir Astley Cooper. The growths which Mr. Lawrence here describes generally contain a large quantity of cartilage tissue, in consequence of which they are now usually classed with the cartilaginous growths.]

When a pancreatic sarcoma is indolent, and increases slowly, the surrounding parts and the glands in the axilla are not affected. But some of these swellings deviate from their common character, and become of a very irritable nature, occasioning severe and lancinating pain, and producing an inflammatory state of the skin covering them, so that it becomes adherent to their surface. The absorbents leading to the axilla are also irritated, and the glands enlarged. Pancreatic sarcoma does not grow to a very large size; but, when its progress is unrestrained, the pain attendant on the disease becomes lancinating, and so severe, as to make the patients feverish, and lose their health and strength. Mr. Abernethy remarks that, when the axillary glands become affected, one generally swells at first, and is extremely tender and painful; but afterwards the pain abates, and the part remains indurated. Another is then affected, and runs through the same course.

To another species of sarcoma, Mr. Abernethy applies the epithet *mammary*, from the resemblance which this gentleman conceives its appearance bears to that of the mammary gland. This kind of disease, Mr. Abernethy says, he has not often seen. In the example which he met with, the tumor was about as large as an orange, and situated on a



woman's thigh. The swelling was removed by an operation; but the wound afterwards degenerated into a malignant ulcer, attended with considerable induration of the surrounding parts, and the woman died of the disease in two months. [Probably the growths we describe as recurrent fibroid at this day.] Mr. Abernethy conceives that the whole of the morbid part had been cut away, but that the contiguous parts had a disposition to disease, which was irritated by the operation; and that, if the nature of the case could have been known beforehand, it would have been right to have made a freer removal of the substance surrounding the tumor.

Mr. Abernethy places the mammary sarcoma between those sarcomatous swellings which are attended with no malignity, and the following ones which have this quality in a very destructive degree.

[M. Robin has described, under the term heteradenoid growths, tumors which, although developed in regions destitute of glands, yet possess the structure of glandular parenchyma. They are very rarely met with. See *Follin*, t. i. p. 194.]

The *tuberculated* sarcoma is composed of a great many small, firm, roundish tumors of different sizes and colours, connected together by cellular substance. Some of the tubercles are as large as a pea; others equal a horsebean in size; most of them are of a brownish red colour; but some are yellowish. Mr. Abernethy met with this species of sarcoma chiefly in the lymphatic glands of the neck. The disease proceeds to ulceration; becomes a painful and incurable sore; and ultimately occasions death. [This was probably cancer of the cervical lymphatic glands.]

Another kind of sarcoma, mentioned in Mr. Abernethy's classification of tumors, is distinguished by the epithet *medullary*, from its having the appearance of the medullary matter of the brain. It appears to be an exceedingly malignant disease; communicates to the lymphatic glands a similar distemper; ulcerates and sloughs, and at last proves fatal. It is treated of in other parts of this book. (See CANCER, FUNGUS HÆMATODES, MAMMA, and TESTICLE, DISEASES OF.)

Mr. Abernethy includes also in his classification, *carcinomatous* sarcoma. (See CANCER.)

This last term is not consistent with other names adopted in the classification, which are taken from anatomical comparisons. Abernethy's arrangement omits, likewise, various new growths, which, according to his own principles, are tumors, and ought to have been included, as, for instance, those now frequently called morbid erectile tumors. (See ANEURISM by ANASTOMOSIS, and NÆVI.) Mr. Lawrence has published a description of a tumor which occurs in that kind of cellular tissue which does not contain fat, and which he proposes to name the *cellular tumor*. Like the adipose, it is not attended with pain, may attain a considerable size, and becomes troublesome or dangerous only in consequence of its bulk. A case is detailed, in which such a tumor occupied the labium pudendi and buttock. Between this cellular tumor and the enormous swellings in which the male organs of generation are sometimes involved, it seems to Mr. Lawrence that there is this distinction, that while the former are new productions, rising and increasing insensibly, without local or

general disturbance or pain, the latter are mere enlargements of the cellular and cutaneous tissues, resulting from interstitial deposition, consequent on repeated attacks, or a long continuance of more or less violent inflammation, attended with the usual symptoms of it in the part, and in the constitution. (See *Med. Chir. Trans.* vol. xvii. p. 17.) All hypertrophies of the scrotum would not, however, agree with this description. (See SCROTUM.)

[Certain growths composed of very definite elements have been for some years distinguished by characteristic names from those tumors formed of solid substance, and grouped by Abernethy in his division of sarcomatous and fibro-cellular.

They are termed fibro-plastic, myeloid, recurrent fibroid, and myxoma.

Fibro-plastic growths, plasmoma.—M. Lebert distinguishes three varieties—1, fibro-plastic tissue having an inflammatory origin; 2, fibro-plastic hypertrophy; 3, autogenous fibro-plastic formations. This division, as M. Follin observes, may be very good in a treatise on pathological anatomy, but in a book on pathology it is only necessary to study the tumor composed of an accidental accumulation of fibro-plastic tissue.

They grow in connection with the fibre tissues, and are generally enveloped in a well-defined capsule, often very delicate, however. Their surface, as long as the growth is small, is regular; but when large, marked irregularities arise upon their exterior. They are not very firmly attached to the organs, amongst which they intrude themselves; but they frequently have a basal attachment to the fibrous tissue from which they originate. Their vascular supply sometimes consists of innumerable minute vessels, at other times two or three or more principal trunks run into the mass, and ramify therein. They increase often very rapidly, and when not interfered with attain enormous proportions, weighing many pounds. In their early stage, and when small, they are firm, and resist pressure; but as they increase they become softer and softer, and more and more lobulated. When the integuments covering them, which never become infiltrated with their growth, ulcerate, they form great outgrowths which retain their vitality, and from which serous fluid oozes. A section of one of these tumors is more or less smooth, having, occasionally, here and there spaces or cavities; rather than well-defined cells. It is usually juicy, more or less so according to the quantity of fibre tissue present. The juice is never milky, but clear and pale yellow. Nucleated, oval cells; elongated, fusiform, spindle-shaped fibres, of variable length, and with one or two nuclei and nucleoli, constitute, together with delicate fibre tissue, the elementary structure of these growths.

The clinical history of these tumors deserves close attention. Unlike the growths called cancer, they do not appear to infiltrate organs, or to infect the lymphatic system. Consequently, the neighbouring lymphatic glands are not affected by their proximity. But, like cancer, they enjoy an undoubted tendency to local recurrence; and, even associated with their formation in the extremities, indisputable evidence exists to prove that they may become developed in some of the internal organs after the removal of the first growth.

The treatment of these growths consists in early

excision. This should be done as freely as practicable, and always with that part of the fibrous organ from which the tumor especially springs. When, as becomes sometimes necessary, a portion of a member is sacrificed by amputation, a joint intervening between the locality of the growth and the section of the bone above, the operation may be attended with a good result. The writer has, at this moment, a patient under his observation from whom he removed the leg and a recurrent fibro-plastic tumor, growing close to the knee joint, twelve and a half years since. Amputation was performed through the femur, and there has not been any reappearance of the disease.

*Myeloid growths* are more especially associated with the osseous system. They affect, for the most part, the articular ends of the long bones, more especially in early age, although instances are recorded of their existence in connection with the flat bones, and even the jaws, in the middle period of life. The reader should consult the monographs by Mr. Henry Gray (*Med. Chir. Trans.* 1856, p. 122), and Dr. Wilks (*Guy's Hospital Reps.* 1857, p. 143), in which he will find much valuable information. The distinguishing elementary structures composing these growths resemble those found in the marrow and other elements of bone in the fœtus. Now, these growths, although at first local and entirely removed, as by amputation of a member, may subsequently appear in some distant organ of the body, in another bone for example, without any affection of the stump, or infection of the lymphatic system.

*Recurrent fibroid growths* are chiefly characterised by a large proportion of the fibre element. Their section is, therefore, very firm, with difficulty torn, not very juicy. The distinction is rather in relation to their elementary structure than of clinical signification.

*Myxoma*, a modern term, is applied to those growths which contain, together with a very delicate fibre element, a large proportion of a mucoid fluid, which draws out in threads. Their clinical history closely resembles the fibro-plastic.]

Dr. Warren, of the United States, in a work replete with valuable information, prefers the classification of tumors founded upon the different textures in which they form and grow. I apprehend, however, that this classification will not be found to answer: indeed, Dr. Warren acknowledges certain objections to it; namely, that it is often difficult to ascertain in which texture any given tumor originates, and that the proposed arrangement refers to the same general head, without distinction, malignant tumors, and those free from this character. A third objection, noticed by a critical writer, and perhaps a still more serious one, is the fact, that many tumors consist of morbid products, which affect several tissues indiscriminately, and sometimes simultaneously in the same subject; such, for instance, as the medullary sarcoma, or fungus hæmatodes, which generally affects, not only several different tissues, but several different organs at the same time. But, our knowledge of tumors is still so imperfect, that probably it will be long before a classification of them can be established, even with few defects or inconsistencies. (See *Edinb. Med. Journ.* Oct. 1837, p. 491.)

[*Classification of tumors.*—The following classification of tumors, taking that word in its

widest sense, is based upon their elementary composition, and has been arranged especially with regard to facilitating their diagnosis at the bedside.

The primary divisions are in accordance with their palpable physical characters and the elementary structures of the body.

I. Tumors produced by collections of fluid.

II. Tumors composed of solids.

III. Tumors consisting of fluid and solids in variable proportions.

I. Those consisting of accumulations of fluid are generally composed of one of the ordinary fluids of the body—as, for example, of the blood—*hæmatoma*: a collection of serum in one of the serous sacs, as hydrocele tunica vaginalis; or of serum in a closed sac or cyst, in the connective tissue of the body, as sero-cysts, *hygroma*: of mucus, in association with the mucous glands and ducts, *myxoma*: of a retained secretion, as the milk, *galactoma*: of the products of inflammation, as pus, *pyoma*: of collections of fluid associated with defective development or deformity of bony cavities and canals, as the accumulations of cerebro-spinal fluid in the cephalic and trachidian meningeal sacs: of entozoa cysts, as *echinococcus hominis*, *entozooma*.

II. Tumors composed of solid growths.

A. New growths, neoplasms, histoid tumors, the elementary composition of which resembles more or less closely one or other of the organs or structures of the body in their fully developed state.

1. Fibrous tissue growths, *Fibroma*. 2. Bony growths, *Osteoma*. 3. Cartilaginous growths, *Chondroma*. 4. Fat growths, *Lipoma*. 5. Vascular growths, *Angioma*. 6. Nervous growths, *Neuroma*. 7. Glandular growths, *Adenoma*. 8. Papillary growths, *Papilloma*. 9. Epidermic growths, corns, horns, *Epidermoma*.

B. Growths composed of elements in a more or less rudimentary or embryonal stage.

1. Fibro-plastic growths, *Plasmoma*. 2. Cell growths, as myeloid, *Epithelioma*, *Carcinoma*, tubercle.

III. Tumors composed of both fluid and solid substances.

This composition of a tumor may be its characteristic from the first, as in those growths termed cystosarcoma; but it very often depends upon changes taking place during its progressive increase. For example, in the blood tumors, which, at first fluid, become more and more solid; and the converse, as in some forms of cell growths, when serum exudes from the growth, and a large circumscribed accumulation of fluid, constitutes the most notable feature of the tumor. Also, instances of growths connected with special organs, generally glandular, as in new growths affecting the testis, ovary, mammary gland, and cutaneous follicular tumors. Even hernial tumors belong to this category, as well as hæmorrhoidal growths.

In a clinical point of view, the following classification of tumors is made by Billroth. (*Die allgem. chir. Pathol. & Therapie*, 1866, p. 633.)

1. Tumors of very slow growth, which may exist throughout the whole life without becoming infectious; they are curable by excision, and may make their appearance singly or in indefinite numbers. However, this last condition is not frequent. We designate them especially as innocent or



benign. They consist of simple cysts, lipoma, fibroma, chondroma, osteoma, true neuroma, horny papilloma.

2. Tumors with very great diversity in rapidity of growth, and great proneness to local return; they become rarely infectious, but often appear in great numbers; e.g., sarcoma, adenoma.

3. Tumors of rapid growth, which are always infectious, show not only great proneness to local return, but very frequent infiltration of the neighbouring lymph glands, and successive appearance of many similar tumors in different organs; e.g., carcinoma.

4. Tumors of rapid growth and of very infectious nature, with, not uncommonly, at the same time the appearance of many similar secondary tumors, always very soft; e.g., medullary fungus.]

Besides many operations which have of late years been performed, and are remarkable on account of the great size of the swellings removed, others, still more interesting, claim attention on account of the nature and situation of the parts extirpated. On the excision of the thyroid gland I need not here dwell, as it is elsewhere noticed (see THYROID GLAND); but I feel called upon to mention some other very bold operations, the particulars of which are full of instruction. The first is that performed by Mr. Goodlad, of Bury, in Lancashire. The case was an immense tumor, situated on the left side of the face and neck, and the base of which was about twenty-eight inches in circumference. The disease extended from the external canthus of the eye above to within three-quarters of an inch of the clavicle below, and some idea of the depth of its attachments may be conceived, when it is known that the whole parotid gland was involved in it. For the purpose of obviating all danger of hæmorrhage, Mr. Goodlad began with tying the carotid artery. The nature of the operation will be best understood by adverting to the appearances afterwards presented by the wound. "The whole sterno-mastoid muscle was exposed, and its fibres dissected clean, except about half an inch from its insertion into the clavicle. The wound extended backwards from behind the mastoid process to the trachea anteriorly, but became narrower in the direction of the muscle at the lower part of the neck. The submaxillary gland was exposed, and about one-fifth of its substance not appearing healthy, was removed. The digastric, and the greater portion of the mylo-hyoideus, were exposed. The ramus of the jaw was only covered by periosteum, except where covered by the masseter muscle, part of which, not appearing healthy, was dissected away. The whole of the condyloid process of that bone was laid bare in the same manner, and behind it the pterygoid muscles were also exposed. The membrane of the cheek was only covered by a cellular substance, which did not appear healthy; but sufficient skin was saved to cover the zygoma. *The parotid gland was entirely removed.*" This enormous wound healed in ten weeks; but unfortunately the cure was not permanent; the disease returned, and, fifteen months after the operation, the poor woman died. (See *Med. Chir. Trans.* vol. vii. p. 112, &c. vol. viii. p. 582.)

Respecting the foregoing severe operation, many surgeons may doubt the propriety of tying the carotid artery, as a preparatory step, and, in-

deed, it is positively condemned in an anonymous note attached to the above case; simple temporary pressure on the exposed vessel being represented as preferable.

[Acupressure might be employed instead of a ligature.]

Another interesting case of removal of a large tumor involving the parotid gland, and connected with the transverse process of the atlas, the basis of the skull, the meatus auditorius, mastoid process, and angle of the jaw is narrated by Mr. Carmichael, who, in order to complete the dissection, was obliged to divide the trunk of the facial artery: "Instantly (says he) an alarming gush of blood, which evidently came from a large vessel, followed the division; and the danger appeared the more imminent as the pressure, which Mr. Todd applied with all the force he could exert upon the carotid trunk, was actually incapable of repressing the torrent. There was not a moment to be lost. Mr. Colles plunged a dry sponge to the bottom of the wound, and firmly pressed on the bleeding vessel, while I made a horizontal section of the tumor, till I arrived at the cavities occupied by the sponge, with the view of exposing as quickly as possible the mouth of the bleeding vessel. This was accomplished in sufficient time to save the patient's life." Mr. Carmichael, at the conclusion of the history, remarks that, if he were called upon to perform such an operation again, *he would, in the first instance, pass a ligature under the carotid trunk, which might be tightened, or not, as occasion should require.* The case here spoken of had a successful termination. One remarkable consequence was a paralysis of one side of the face, brought on by the division of the trunk of the portio dura in the operation. (See *Trans. of the King's and Queen's College of Physicians*, vol. ii. p. 101, 8vo. Dublin, 1818.)

The next instance which I shall notice, of the removal of an enormously enlarged parotid gland, is that recorded by Klein, of Stuttgart. The patient was a woman of seventy, and the swelling extended from the ear to the shoulder. In the operation, all the branches of the facial nerve were divided; a piece of the masseter was left hanging; the external carotid artery and par vagum were left quite bare; the dissected sterno-mastoid lay on one side; and the temporal, external maxillary, and auricular arteries, were of course divided, along with several arteries of the neck; the largest of these were tied, yet the bleeding was very considerable. The event was so successful, that in less than three weeks the wound entirely healed.

The same distinguished surgeon also removed a fatty tumor, *extending from the buttock to the ham, and measuring three feet one inch in length, and two feet six inches in circumference.* Klein undertook its removal, on the supposition that it was an encysted tumor lying above the fascia lata; but it turned out to be fat—a lipoma—coming from beneath it, and reaching to the thigh-bone, and in every direction amongst the muscles, nerves, and blood-vessels of the thigh. At length, partly with the fingers, and partly with the knife, the fatty mass was separated from all its important connections. Several vessels were tied, and amongst them the profunda femoris. However, not more than a pound of blood was lost. The tumor, after its removal, *weighed twenty-seven*

pounds and three quarters. The patient, a woman 44 years of age, went on very well for eight days ; but, on the ninth, she was constantly complaining of uneasiness in the foot of the affected limb ; her pulse became weak and intermitting ; and she sank in the most unexpected manner. (See *Journ. für Chirurgie. Herausgegeben von D. L. Graefe und D. P. F. Walther*, b. i. p. 106, &c., 8vo. Berlin, 1820 ; or *Quarterly Journal of Foreign Medicine, &c.*, vol. ii. p. 373, &c.)

In the autumn of 1823, M. Bécлар is stated to have removed the whole of the parotid gland, which is described as being in a truly scirrhus state : the disease, however, returned, and the patient ultimately died of it. (See *Arch. gén. de Méd.* janvier 1824.)

Dr. Warren, of the United States, relates an interesting but formidable case, in which he removed a glandular tumor from the neck, situated so closely to the vessels and nerves that it was difficult to distinguish them. The jugular vein was obliterated, the carotid artery diminished in size, and the pneumogastric nerve so closely mixed with it, that, though separated from, it was not wholly cleared of the tumor ; while the gustatory nerve required to be divided, and the pharynx was opened, yet the patient recovered from the immediate effects of the operation. After an interval of some months, however, ulceration took place, and destroyed the patient, about one year from the date of the operation. (See *Warren, on Tumors, &c.*, 8vo. Boston, 1837.)

[Another case is related by Dr. Warren in which, during an operation for the removal of a large tumor from the cervical region, the internal jugular vein was cut and tied. (P. 182.)]

In the removal of a tumor from the neck, Dr. A. H. Stevens, Professor of Surgery in the University of New York, had occasion also to tie the internal jugular vein at an earlier period than Dr. Warren. "A man of middle age (he states) came under my care in the New York Hospital, during the last winter (1830), with an extensive flattened tumor under the sterno-mastoid muscle, formed of the chain of lymphatic glands, which accompanies the great vessels on the left side of the neck, in a state of great enlargement. It had been the subject of a previous unsuccessful operation, and was then alarmingly obstructing the powers of deglutition and respiration. In the course of my operation for the removal of this tumor, after it had been detached, except at its inner and posterior edge, I drew the tumor outwards and forwards, and divided a vein of considerable size passing horizontally outwards, near its junction with the internal jugular. Half an ounce of venous blood escaped, and in an instant afterwards, a peculiar sound was heard, like that occasioned by drawing into a syringe the last portions of water from a basin. It was a moment of intense anxiety, for the fate of Dupuytren's patient was fresh in my recollection. I immediately placed my finger on the aperture in the vessel, seized the pulse with the other hand, and watched the patient's countenance. All seemed well, &c. After a moment's deliberation, I determined to pass a ligature around the internal jugular, below and above the junction of the wounded branch. It was accordingly separated from the par vagum and carotid with the blunt point of an eyed probe, armed with a double ligature, and one of the

ligatures was secured below, the other above, the wounded vessel. The operation, of which little remained to be done, was then completed. The man suffered from cough and difficult respiration between the fourth and seventh days after the operation, for which he was twice bled, and saline purgatives administered. The ligatures came away on the fourteenth day, and the case went on without any peculiarities.

"If the par vagum can be divided on one side, without endangering life—a question, I believe, not yet settled by positive experiment—the proposition will be established, that many tumors in the side of the neck (the removal of which is now deemed impracticable) may be successfully extirpated." (*Rees's Amer. ed. of this Dictionary ; Supplementary Appendix.*)

I suspect, that many accounts published of the removal of the whole parotid gland did not truly relate to the body itself, certain portions of which seem to be beyond the reach of the knife in the living subject ; for who could cut out the portions of it between the articulation of the lower jaw and the pterygoid processes ? Such accounts, I think, refer to the taking away of tumors which have grown, and more or less displaced, or produced, absorption of the parotid. I find in Liston's *Practical Surgery* several good remarks on tumours formed over the parotid, and behind the ramus and angle of the jaw. "These (says he), whether enlargements of the lymphatic glands, or adventitious formations, are bound down by a strong, condensed, cellular sheath, or fascia, and also by the fibres of the platysma myoides, which pass upon the side of the face. Their growth and prominence externally is equally extensive among the deep-seated parts. The parotid gland is displaced and absorbed ; the diseased mass is imbedded in its substance, and ultimately occupies its place. The vascular supply is abundant, and the nerves become intimately attached to the posterior surface of the condensed cellular cyst. The tumor is firmly fixed in all ways by its strong investments, firm adhesions, and by its being, as it were, dovetailed by its processes between the bones. I have sometimes, after the removal of tumors of long standing in this situation, found exposed the whole cavity betwixt the mastoid process and the ramus of the jaw, the styloid and pterygoid processes, muscles, &c. The interference with these growths (parotid tumors, as they are called, though the parotid gland itself is not very subject to disease) requires no small degree of consideration. If there be reason to suspect that the disease is of a malignant nature, and not strongly limited by a cellular cyst, no interference is admissible. If, on the contrary, it be at all moveable, has advanced slowly, possesses a smooth surface, and is firm (neither of stony hardness nor pulpy), then the operation may be contemplated. A very free division of the superimposed parts is essential to the success of the proceeding. For this object, a perpendicular incision is first made, and others added, so as to form two or more flaps. The incisions must penetrate to the substance of the tumor, and divide its immediate investments ; it being a more easy matter to turn a diseased part out of its cellular cyst, than to dissect that out of the parts to which it adheres, and from whence it draws its supplies.

"The dissection should now be carried deeply



to the lower boundary of the disease, where the vessels are known to enter. These will be at once divided and compressed, or tied, if it be thought worth while, and the vessels be very large; for the fingers of the assistant are in the way of the further and perhaps more delicate dissection. This is pursued much more safely and satisfactorily thus; and it will be found always much better to meet the danger at once, than to be obliged to tie one vessel after another, and perhaps the various branches over and over again, instead of the trunk. Much less blood will be lost; the time occupied in the operation will be abridged; and the pain and suffering very much diminished. The utmost care must be taken to avoid the branches of the cervical nerves, and those of the portio dura, by dissecting the posterior aspect of the tumor carefully, and in the direction of their course, the edge and point of the knife being constantly turned towards the part to be removed; but in some cases of this kind the division of part of the pes anserinus is quite unavoidable; and we have sometimes to decide between leaving part of the tumor, and causing a temporary paralysis of part of the face." (See *Liston's Practical Surgery*, p. 275.)

In the section on *Erectile Tumors*, contained in Dr. Warren's work, several interesting remarks may be found, which, had I been acquainted with earlier, I should have noticed in the articles ANEURISM and NÆVUS. He gives an instance of aneurism by anastomosis, situated near the internal angle of a young woman's right eye, where the anastomosis of the facial, ophthalmic, and frontal arteries takes place, and where the disease produced a pulsating tumor as large as a hazel-nut. The anastomosing branch of the ophthalmic artery was first tied, the facial artery divided, the tumor emptied, and a compress applied over the artery and sac. On division of the facial artery, the pulsation ceased; but there was a return of slight pulsation on the third day. In a fortnight, the tumor pulsated as strongly as it did before the operation, and the carotids throbbed violently, especially the right one. After the trial of some general remedies and low diet for two months, without benefit, Dr. Warren tied the right carotid artery. The pulsations on that side were immediately relieved, those of the left gradually abated, and the operation led to a complete cure.

In the foregoing case, considerable perplexity was occasioned by the pulsations being almost as powerful and distressing on the left side of the head as on the right, so that it could not be foretold whether tying the right carotid alone would have been followed by their cessation, or the left carotid might not also have required the application of a ligature to it. The result seems to Dr. Warren to prove that the pulsations were sympathetic. In this example, it likewise merits notice, that the interruption of the current through the small arteries was not adequate to stop the pulsations of the tumor, nor to check its growth, which could only be accomplished by putting a stop to the stream of blood in the large trunk. From this, however, Dr. Warren does not deem the inference warrantable, that it is necessary, in every instance of aneurism by anastomosis, to tie the arterial trunk from which the nutrient vessels of the tumor proceed. Such trunk might also be tied, and yet the disease not invariably be cured; an

example of which Dr. Warren met with in his own practice. The reason of the difference seems to be, that, in some instances, a cure will not be effected, unless the vessels immediately entering the tumor are secured, and also the large trunk from which they are derived. The first proceeding is rendered indispensable by the free anastomosis of the small vessels of the head and face; and the second by the necessity of excluding the tumor and its nutrient arteries from the constant impulse of the heart, and the influx of blood, until adhesion has been completed. (See *Warren, on Tumors*, &c., 8vo. Boston, 1837.)

With respect to the disputed question, what is the structure of these erectile tumors? I may refer to a very interesting case and observations, recently published by Mr. T. B. Curling. (See *Lon. Med. Gaz. for Aug. 1838*.) From his examination of a large tumor of this kind with a microscope, he found the arteries terminating by direct continuity of tube in the veins, and not in cells, as has been sometimes represented. [Mr. Birkett has described the structure of a subcutaneous nævus in the *Trans. of the Royal Med. Chir. Society*, vol. xxx., 1847, and shown the relation which these new growths have to the fibrous tissues. The fibrous stroma resembles very closely that of the Corp. Caverosa penis, as stated by John Bell (*Principles of Surgery*, vol. i. p. 469).] The erectile tissue, which is one of the analogous tissues of Carswell and other pathologists, is described by the latter as presenting varieties similar to those observed in the natural erectile tissues, sometimes consisting of a spongy or cellular structure, intercepted by fibrous tissue; but, at other times, and most frequently, consisting of an almost inextricable network of arteries and veins, sometimes the one, sometimes the other, of these sets of vessels predominating. In one case, which Dr. Carswell had an opportunity of examining after death, in an infant, the tumors were formed of the dilated extremities of the vessels, some of which were bulbous, sacculated and distended with fluid, or coagulated blood. One of them burst, and occasioned fatal hæmorrhage. (See *Carswell's Illustrations of the Elementary Forms of Disease; Fasc. on Analogous Tissues*.)

In the article, MAMMA, DISEASES OF, I have noticed the little agonising swelling called the *painful subcutaneous tubercle*, which both Sir Astley Cooper and Baron Dupuytren concur in describing as a fibro-cellular, or fibro-cartilaginous tumor, invested by a cyst, situated almost always under the integuments of the limbs, presenting nearly a round shape, and scarcely ever exceeding the size of a pea. According to Dupuytren, it finally undergoes the kind of softening peculiar to cancer; a remark, however, which I do not find agree with the statements of other pathologists, and the correctness of which I have not seen exemplified in practice. Several writers describe the painful subcutaneous tubercle as formed in the texture of nerves, or in the track of them. Thus, M. Antoine Petit, in his discourse on pain, remarks that, on dissection, a white tubercle is met with, covered by a fibrous membrane, commonly adherent to the skin, but loose in the cellular tissue, where it appears to be connected only with filaments of nerves, of which it is the termination. The greater number of swellings of this kind on which he had operated, were in the legs, only one

having been situated on the arm. Cheselden had twice met with a little tumor of about the size of a pea, under the skin covering the tibia, attended with excessive pain, and remarkably hard. The disease was cured by extirpation. (*Anat. ed. 10. p. 136.*) The same disease had been frequently seen by Camper, who represents it as situated within the tunic of the nerves. (*Demonstr. Anat. Pathol. lib. i. p. 11.*) Chaussier also describes this sort of swelling as most frequent in the lower extremities, though he had seen it on the back, and as placed in the course of a nerve, and connected with its filaments. In Mr. Liston's museum, there is indeed a specimen, which corresponds to these accounts. On the other hand, Sir Astley Cooper and Baron Dupuytren concur in the statement, that these painful subcutaneous tubercles are not thus directly connected with the nerves. "I have (says the latter) dissected many in the dead subject with the most minute care; and in order to learn their nature more certainly, I have, in extirpating them, removed, at the same time, a considerable quantity of cellular tissue, but never found the smallest nervous filament adhering to their surface. Their texture is evidently fibro-cellular rather albuminous, and, in time, they become scirrhus." Amongst other particulars he mentions, that, though they are mostly situated in the subcutaneous, or subaponeurotic cellular tissue, they are sometimes noticed elsewhere; and he had seen them in the breast, scrotum, back and face. There are rarely more than one in the same individual. I have now (1838) a male patient at the Bloomsbury Dispensary, who has a painful tubercle of this description close to the nipple. Dupuytren represents this kind of little tumor as being more common in women than men, and between the ages of 35 and 60, than at an earlier period of life. In order to prove further that the swelling is not a disease of a nerve, he relates a case, in which a surgeon divided the infra-orbital nerve for a supposed neuralgic affection of the face; but, instead of being cured by this measure, the disorder became much worse. Dupuytren detected a painful subcutaneous tubercle in the cheek, removed it by excision, and the patient was immediately cured. "It is manifest (says he) that if the tubercle had been formed of the nervous filaments of this branch of the fifth pair, or had been specially applied to it, the division of the nerve would instantly have put a stop to the pain; on the contrary, it continued, grew more severe, and only terminated with the existence of the tumor." In another case related by Dupuytren, the tubercle did not become painful till after a lapse of seventeen years. He asks, could this have happened had it been formed in the track or substance of a nerve? In another instance, the tubercle was only painful when pressed, and the pain did not extend towards the fingers, but the trunk. He gives an instance, in which one was occasioned on a shoemaker's finger, by the prick of an awl, (See *Dupuytren, Clin. chir., t. i. art. 18.*)

**TUMORS, ENCYSTED.** These, which are commonly named wens, consist of a cyst, which is filled with different substances. When the contained matter is fatty, the swelling is termed a *steatoma*; when somewhat like honey, *meliceris*; when like pap, *atheroma*. These are the three species into which writers usually divide encysted tumors. However, some of these swellings do not conform

to either of the above distinctions, as their contents are subject to very great variety indeed, and are occasionally of an earthy, bony, or horny nature. Some encysted tumors of the latter description occasionally burst, and assume the appearance of horns, by the gradual projection of the matter secreted within their cysts. (See *Sir Everard Home's Obs. on the growth of horny Excrescences, in Phil. Trans. for 1701.*) In the year (1824) I attended, with Mr. Drew of Gower-street, a medical gentleman, from whose nates I removed a swelling of this nature, which had become very troublesome, in consequence of its pressure making the parts around its base inflame. It had been cut off many years ago by another surgeon, but grew again. At present (1838), there is no appearance of its reproduction, against which I guarded by carrying the incisions very deeply. I saw an excrescence of this kind removed some years ago from the scrotum of a man in St. Bartholomew's Hospital. Sir James Earle performed the operation; and if I am not mistaken, the preparation of the disease is now in the museum of that Institution. But, still more remarkable specimens of such excrescences are preserved in the Anatomical Museum of St. Thomas's Hospital; one in particular, which resembles a ram's horn in shape, and was removed from a gardener's head, by Dr. Roots, of Kingston. A further account of the case is given in Rees's Cyclopædia, article *Horny Excrescence*.

I suppose everybody in London has seen in the British Museum the horn deposited there as a curiosity, and which, with another of the same size, grew upon the head of a human subject. What is equally curious, hairs are not unfrequently found growing in the cavities of encysted tumors (*Delpech, Précis des Mal. chir., t. iii. p. 412*); and even teeth, more or less perfectly formed, have been strangely met with in the same situations. An interesting specimen of the latter occurrence, in a double encysted tumor in the orbit, was published some time ago by my friend Mr. Barnes, of Exeter. (See *Med. Chir. Trans., vol. iv. p. 316.*)

It is observed by Sir Astley Cooper, that it is when encysted tumors are situated upon the temple, and near the eyebrows, and other hairy parts, that they sometimes contain hairs: these "have no bulbs, nor canal, and differ therefore from those which are produced on surfaces of the body, which naturally form hair." In sheep, the cysts sometimes contain wool. (*Surgical Essays, part ii. p. 233.*) The manner in which these horny excrescences are produced is stated to be as follows: "The horn begins to grow from the open surface of the cyst; at first it is soft, but soon acquires considerable hardness; at first, it is pliant, but after a few weeks, it assumes the character of horn." (*Vol. cit. p. 235*; see also *Home, in Phil. Trans. for 1791.*)

Encysted tumors are generally of a roundish shape, and more elastic than the generality of solid swellings. However, the latter circumstance depends very much upon the nature of their contents, and the thickness of their cysts. So far as my observation extends, encysted tumors form more frequently on the head than any other part; but they are very frequently met with in all situations under the integuments, and sometimes in deeper places. Encysted tumors are likewise often seen on the eyelids. They are in general



nearly globular, and, when seated on the head, feel very firm, but upon the face they are attended with a fluctuation, more or less obscure. The skin covering them is generally uninfamed; but it is now and then streaked with blood-vessels, which are larger than those of the surrounding integuments. "In the centre of the tumor, on the skin, it often happens that in its early state a black or dark-coloured spot may be seen, which sometimes continues through the whole course of the disease. In general, they are unattended with pain, are never in themselves dangerous, and only require removal from the parts in which they occur, on account of the unseemly appearance they produce. They move readily within the cellular membrane, if they are free from inflammation, but the skin in general does not easily move over them." (*Sir A. Cooper, Surgical Essays*, part ii. p. 230.) The greatest number of encysted tumors, which this experienced surgeon has met with in the same individual, was sixteen, situated upon the head; and he has seen nine in another patient, as many as which number on one person I have seen myself. Four, five, and six, as Sir Astley remarks, are not uncommon. The largest which he has ever seen was equal in size to an ordinary cocoa-nut, and grew upon the head; but in general they are not more than one or two inches in diameter. He considers them in some degree hereditary, as he has often heard a patient observe, "I have several swellings upon my head, and my father (or my mother) had several." They also frequently occur in several members of the same family. (P. 231.)

According to Sir Astley Cooper, when encysted tumors are dissected, some part of their surface is found firmly adhering to the skin, while other parts are connected to it merely by the cellular membrane. The cyst itself is embedded more or less deeply in the cellular membrane, and its thickness is different in different parts of the body. On the face, or near the outer canthus, the cyst is very thin; but on the back it is much thicker, and on the head it is so thick and firm that it retains its form after the discharge of its contents, and is so elastic that, after being compressed, it readily expands again to its former size. Within the cyst, Sir Astley Cooper remarks, there is a lining of cuticle, which adheres to its interior, and several desquamations, of the same substance, are formed within the first lining. If the vessels of the cyst are injected, they are found to be numerous, but of small size. The cysts are occasionally met with in an ossified state. (*Surgical Essays*, part ii. p. 232, 233.) The investigations of Sir Astley Cooper prove that many encysted tumors arise from the enlargement of the follicles, or glandular pores, in consequence of the obstruction of their orifice. (P. 236.) This view furnishes another consideration against the view taken of the formation of tumors by Dr. Baron.

Sir Astley Cooper was so obliging as to present me with two preparations, in which this origin of two superficial encysted swellings is very manifest. These specimens I have placed in University College Museum. I have also to thank him for his kindness in showing me two cases, in which the fact of there being an opening in the skin, communicating with the cavity of the swelling, and giving occasional exit to its contents, was completely evident. I frequently meet a surgeon who has had for some years an encysted tumor on the

cheek, and in whom the small black point on the centre is very conspicuous. Of course, it is not intended that this doctrine, concerning the origin of an encysted tumor, should extend to the formation of cysts in general, which often present themselves, not only with great diversity of structure, but under circumstances in which their beginning could not possibly be accounted for by the obstruction of the orifices of any sebaceous follicles.

As all Sir A. Cooper's opinions on surgical questions are deservedly valuable, I subjoin the advice which he has given, founded upon the preceding doctrine. If the follicle can be seen only as a black spot, filled with hardened sebaceous matter, he recommends a probe to be passed into it, and the sebaceous matter to be pressed out of the tumor, which is done with little inconvenience. But, if the contents cannot be pressed out without such violence as would create inflammation, he says, that the best plan is to make the opening larger. Other surgeons have tried to cure encysted tumors by pricking them with needles, and squeezing out their contents; by opening them more freely, and filling them with lint, or charpie (*Delpsch, Clinique de Chirurgie*, t. ii. 1828); or by applying stimulating and discutient applications to them. However, some of these plans mostly fail, and the others have been known occasionally to convert the case into a terrible disease, in which a frightful fungus shoots out from the inside of the cyst, attended with immense pain and irritation, and even proving fatal. (See *Abernethy's Surgical Observations*, 1804, p. 94.) Similar dangerous fungous diseases may also arise, whenever the surgeon, in cutting out encysted tumors, leaves any part of the cyst behind.

The most advisable method, I believe, is to have recourse to the knife, before an encysted tumor has attained any considerable size. However, if it be large at the time of the operation being done, a portion of the skin must be taken away with the swelling, in the manner described in the article MAMMA, REMOVAL OF. The chief piece of dexterity in the operation consists in detaching all the outside of the cyst from its surrounding connections, without wounding it. Thus, the operator takes the part out in an entire state, and is sure that none of the cyst remains behind. When the cyst is opened, some of the contents escape, it collapses, and the dissection is rendered more tedious and difficult, but sometimes more easy.

Sir Astley Cooper believes, that the best manner of performing the operation is to make an incision in the swelling, and then to press the sides of the skin together, by which means the cyst may be easily detached and removed. If the attempt be made to extract the tumor whole, "the dissection is most tedious, and, before it is completed, the cyst is either cut, or burst. So many incisions and so much pain may be readily prevented by opening it freely by one incision, raising its edge between the forceps," and dissecting it from its adhesions to the surrounding membrane. (*Surgical Essays*, part ii. p. 240.) When the swelling is in the scalp, Sir Astley directs an incision to be made through its centre, from one side to the other, when its contents, which in this situation are very solid, are immediately discharged in a mass of the same shape as the tumor. The cyst being raised with a tenaculum, may then be easily separated. When the foregoing difficulties are likely to be encoun-

tered, one writer suggests the plan of first opening the cyst, washing out its contents, and then injecting into it a thin mixture of sulphate of lime, which will immediately harden, and facilitate the excision of the cyst. (*McGhie*, in *Ed. Med. Journ.* No. lxxvi.) This proposal, though ingenious, is not likely to be adopted, because the operation, which is generally easy enough without it, would thus be rendered long and complex.

I shall conclude the subject of tumors with a few observations, delivered by Sir Astley Cooper and Professor Langenbeck. "The removal of encysted tumors (the first gentleman observes) is not entirely unattended with danger. I have seen three instances of severe erysipelatous inflammation succeed the operation of removing these swellings upon the head, and, I believe, it is owing to the tendon of the occipito-frontalis being wounded in the attempt to dissect them out whole." (*Surgical Essays*, part ii. p. 241.) I have witnessed several fatal cases of the same kind.

[Doubtless, the most trifling surgical operations are sometimes followed by erysipelas, but we are not aware that the removal of an encysted tumor of the scalp is more likely to be followed by that disease than operations in other parts. We consider that the above remarks, by a surgeon of such great repute, are calculated to excite unnecessary alarm.]

In the extirpation of tumors about the neck, Langenbeck adopts the following rules: he makes a free division of the integuments, and dissects the muscles from the tumor, which lie over it, but he avoids cutting through, or injuring them; in this manner, the swelling is rendered more moveable. By the situation of the muscles, he is then enabled to know the place of the chief blood-vessels; and, on this account, he particularly advises young surgeons to study myology with the greatest care. It is indeed an important advantage after a muscle has been exposed, to know what vessels lie at its edges, or underneath it. Thus, the sartorius is a sure guide to the crural artery, and the sterno-cleido-mastoideus to the carotid. A surgeon who knows correctly the anatomy of the parts, will not be in danger of wounding unintentionally any large vessel. When the surface of the tumor has been cleared, but the base of it is yet firmly attached, Langenbeck commences the separation on the side which presents the least risk, that is, where the least considerable blood-vessels are, and thence he proceeds, by degrees, towards the most hazardous side. In favour of this method, he offers the following considerations: if, by chance, an artery, requiring a ligature, should be cut, it can now be more easily secured, as the base of the tumor is already partly detached. The loosened swelling may also be drawn away from the large vessels with the hand, or a tenaculum. Langenbeck never introduces the knife deeply, when there are large blood-vessels there, but pulls the swelling outward, and then divides the cellular tissue, thus stretched, which is situated upon the already exposed portion of the tumor. In this manner, the swelling can always be drawn more and more away from the vessels, until, at last, there is no danger of wounding them. By attending to these principles, Langenbeck has succeeded in removing many very large tumors from the neck, where nearly all the muscles of that part were ex-

posed by the dissection, and the carotid denuded. After one of these operations, not only the styloid process could be felt, but all the muscles originating from it could be distinctly seen. (*Bibl. für die Chir.*, b. ii. p. 312, &c. 12mo. Göttingen, 1808.)

*John Birkett.*

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The reader will find references to books on special tumors in the Bibliography at the end of the articles on "Cancer," "Dis. of Mammary Gland," &c.]

**TUMORS OF THE EYELIDS.**—[Cysts in the skin are often observed, especially in elderly people. They appear as little, watery-looking, roundish tumors, single or in groups, along the outer edge of the lid. Some reach the size of a hemp-seed.

The milium is a small, yellowish white and opaque tumor (nodule), of the consistence of cartilage, projecting among the eyelashes, from the margin of the tarsus. Several milia are generally present simultaneously. On minute examination, we find the milium consists of concentric layers of cells.

**Treatment.**—Cyst and milia have been removed successfully for reasons of appearance, or on account of their irritating the cornea. The same applies to warts.

The **MOLLUSCUM** (glandiform, albuminous tumor) is more whitish than the milium. Its surface is shining, slightly nodular, and projects from the skin, which over the large one is somewhat vascular. It may reach the size of a large pea. When squeezed, some milky fluid escapes through a small opening on its surface. It occurs frequently in children, together with other ones in the skin of the lips, nose, &c., and is believed to be the result of a change caused through some animalcule having become lodged in a sebaceous follicle.

**Treatment.**—With a cataract knife, we divide the little tumor into lateral halves, then nip it well with a forceps, or between the thumb nails, and thus squeeze out the halves of a whitish, nodular, solid substance. The empty bag of loose skin is left. Return of the tumor has occurred, if it has not been squeezed out thoroughly. All present about face or lids should be removed at one

sitting. The molluscum can always be removed in this manner; not so the milium.

**Tarsal Tumor.**—(Encysted tarsal tumor, cysts in the tarsus, chalazion.)—One or several tumors may occur in the same eyelid. They are the result of morbid changes of the glands within the tarsus, and are often preceded by inflammation. (Sties). The tumor is usually situated near the inner surface of the tarsus, sometimes with few granulations round an opening of perforation in the adjoining conjunctiva. But even when projecting from the anterior surface of the tarsus and bulging the skin, can its position readily be recognised, on everting the eyelid, by a darkish grey red spot on the inner aspect of the eyelid, covered with abnormally vascular conjunctiva, indicating the place where the tarsus covering it is thinnest.

**Treatment.**—Derangement of the functions of the eyelid or of the cornea, or reasons of personal appearance, may require the removal of the tumor by operation. If several are present, they should be removed at the same time. The patient seated in a chair rests his head against the operator's chest (who stands behind). The hands and eyelids of the patient must be secured. The tumor is not removed through the skin; but through the conjunctiva, by everting the eyelid, and with a narrow pointed knife making an incision through the abnormally vascular conjunctiva and through the grey red thinner portion of the tarsus. The knife, if the cyst is near the anterior surface of the tarsus, may have to pass through the entire thickness of the tarsus. The texture of the tarsus being very dense, some force has often to be used, to carry the instrument through it, into the tumor. The incision made parallel with the margin of the lid should be equal in length to the greatest diameter of the tumor, as felt through the skin. A cross incision is sometimes necessary if the tumor is large. Generally some serum, pus, or grey gelatinous substance escapes at once. A small scoop is then carried along the surface of the tumor, with a view to separate the bulk of it from the surrounding tarsus. If this should not succeed, or the contents be fluid throughout, then the scoop is turned rapidly about, to break away the gelatinous contents from the walls of the cavity. This must be continued until all appears to have escaped. Blood frequently fills the cavity, and the tumor often appears even larger than before the operation. This merely retards the recovery. Through not having removed all the contents, we are sometimes compelled to use the scoop a second or third time; which does not occur, if the operation is performed thoroughly at first. Cold water dressing is applied to the lids, for a few days.

Sometimes ten weeks elapse before the tumor or the hardness have disappeared completely. No second operation should be performed, as long as the tumor gets smaller.

The **SEBACEOUS** tumor is generally observed in children. It is congenital, and almost always situated beneath the skin, near the outer and upper margin of the orbit. It sometimes reaches the size of a small walnut, and if large is in part adherent to the skin. The latter usually has its natural colour, sometimes it is vascular where the tumor is adherent; in rare cases a small opening in the skin leads into the tumor, which, when pressed open, gives vent to some sebaceous matter of unpleasant smell. The matter is enclosed

within a bag of varying thickness, together with hair, of the shape and often of the colour of the eyebrows. These may be found attached to the sac, or be curled up and mixed with the sebaceous matter.

Old tumors of this kind contain a yellow oily substance enclosed in an often extremely thin bag of fibrous tissue. The tumor is the less moveable the more extensive its adhesion is to the perioste of the orbit.

*Treatment.*—The tumor has to be removed by operation, which, if performed thoroughly, is always successful. It rarely suffices to puncture the cyst, and to cauterise its interior. Chloroform should be administered, the operation being a tedious one, and accompanied with troublesome bleeding. Two assistants are required. The incision, if possible, should be made parallel with the margin of the orbit, by raising the skin over the tumor into a fold and dividing it. It should always be sufficiently long to give easy access to the tumor. If the latter is large a cross incision is required, or an elliptical one if the skin is adherent to part of the tumor, so as to carry it near the adhesion. To avoid a return it is necessary to remove the walls completely, which should be done by carefully dissecting out the tumor without opening it. A forceps to fix the tumor, and a cataract knife, or better, strong narrow-bladed pointed scissors, are used for the dissection, while a continuous good view of the tumor must be obtained by having the large skin incision kept open, and the blood properly sponged away. After having separated the adhesions of the tumor to the skin and other soft parts up to its greatest circumference we separate its attachment to the perioste, which sometimes is broad, sometimes has the form of a pedicle. The white sebaceous matter escapes, if the tumor has been opened during the operation, which renders the complete removal difficult. Portions left behind should be touched with nitrate of silver. Incisions through the suspensory ligament, sometimes with removal of portions of fat of the orbit, may readily be avoided by dissecting close to the walls of the tumor. The wound being deep and lacerated, some suppuration generally follows; lint dipped into cold water is applied as frequently as it is pleasant to the patient. We may, to hasten union, insert one or two sutures near the corners of the incision. The wound heals in from five to seven weeks. The cicatrix is scarcely perceptible, and no other disfigurement follows the operation.

*Nævus* about the eyelids occurs frequently. One or several may be found in the same eyelid; or it may extend from the eyelid into the orbit. The appearance and symptoms are similar to those which occur in other parts of the body. It generally, if left alone, increases to a certain size, and then remains stationary, or becomes smaller.

*Treatment.*—Ligature or injections with the tincture of perchloride of iron have been followed by sloughing of the eyelid. The safest and quickest, the size and situation of the *nævus* permitting, is completely to remove the *nævus* by operation. Next to this can be recommended the insertion of stout silk threads, previously moistened with the tincture of perchloride of iron.

Due regard must be paid to the portion of the eyelid we operate upon, to avoid disfigurement, displacement, &c.

*LUPUS* has been observed, in various stages in the eyelids, either extending from the face or commencing in the lids (generally along their margin). Its extension to the eye or to the orbit has caused death in several instances. It differs from epithelial cancer by generally appearing in young persons of otherwise good health, by spreading over large surfaces (different stages of the *lupus* being present simultaneously) by its peculiar star-shaped cicatrices, by the absence of pain, and by its curability.

*Syphilitic ulcers* are, as a rule, primary, and commence as infiltrations at the margin of the lids.

Syphilitic nodes, from their chronicity, hardness, and, if ulcerating, from the dirty appearance of the ulcer, can hardly be mistaken for cancer nodes. The local application of mercury is found of great use.

*Cancer of the Eyelids.*—The medullary and melanotic form are rare primarily. Small hard nodules of both forms, springing from the margin of the tarsus, have been removed by excising a V-shaped portion of the entire thickness of the lid including the cancer. Both forms are not unfrequently secondary, extending upon the lids from the eyeball or orbit.

Epithelial cancer appears in two forms—either as so-called alveolar cancer, or under the form of small roundish hard nodules. The nodules situated in the skin of the lid, or over the lacrymal sac, extending from the inner canthus towards the nose at a later period become covered with yellow crusts, and overrun by enlarged veins. Beneath the crusts we find an ulcerating surface with irregular outline, and everted margins secreting but little pus, &c.

The alveolar cancer appears either as a defined tumor, or as ill-defined infiltration of the skin. The latter form is less common, and occupies the skin, or commences beneath it, and is painful to the touch. The dark red, nearly flat surface of the cancerous infiltration, after some weeks, becomes ulcerated; crusts appear with an offensive purulent discharge. The edges of the ulcer are swollen, roundish, and nodular.

Epithelial cancer has been mistaken for *lupus*. It may exist for years. In the alveolar form the neighbouring glands are much sooner affected. Cases have occurred in which the eyeball was destroyed by numerous attacks of inflammation, in several inducing perforation of its tunics, escape of the vitreous, and shrinking.

*Treatment by operation.*—The cancer, if small, confined to the skin, and in a strong patient, may be removed by operation. The loss of substance is covered by skin transplanted from healthy neighbouring parts. A much more rapid progress of the cancer must be expected, if an operation be performed, once the glands are implicated.

*By the application of a paste made with starch and chloride of zinc.*—Care must be taken that the paste does not touch the eyeball. A layer of the paste is spread over the surface of the ulcer, its margin, and over a narrow strip of the adjoining healthy skin, sufficiently thick to hide these parts from view. The paste temporarily destroys the growth, and a cicatrix forms. The application is repeated whenever any part of the margin of the ulcer shows an inclination to extend or when fresh nodes appear. The general health of the patient should be well supported.



XEROSIS signifies a peculiar alteration or even destruction of the secreting power of the conjunctiva, thorough destruction, or obliteration of its glandular structures, and of the tear-ducts opening upon it. The conjunctiva assumes an opaque fibrous appearance; its surface becomes covered with dry epithelial scales, with fat and with particles of chalk. This form by some is termed Xerosis Squamosa, to distinguish it from a condition called Xerosis glabra, in which the surface of the altered conjunctiva is moistened by tears. Sometimes only a narrow dry and opaque band of conjunctiva is left, which, extending from the margin of the eyelids to the eyeball, completely prevents the movements of the eye. Thickening and distortion of the tarsus and inversion of the eyelashes are usual complications.

The surface of the cornea, the curvature of which may be good, is dry, covered with crusts, epithelial scales, and with a semi-transparent cuticle.

Xerosis occurs after long-continued or badly-treated ophthalmia, especially diphtheritic or granular.

Entropion, Ectropion, or Trichiasis, chemical injuries and burns, are the usual causes. No curative treatment is known. Frequent washing with warm milk, or the application of glycerine, may be found beneficial.] *C. Bader.*

**ULCERATION AND ULCERS.**—[Ulceration is a result of inflammation, and consists in the molecular death and removal by minute disintegration and solution of the superficial vascular particles of the inflamed part. There is a minute atomic division of the particles of the affected tissue, and these molecules are removed in the "ichor" or discharge which escapes from the surface of the sore or "ulcer" which forms. The terms desquamation, or excoriation, or abrasion, are applied to the removal of epithelium alone, while ulceration implies a deeper penetration of the destructive action. Inflammation, if it does not destroy, greatly weakens the vitality of the tissues it invades, and the effusions or exudations which result from inflammatory action have a like influence, so that the liquefaction or disintegration of the structure is powerfully promoted. Dissolved or floated in the ichor, the eroded tissue escapes, and can by its chemical or microscopic characters be occasionally detected,—not, perhaps, in its proximate, but in its ultimate, elements. There seems also good reason to believe that the ichor, when formed, conduces to the further disintegration of the structure, especially in some forms of ulceration; and this may either be due to the influence of the ichor in maintaining or relighting the inflammation, or from its exerting a quasi-solvent or catalytic action on the weakened particles. Hunter, in his celebrated Treatise on Inflammation, ascribed the removal of the tissues in ulceration to absorption, which he supposed was accomplished by the absorbents. "Ulcerative absorption" came thus to be spoken of, and it was in a great measure confounded with "interstitial absorption." Suppurating wounds, too, and ulcers were for long held to be synonymous, and in truth the doctrine of ulceration underwent various changes along with the varying phases of medical belief.

Ulceration begins by the death or sloughing of a minute point, and the establishment thereby of a breach of surface. From this point the destructive

action extends in the weakened tissues around, and the broken-down particles are thrown out from the surface of the sore which is thus formed. The death of the initial point may be brought about either by violence, by chemical agency, by extreme heat or cold, by acute inflammation anyhow produced, by the presence of some specific deposit, or by the bursting of a vesicle or pustule, or, in short, by any cause which is capable of breaking the surface. The ichor, or discharge, containing as it does the detritus of the dissolved tissue, may in certain specific sores, be capable of inoculation. It is thin, serous, and sanguineous, and loaded with the elements of the liquefied structures, though it will vary in its character with the nature of the sore—its cause and progress—from which it comes. This ichor often smells badly when decomposition is active, and it presents none of the features of healthy pus till the breach of surface from which it flows begins to heal.

When ulceration ceases, and the inflammation on which it depends has disappeared, the breach of surface left is repaired by the effusion and organisation of lymph, *i.e.* by granulation. Pus takes the place of the ichor, the weakened tissues gradually recover their vigour as their nutrition is restored, and a healing granulating wound takes the place of the ulcer. Finally, the sore cicatrises, and a mark of greater or less dimensions, and occasionally of a characteristic shape and appearance, remains at the seat of the ulcer.

It is in vascular structures, and especially in those distant from the centre of the circulation, that ulceration is apt to occur. The skin, mucous membranes and cellular tissue are liable to be so affected; while muscle, bloodvessels, bone, tendons, ligaments, nerves, and cartilages are much less apt to be the seat of such action. Newly-formed textures, such as cicatrices, callus, &c., are easily made to ulcerate.

Ulceration may be acute or chronic in its progress, according to the nature of the inflammation which preceded it, the nature of the exciting cause, and the condition of vital vigour of the part attacked. A part which has been long congested, or the seat of inflammatory deposits, is often rapidly broken down by ulceration.

Ulceration, then, being a result of inflammation, recognises the same predisposing and exciting causes. Anything which lowers the vitality of the part by interfering with its nutrition would render it liable to ulceration. If the blood circulating in the part is unfit either in amount or composition for its requirements, if it does not circulate healthily, if the innervation is feeble, if the atomic elements of the parts are so changed as not to be able to make good use of the blood and nerve force supplied to them, then a diminished vitality would be established, and a liability to ulceration arise, which may be called into activity by a very slight exciting cause. It is by interfering with the nutrition of the tissues that certain specific diseases—such as syphilis, scurvy, and scrofula—predispose to ulceration; and that starvation, or the prolonged use of unsuitable food (such as the exclusive employment of non-azotised materials), and lowering or weakening ailments of all kinds, tend to produce the same result.

When "sloughing" is combined with ulceration, the degenerated tissues separate in visible masses, as well as being partially dissolved and

discharged as ichor. In this way "sloughing ulcers" form. "Phagedænic ulceration" again means much the same thing. The tissues die so rapidly, that they separate in mass and disappear as if quickly eaten or consumed away. In "gangrene," the most destructive of all the effects of inflammation, the part dies throughout its whole thickness—the action is essentially the same, only much more rapid and severe.]

**ULCERS.**—[These are the sores which form as a result of ulceration. Boyer used the term in a wider sense, and his definition has been in a great measure adopted by systematic writers. He says:—"An ulcer is a solution of continuity of the soft parts, more or less ancient, accompanied by a discharge of purulent matter, and maintained by a local vice or an internal cause."]

We have two stages in the history of an ulcer which are distinct, and not unfrequently separated by a third, or condition of quiescence or rest. During the first stage they spread or enlarge, while during the second they heal. The first is the true ulcerative stage, when destruction predominates; the second is the period of repair, when healing or cicatrisation is in progress, and we find lymph deposited and becoming organised into new tissue. The period of quiescence which interposes may be of greater or less duration, being at times little observed, and at others so prolonged as to extend over a lengthened period.

When an ulcer is spreading, the signs of inflammation will be more or less evident around it; and, as a rule, the more they are marked, the more rapid will be the destruction of tissue. Heat, pain, redness, and swelling will be present, and the ulcer will deserve more or less the designation of "inflammatory." In general, the inflammation which attends spreading ulcers is of a low type, and marked by dusky redness and dull pain, while œdema and increased heat are also present. Occasionally the inflammation is eczematous, and cracks form, giving out a thin or gummy discharge, and causing much itching and discomfort. A spreading sore has irregular edges, as a rule, and a greyish adherent slough. The more rapid the destruction, the less will the discharge partake of the character of healthy laudable pus. When the spreading stops, and the stage of rest or cessation occurs, the signs of inflammation having disappeared, the slough separates or is broken down in the discharge, the pain diminishes, the appearance of the edges and surface improves; and so the period of repair is slowly established by the effusion of plastic lymph on the surface and edges, the organisation of that lymph into granulations, and the final closure of the wound by the coalescence of these and the formation of tissue. The edges get rounded off, and are approximated more or less to one another; pus takes the place of the thin ichorous discharge, and the ulcer becomes a "healing sore." Ulcers, then, heal mainly by granulation, but their repair is materially aided by the approximation of their sides or edges, and it is in order to assist these two processes that our curative measures are directed. The smaller the cicatrix which remains after healing, the less is the risk of the sore becoming re-established.

The plastic lymph deposited on the surface and edges of a healing sore becomes vascular by the extension to it from neighbouring vessels of outgrowing arterial loops. The lymph soon assumes

the papillary arrangement so characteristic of granulations; these become converted into fibro-cellular tissue, and finally get covered with skin, by which the integrity of the part is restored. The appearance of the granulations will vary considerably, according to the blood supply, &c., and such appearances will convey to the instructed attendant most important information, not only as to the tendency of the sore to heal, but also as to the state of the patient's health and the condition of the part in which the sore is situated; and it is this frequent changing with the temporary conditions of the patient's health that is one reason why the characters of ulcers are often so various and confusing. When the sore is healthy and tending to heal, the granulations are small, red, acuminate, sensitive, close-set projections bathed in creamy pus. They grow to a level with the edges of the sore (which, if formerly elevated, subside by the removal of the inflammatory deposits in them), and from these edges the healing process proceeds inwards towards the centre, where the last point to close will be found. A fine whitish-blue scale will be seen to form over the granulations lying along the edge, and this shades off towards the sore in a delicate red hue, and comes to mark the sore round with a smooth opaline glazed band, of greater or less breadth, which soon becomes converted into new skin. The whole surface before long gets glazed, the discharge diminishes, the diameter contracts so as to lessen the extent to heal and render the resulting cicatrix considerably less than the original sore, and this cicatrix may go on contracting for a length of time, but ultimately assimilates itself more and more to the normal structure of the part. When some portions of old skin have remained in the ulcer, they supply detached centres from which new skin forms, and then the final healing is greatly accelerated. The contraction which follows cicatrisation is greatest in loose textures, and it is after burns that we find it longest present and most marked. (See GRANULATION, in vol. i.) The nearer ulcers are to the centre of the circulation, as a rule, the easier are they to heal. Those placed on the trunk cicatrise fastest, other things being equal; next those on the upper extremity, and lastly those on the lower limbs, especially in tall persons. The state of the general health and the local condition would however greatly influence the healing tendency.

Ulcers may be situated anywhere under special circumstances, but it is on the lower part of the leg that they are commonly met with. The distance from the heart, and consequently the weakened circulation, the difficulty attending the venous return, and the many obstructions to which it is liable, cause varix to arise, the vitality of the integuments to be diminished, and thus their destruction by ulceration to be facilitated. When the circulation is further weakened by low fevers, starvation, old age, or other debilitating cause, or when the limb is kept in a congested state by too prolonged maintenance of the erect posture, or by being much immersed in water, then the same result is apt to follow. In short, congestion being most liable to occur in the lower extremity, renders the formation of ulcers there more frequent than in other parts.

Ulcers have been variously classified by different authors, and generally on insufficient and unsatis-



factory grounds, the distinctions being for the most part founded on non-essential characters, and being too refined and minute for practical purposes. From the very numerous circumstances which affect the features of sores, it would be possible to subdivide ulcers indefinitely according to the changes which constitutional, local, or individual peculiarities introduce into their appearance and progress. Some writers have taken the supposed constitutional or local origin of the sore as their chief ground of distinction, some their simple or specific nature, some the violence of the morbid action attending them, some the texture in which they are situated, some such accidental conditions as their irritability, weakness, congestion, &c. It will be at once evident how confusing and unsatisfactory any grouping of ulcers by such inadequate and often transient and unstable distinctions must be, and it is doubtless to this cause mainly that we are to ascribe the distaste men have shown to the careful study of ulcers, and the indifferent success which so generally attends their management.]

Sir Everard Home, in his treatise, divides ulcers into six principal groups, and as these have been frequently taken as the bases of subsequent classifications, it is well to record them.

1. Ulcers in parts which have sufficient strength to carry on the actions necessary for their recovery.

2. Ulcers in parts which are too weak for that purpose.

3. Ulcers in parts whose actions are too violent to form healthy granulations, whether this arise from the state of the parts or of the constitution.

4. Ulcers in parts whose actions are too indolent, whether this arise from the state of the parts or the constitution.

5. Ulcers in parts which have acquired some specific action, either from a diseased state of the part or of the constitution.

6. Ulcers in parts which are prevented from healing by a varicose state of the superficial veins of the upper part of the limb.

[It is useless to comment on the obvious imperfection of this classification, which, as Cooper remarks, "assumes hypotheses the truth of which can never be established nor proved."

For practical purposes, ulcers may be grouped under four heads, viz. :—

1. Healing sores.
2. Ulcers failing to heal from excess of action.
3. Ulcers failing to heal from defect of action.
4. Ulcers failing to heal from peculiarity of action.

It is true that ulcers may, and frequently do, present during their progress the characters of two, or possibly all, these groups; but it will be found that their successful treatment will mainly depend on the due recognition of the defect present at the moment, and the knowledge of how best to obviate that source of failure to heal. The healing sore is the type by which we compare other ulcers, and to resemble which it is our object by treatment to bring them. The difference in features which we observe in ulcers, and which enables us thus to group them, depends for the most part on both local and constitutional causes, but either may alone be active, or may at least greatly predominate. Many sores are very sensitive exponents of the patient's state of bodily, and even to some ex-

tent mental, condition, while atmospheric, dietetic, and other causes of a passing nature occasionally exert an obvious influence on them.

In judging of the nature of an ulcer, we observe its shape, depth, edges, surface, granulations, discharges, sensitiveness, and the state of the surrounding parts.

The age, constitution, state of health, and habits of the patient also throw no small light on the character and proper treatment of an ulcer; and its position as regards the centre of the circulation, its dependence, &c., together with the state of the digestive organs and the nature of the structures in which it is placed, are all proper objects of consideration.

I. Healing ulcers such as arise in healthy persons after the suppurative of a slough caused by violence.

A healing, simple, uncomplicated sore has the following characters—always premising that it may occur on any part of the body where an injury has been sustained, that its shape, size, &c., will obviously vary with the nature of that injury, and that it presents the most favourable features which a sore can exhibit.

*Shape*: Varies, but generally ultimately assumes a round or oval contour.

*Depth*: Slight.

*Edges*: Healthy tissue, firm and slightly hyper-vascular. The integuments shelve down to the surface of the sore, and are neither everted, inverted, or undermined. The epidermis is perhaps slightly thickened, and presents a purplish zone near the edge, bounded externally by a delicate bluish-white opaque line at the union with the entire skin.

*Surface*: Fresh, blood-coloured, even and regular.

*Granulations*: Numerous small acuminate, pliant, elastic yet firm, which shed a little red blood when roughly handled. Those granulations which are near the edge are somewhat redder than those at the centre of the sore.

*Discharge*: Laudable healthy pus; not very abundant.

*Sensitiveness*: Healthy; not painful, and yet quite sensitive; frequently itchy.

*Surrounding Parts*: Healthy; possibly somewhat more charged with blood than normally.

Such are the typical features of healing ulcers.

II. Ulcers failing to heal from excess of action. Under this head fall sores designated by various writers as "inflammatory," "irritable," or "neuralgic," "fungous," "exuberant," also one form of "cedematous," and the "phagedenic" and "sloughing."

These ulcers are generally single, and have frequently originally been due to injury. They have not uncommonly been trivial at the outset, but have assumed importance in consequence of the general state of health of the patient. They are also apt to continue long present, and so to become in the long run chronic. The following are their leading characters:—

*Shape*: Round or irregular.

*Depth*: Varies, often considerable, but occasionally shallow; sometimes deep at one portion and shallow at another.

*Edges*: Swollen, abrupt, and irregular; sometimes thick; occasionally, on the contrary, thin, and may be everted and ragged.

*Surface*: Ashy grey; sometimes red and raw, sometimes sloughy.

*Granulations*: May be altogether absent, but if present then they are turgid, and tend to bleed when touched. They are sometimes "exuberant," i.e. in excess, large, red, and prominent.

*Discharge*: Profuse; thin; often bloody and acrid.

*Sensitiveness*: Augmented; sometimes greatly so, especially when limb is dependent. There may be much pain of a burning, stinging, gnawing, or boring character, which is much complained of.

*Surrounding Parts*: Red, inflamed, and irritable; frequently œdematous, so that they pit on pressure. Sometimes they are dark red and swelled, the capillary vessels refilling quickly when they have been emptied by pressure. Occasionally the neighbouring parts are eczematous, cracked, and itchy, exuding a thin or sticky discharge from the vesicles, and being very chronic and difficult to cure. Sometimes the redness is erysipeloid.

When sloughing or phagedæna attacks ulcers, they spread with much rapidity, and the dead tissue forms a greater or less covering to the sore. It is probably in syphilitic ulcers that sloughing is most common, very possibly from the habits and condition of health of the persons in whom these sores are commonly seen. A combination of syphilis, scrofula, and intemperance will very strongly increase the tendency to sloughing of the worst kind.

The term "irritable" or "neuralgic" again is applied to a sore frequently met with in weakly, delicate females at the middle period of life, with a more or less varicose state of veins on account of the extreme pain which they occasion—a pain which is not explicable by any visible condition of the sore, which is often small and insignificant enough. It is commonly placed at or close above the ankle, or in front of the tibia, and rarely exhibits signs of inflammatory action. The surface is brick-coloured for the most part, but may be glazed and marked by bright specks. The discharge is thin and scanty, the edges irregular, and the surrounding parts dark and congested, or tolerably healthy. It is the pain which is the leading and characteristic feature. It is doubtless considerable, and the expression of that suffering loses nothing in the narration of the patient.

The "fungous," "exuberant," and "œdematous" ulcers present excessive, prominent, soft granulations, which bleed on the least touch, or even spontaneously. They occur in weak, debilitated persons, especially those of lymphatic temperament, and frequently result from the prolonged use of soddening applications.

Ulcers failing to heal from excess of action chiefly occur on the leg, and in persons of weak and irritable condition of body, those of full habit who are tipplers, in the poverty-stricken, in the feeble, over-worked and under-fed, and in women at the change of life.

III. Ulcers failing to heal from defect of action are the most common of all ulcers. This "defect" may depend on local or constitutional causes. It is frequently directly referrible to bad hygienic conditions, or to the cause which originally occasioned the ulcer to form, or it may be solely due to its long continuance or to its bad management. Ulcers which have remained long open,

or which have been much poulticed or had emollient applications long applied, or which occur in parts that have had their vitality impaired by injury or previous morbid action, are apt to assume the features of this class. It is on the leg near the ankle that these sores are usually met with, but they are not infrequent on other parts, as the fingers and toes in persons of weak circulation. Weak, thin old men often present the worst types of ulcers of this class; and while in size these sores vary greatly, yet in such persons they are occasionally so large as to surround the leg.

Under the general designation of ulcers failing to heal from defect of action rank the following varieties:—"Weak," "atonic," "cachectic," "cold," "senile," "chronic," "languid," "mucous," "sluggish," "indolent," "callous," and one form of "œdematous."

*Shape*: Various, but generally oval or round; often "punched-out" looking.

*Depth*: Varies; sometimes deep and concave; sometimes shallow and flat; sometimes elevated.

*Edges*: Frequently well defined; elevated; often overlaid with dense white epidermis; thick, white, dead-looking, or thin, flat, smooth, and glazed. Occasionally they are depressed, inverted, or everted. Sometimes these sores slowly spread in one direction while they heal in another; more often they have been long quite stationary.

*Surface*: Pale, cheesy, brown or pink, and for the most part firmly bound to the underlying parts.

*Granulations*: Often absent, or greatly defective in quantity and unhealthy in quality. They may be large, but they are flabby, flat, or bulbous in shape, semi-translucent, pale, or turgid with dark blood.

*Discharge*: Scanty, thin, gleety, serous, or bloody; sometimes fetid and viscid.

*Sensitiveness*: None; painless, callous.

*Surrounding Parts*: Soft, œdematous, passively congested, sodden, discoloured, but frequently hard, bound down; smooth, shining, and varnished; occasionally dry, scaly, shrivelled, brown, and eczematous.

The "weak" ulcer is that which wants power to cicatrize. It presents large raised flabby granulations, which are either pale, gelatinous and watery, or turgid with dark blood. Its edges are flat, smooth, and often glazed, and the discharge pale, thin, serous, and often profuse. They are situated on the leg of weak, ill-fed, and badly-housed persons of low vital power, and are not uncommonly in a great measure due to the prolonged use of relaxing applications.

The "callous," or "indolent," or "chronic" sore, again, is of very frequent occurrence. Boyer defined it as an "ulcer whose bottom (surface) edges and surrounding parts were hard, and in a constant state of chronic inflammation." Ulcers which from any cause have long kept open are apt to assume this character. It is in middle-aged men, and near the ankle, that they are usually seen, especially in those following a laborious occupation. They are often deep, scooped-out, or flat, pale, smooth, regularly-shaped sores, with few or no granulations; a scanty, thin, ill-smelling discharge; thick, leathery white, abrupt edges, and usually quite painless. The surrounding parts are glazed, hard, and bound closely to the underlying structures, and they are often congested and



deficient in cellular tissue. Occasionally they present a very firm oedematous condition. In not a few instances these callous sores present an appearance which has been well described as like "pale mucous membrane set in a ring of cartilage."

IV. Ulcers failing to heal from peculiarity of action. This "peculiarity" may lie in the part or in the constitution.

From *constitutional* peculiarities we have the "syphilitic" (primary, secondary, and tertiary ulcers), "scrofulous," "vicarious," or "menstrual," or "hæmorrhagic;" "cancerous," "glanderous," "mercurial," "gouty," "scorbutic," "dyspeptic," "lupous," "dartrous," and those which occasionally attend diabetes and Bright's disease of the kidney.

From *local* peculiarities we have ulcers depending on the presence of a foreign body (as dead bone, tendon, cellular tissue, or any extraneous body impacted in the tissues), varicose veins, the inodular tissue of cicatrices, &c.

These ulcers may in their features resemble healing sores or those failing to heal from excess or defect of action; but they have other elements *besides and beyond* these which demand attention. In many cases we have no difficulty in recognising this "peculiarity," as when it consists in some visible, tangible local condition, as the presence of a foreign body or varicose veins. But at other times it requires to be carefully and intelligently inquired after, as when it lies in the constitution or habits, and then the whole history of the affection, and possibly the past and present history of the patient, have to be learned and studied before the latent cause becomes evident.

The "syphilitic" ulcers will be found described in the article on *VENEREAL DISEASE*, and really demand no further mention here; but as the tertiary sore is liable to be confounded with ordinary ulcers, it may be shortly described. It is on the face, back of the shoulders, nates, and near the larger joints, that they mostly occur; and in broken-down, delicate persons who, from bad constitutions, or bad treatment, or bad habits, or unfortunate circumstances, have come to feel the full violence of the syphilitic virus. They may break out long after the primary and secondary manifestations of the disease have passed away; and very similar sores are seen on young persons who have not themselves contracted the disease, but who have inherited it from their parents. Syphilitic ulcers are usually superficial, and often large, but they also occur in a deep and small form. They succeed pustular and tubercular eruptions, and occur over gummy deposits in the cellular tissue. Frequently they start from several independent points, but come to coalesce, and form an irregular sore of an annular, or crescentic, or horseshoe shape, which incloses portions of healthy or changed integument within its area, and which spreads at one side while it heals at another. The surface of these sores is commonly level and tolerably clean, but if deep and destructive may be covered with slough. The edges are abrupt and clean cut; the pain is slight; the obstinacy to heal greater than the appearance would promise. Well-marked scabs form by the drying of the discharge, and the surrounding parts are tolerably healthy and unchanged, unless it be the dusky dark colour they commonly present. These sores may be solitary, but are more usually multiple, and they are very apt to recur.

We have, as a further guide to the nature of these ulcers, the history of the previous manifestations of the disease, and the cachexia which accompanies them. The effect of treatment, too, is often highly important, in a diagnostic point of view, as determining their true nature.

"*Scrofulous*" or "strumous" ulcers may or may not form over a local deposit of tubercular matter. They are often placed over diseased glands, and may be single, but are much more frequently multiple, many small sores joining to form a large, superficial, irregular, worm-eaten ulcer, seated on the face, neck, axilla, hips, groins, or limbs, especially near joints in young persons presenting other evidence of the diathesis. The edges of this sore are commonly thin and undermined, of a pink or blue colour, and on the hands and feet may be covered by thickened papillæ, which give a coarse, warty look to them which is easily confounded on careless examination with epithelial disease. The granulations are large, flabby, pale, often exuberant, and easily made to bleed. The discharge is thin, whey-like, occasionally curdy. The ulcer is peculiarly chronic. It is indolent and painless unless inflamed. If placed over bone, the periosteum or the osseous tissue may become implicated, and lead to thickenings and disease; and in the face, to unsightly scars from the adhesions which arise. The surrounding parts are often healthy, but may be thickened, swelled, and changed. The cicatrix is weak, often bossy and hollow, irregular, and very liable to erosion, or destruction by injury, or even exposure to cold. It is not uncommonly bridled, puckered, prominent, arched with pits between.

The "*vicarious*" or "*hæmorrhagic*" ulcer is that which occurs in females having in general deranged or suppressed catamenia—a sympathy existing between the ulcer and the uterine function—and the bleeding often being vicarious of the uterine discharge. The term "*hæmorrhagic*" is also occasionally applied to ulcers that bleed from the erosion of a bloodvessel, venous congestion, scurvy, or that peculiar condition known as the hæmorrhagic diathesis. The true vicarious ulcer behaves differently in different cases. In some it is active during the catamenial period, and bleeds; while in others it is during the interval it gives trouble.

"*Cancerous* ulcers form over cancerous masses, or after the bursting out of a cancerous mass, and they will vary considerably in their appearance, according to the form of cancer with which they are associated. Their edges are usually very characteristic, being elevated, sprouting, everted, hard, thick, warty, and irregular. It is in the edges that the activity of the cancerous element is most seen; and though the sore continually increases, yet these edges are not destroyed or removed. The granulations are hard and coarse, and the surface generally indurated and nodular. The discharge is ichorous, bloody, and foetid, containing cancer cells when examined by the microscope. There is frequently a hard marked scab formed by the drying of the discharge. The parts around it are hard and brawny, and the lymphatic glands enlarged, infiltrated, and hard. They are most common in persons beyond middle life.

"*Glanderous* ulcers" occur in connection with glanders, and form one of its most characteristic features. (See *GLANDERS*.)

The "*mercurial* ulcer" in some cases very closely

resembles the superficial syphilitic sore. It occurs in cases (non-syphilitic) in which mercury has been long administered (abused), and the nutrition of the tissues thus gravely compromised. It is much seldom seen now than formerly, and is an irregular, spreading, ragged sore, with supple base and scanty discharge, which can only be recognised by a consideration of the history of its rise and progress.

The "*gouty ulcer*" forms over gouty deposits, or in parts much affected by gout. They are chronic in their course, and present insufficient or no granulations. They are superficial, and their edges are not indurated or thick, and the surrounding parts are to the eye healthy. Their characteristic feature is the drying of their exudation into a thin, white, chalky material.

The "*scorbutic ulcer*" may form anywhere, but more commonly it occurs on the gums, inside of the cheeks, on the legs, and on the dorsum of the feet. Their surface gets covered by a fibrinous, deeply-coloured exudation, which gives the sore a tumid, spongy, livid appearance. The slough which is attached to it so firmly is dark, thick, fungous, and reappears quickly after removal. It bleeds easily. It was the peculiar dark, coagulum-looking character of this fungous mass which caused the term "*bullock's liver*" to be applied to it by sailors when it attained a great size, as it often did in former days.

The term "*dyspeptic ulcer*" is a very foolish one, and was applied to ulcers accompanying digestive derangement. The "*diabetic*" ulcer, and that which occasionally accompanies Bright's disease, are distinguished by the disease which they accompany.

The "*lupous ulcer*" is commonly a scrofulous ulceration, and is seated on the face (ala, lip, and cheeks). Its consideration belongs more especially to affections of the skin. It is usually preceded by pink elevations or tubercles. They pass deeply, and cause much destruction, not only to integument, but also to cartilage, and even bone. The spreading of the disease is not usually painful, and the sore shows little healing appearance, the granulations, if present at all, being coarse and unhealthy. The edges are commonly firm, and somewhat elevated, abrupt, and irregular, and the discharge profuse and concreting into thick scabs, under which the sore spreads. It is accompanied by other evidence of the strumous diathesis.

The "*dartrous*" or "*eczematous*" ulcer may form in the midst of a previously existing eczematous eruption, or the eczematous eruption may succeed the ulcer, and come to surround it. In either case it is in the parts around the sore that the special characters of this ulcer are found, and not in the sore itself. To a vesicular eruption follows the cracked, watery, scaly, and irritable condition of eczema, and with its management the treatment of the ulcer is combined. Pustular, bullar, tubercular, vesicular, and other cutaneous eruptions are also occasionally accompanied by ulceration, and to these, as well as to the eczematous, the term "*dartrous*" is often applied. Their consideration belongs to that of the eruption which they accompany.

*Local causes of peculiarity of action* are usually easily recognised. A dead bone or tendon; a musket-ball or splinter of wood; enlarged veins; changed tissue, as in the cicatrices of burns, &c.,

are at once seen and appreciated as causes of irritation or weakness.

"*Varicose ulcers*" are very common, and that in both sexes. They are especially apt to form in females after middle life, after repeated child-bearing, and it is on the leg, at its lower part, that they occur. The skin becomes changed, getting brown or mottled and thick, and the veins form sacculated enlargements at various points. The ulcer is often a direct result of the impeded circulation, maintained by these enlarged and weak veins; but at other times they are specific in their nature, and are complicated and retarded in healing by the varicose veins.

It is with capillary varix that the worst form of ulceration is seen. The surface is permeated by small blue or pink lines; the integument has its nutrition seriously impaired and dies, or if an ulcer forms, does not supply adequate organisable material for recovery. These ulcers are very often inflammatory and highly painful, but occasionally they are chronic and indolent. They are more commonly shallow, superficial sores, surrounded by scaly brown skin; their surface dusky and void of healthy granulations, and the discharge thin and acrid. At other times they are deep and foul, and discharge copiously a fœtid secretion. If a vein of any size is opened in the progress of the ulceration, the hæmorrhage may be very free, but it is easily arrested by elevation and pressure.

The great prevalence of ulcers, and the annoyance they occasion, makes the careful consideration of their *treatment* of much importance.

It is a point of paramount consideration to discover and remove (if still active) the cause which originated the sore. This we must do by a careful inquiry into all those constitutional and local sources of the affection which have been already dwelt upon. The influence of occupation; of the condition of the secretions and abdominal organs; of the circulation through the part; and the effects of any local weakness, must all be estimated. Then, in determining the kind of treatment to be adopted, we require to observe particularly the character of the sore—its features and surroundings, its tendencies and demands—and this interrogation and surveillance must be maintained, as the characters of an ulcer frequently undergo change under the effects of constitutional conditions or the action of remedies, and so the applications must vary from time to time.

It is not unusual for an ulcer to remain after the original cause which produced it has ceased to exist. It has come, as it were, to establish for itself an independent existence in the economy. This we occasionally see in the persistence of specific sores after the constitutional cause has been removed. The most potent local causes maintaining ulcers are congestion from irritation or retarded circulation; weakened vitality from any other source, and deficiency of soft parts.

It is of much moment to obtain, in the treatment of most ulcers, by the use of purgatives and alteratives, a healthy action of the liver and bowels, and when obstinacy occurs in healing, especial attention should be paid to these organs. The state of the kidneys, too, and the uterus should be known; and the history as regards blood affections, syphilis, gout, scrofula, &c., inquired into. Opium is found to be of great service in healing ulcers when not counter-indicated by some special



cause; and iodide of potassium has been much commended by some, and cantharides by others, when any sore is difficult to heal. If the ulcer appears to be connected with chronic skin disease, arsenic is generally highly useful; but otherwise the internal remedies employed in the management of ulcers will depend on the special indication presented to us by the individual case. Tonics, especially those containing iron, are frequently urgently required, and the diet must be regulated according to the case.

*Locally*, our measures are directed to overcome inflammation and allay irritation; to remove congestion and support weakened vessels; to stimulate or soothe the sore as the case may require; to protect it from the air and external injury. The ordinary antiphlogistic remedies are frequently required, sometimes leeches or scarifications, often fomentations or evaporating lotions, poultices, cold, &c. Position must in most cases be very carefully attended to. It is by prescribing an elevated position that venous congestion is most efficiently overcome; while rest to the part and bandaging are essentially necessary in many cases. The nature and condition of the sore must regulate the kind and strength of the applications which are made to its surface. Cleanliness and simplicity should be leading ideas in devising dressings. In very many cases "water-dressing" supplies all the requirements, if combined with careful bandaging, and that in many cases in which at first sight far more powerful local remedies might be supposed to be demanded. The method of applying water-dressing recommended by Mr. Chapman, viz. by strips of lint dipped in water put successively round the limb, as Baynton used adhesive-plaster—these strips being used with firmness, and covered with oiled-silk or gutta percha—and then a bandage from the extremity of the limb, is one of the most efficient methods known for dressing ulcers. It has been largely used by the writer for many years in the out-door department of a large hospital, and he would express the most unqualified approbation of it in very many of the cases which come before one in such a practice. Each strip should be fifteen or sixteen inches long and about two inches broad, and the floccy side put next the skin, as, when wet, it thus adheres with enough of firmness for our purpose. The middle of the strip should be put on the side of the limb opposite to the site of the ulcer, and the ends crossed over the sore at such an angle as to make the whole strip fit closely to the surface. The application should be begun a short way below the position of the ulcer and continued for some way above, if it be a simple case; or from the very extremity of the limb, if the capillary vessels are much affected, and each successive strip should about half overlie the former one. Lead lotion may be substituted for water, or an astringent or stimulant wash applied on the portion of the limb which comes into contact with the sore; but, as was remarked above, it is curious how seldom such applications are needed if the lint, wetted with water, is carefully applied and the bandaging efficiently performed. It is doubtless in the application of the roller that the fault most commonly lies in the dressing of ulcers. It is not carried forwards to the base of the toes as it should be, and the turns on the leg are not so regulated as to cause the bandage to fit closely and equalise the pressure throughout. Many adopt an invariable

method of using the roller, making so many circles of the foot, and beginning to reverse the roller always at the same part of the leg, without bearing in mind the great diversity of shape which the leg assumes, and regulating their movements alone by that. The point sought is to get the roller to compress the lint evenly and equally; to constrict the limb nowhere, yet to give the most perfect support (like an artificial skin) to the whole, and in order to do this, we must vary our reverses to suit the case in hand. In many instances very few reverses are required at all, the muscles of the calf being little developed, while in others we must begin to turn down the bandage immediately after we pass the ankle. In some the bulge of the calf is very sudden, and in these cases it is often difficult to prevent the roller slipping, while in others it answers best (though the result is not so agreeable to the eye) to reverse only every second turn. When it is wished to leave the roller on for some days, it is a good plan to make the patient "baste" the sides, or wear a cotton-stocking which they can garter below the knee, and not remove at night. When a bandaged limb feels tight and uncomfortable, elevation or the saturation of it with cold water will commonly give relief. Water applications are often attended with a troublesome eruption, and then, if we desire to continue such a remedy, we must limit the wet portion to the ulcer, leaving that which comes into contact with the rest of the surface dry. A little chalk or fine starch-powder sprinkled over the surface will remove the irritation complained of, as will a solution of nitrate of silver.

Wet strapping is best adapted for ulcers accompanied by a considerable amount of discharge, and which require compression and support. The lint absorbs the discharge, and so prevents in a great measure the pain which the imprisonment of pus gives rise to. I believe the only reliable rule to regulate the renewal of the lint (or the plaster when it is used) is the feelings of the patient. So long as the limb is comfortable, the application should be left alone; but so soon as it gets painful, the strapping should be renewed.

After water, *lotions* of various kinds are the most useful applications we can employ. Most commonly those of a stimulating or astringent character are needed. Solutions of the metallic salts (zinc, copper, lead, iron, mercury, silver) alone or combined are of frequent use. The mineral acids too (nitric, hydrochloric, acetic, sulphuric and sulphurous acids); vegetable decoctions, infusions and acids; disinfectants; sedatives, &c. The more common remedies are sulphates of zinc and copper, acetate of lead, nitrate of silver, black and yellow wash, bichloride of mercury, the potassio-tartrate and other salts of iron, chloride of lime, permanganate of potash, carbolic acid, solution of opium, &c., &c.

Hey's red-wash is probably as efficient an application of a stimulant nature as could be used for ulcers, if the precaution be taken to begin using it weak, and augment the strength as the requirements of the case indicate. It consists, as is well known, of the following ingredients and proportions: Sulphate of zinc, sixteen grains; compound tincture of lavender and spirit of rosemary, two drachms; and water to eight ounces. This should in most cases be diluted by the addition of an equal quantity (or more) of lukewarm water, to a strength

sufficient just to tell slightly on the sore, and then as a more powerful effect is required, less water may be added, the influence on the ulcer being always watched and taken as the criterion of the amount of dilution required.

*Ointments* are, as a rule, hurtful to ulcers, especially if the discharge is considerable. However made, they are apt to become rancid and cause irritation. When glycerine is substituted for lard in their composition, they are somewhat less injurious; but they can hardly avoid being filthy, or fail to accumulate along the edges, where, mixed with epidermal scales and pus, they form crusts which are highly injurious. In fact, the removal of such collections is often the first step required in the management of ulcers. This we do either by means of a spatula or by the application of a blister, if the sore wants stimulation as well, and its borders are elevated and indolent. In a very extensive outdoor hospital practice of a good many years' continuance, where ulcers of every form are met with in abundance, the writer has long quite abandoned the employment of ointments, with very manifest advantage, and finds water-dressing and dry strapping, blistering, the occasional use of lotions, and above all, careful bandaging, quite sufficient, combined with internal remedies (in such cases as demand them), to cure the ulcers that are presented to him. If desired, however, the different metallic salts may be used in the form of ointment, and some of these will be afterwards alluded to.

*Poultices* are occasionally of much service in treating ulcers. When there is excess of action and a necessity for soothing, emollient poultices, simple or medicated by various additions, are exceedingly beneficial; but as a rule they are used without discrimination, and in so reckless a manner, as to be highly detrimental. It is most painful to see how they are abused in the management of sores, and what harm they occasion. To foul ulcers, too, they are legitimately applied; but it would be on the whole a gain if they were completely banished from the treatment of ulcers, rather than that they should be so frequently employed in cases not adapted for them. Linseed-meal, bread alone, or with charcoal or chlorinated soda or yeast, when a disinfectant is required; the same with opium, or decoction of poppies, or belladonna, or conium, when an anodyne is needed; boiled hops, too, and camomile flowers have a like action. For astringent effect, alum or a vegetable astringent may be mixed with linseed-meal. For disintegrating, linseed-meal mixed with soft soap, or turpentine; and carrot, or turnip, or yeast, may be applied. For mere soothing, bread with water, or milk, or glycerine, or oil; or linseed-meal alone, or arrowroot and water, will be found good.

*Fomentations* may often be substituted for poultices, and they may be medicated by the addition of various decoctions and infusions. Poppy-heads, aqueous extract of opium, belladonna, conium, hyoscyamus, acetate of lead, wine, tannin, cinchona, aconite, &c.

*Powders* are often used to close sores when they are all but cicatrised. When an ulcer has closed "to a point," a few grains of starch, or oxide of zinc, or chlorate of potash, or aromatic powder, or animal charcoal, will often complete the cure; as will also a gentle "caress" of nitrate of silver, or a small bit of goldbeaters'-skin, or the lining-membrane of an egg-shell, or a solution of gum, avoid-

ing the imprisonment of any pus beneath, or a tuft of charpie wetted in collodion. Some have recommended quinine in powder as an application to cachectic sores, without, as it appears, very good grounds; but it may be stated generally, that if there is any considerable amount of discharge, powders are injurious, as they serve to form crusts under which the ulceration extends. In those innumerable cases of "weeping legs" (eczematous ulcers) which occur among working people, no more effectual method of treatment exists (when they are not very severe) than the constant dusting of them with an absorbent powder, such as fine starch, and covering this with dry lint and a bandage. In these cases the writer has always derived more good from this remedy than from any unctions or watery or spirituous applications, and as a rule his experience utterly condemns these appliances in this form of ulcer. Occasionally, when the eczematous eruption is not very extensive, it suits well to have the part rubbed over with nitrate of silver, either in strong solution or the solid stick, and then bandaged; but the use of an absorbent powder, combined with compression, is generally most efficient. Further remarks on this affection will be made afterwards.

*Vapours* are occasionally useful in the treatment of ulcers, especially the syphilitic, the inflamed, irritable and phagedænic. Simple vapour is useful to soothe and subdue inflammation, but when medicated by the addition of sedatives, such as opium, belladonna, hyoscyamus, stramonium, conium, camomile flowers, poppy-heads, &c., or such remedies as iodine, mercury, tar, sulphur, &c., they are much more efficacious. Iodine vapour is sometimes beneficial in indolent sores, and mercurial (calomel, red sulphuret, &c.) in syphilitic ulcers, or those having elevated edges and hard, brawny, unhealthy surroundings. Sulphur fumigations have a very considerable influence in arresting sloughing and phagedæna.

It is in determining the nature and the strength of the local remedy to be used, that experience chiefly aids the surgeon in the treatment of ulcers, but in no detail is experience of more use than in the application of the roller. To employ it in such a way that it will evenly and firmly surround the limb and retain its place, while no part is unsupported and no part unduly constricted, is only to be learned by long practice, and is perhaps the most important element in the treatment of ulcers of the leg. It cannot be efficiently accomplished by a nurse or raw pupil, but only by a fully-instructed hand. The bandage must surround the limb from its very extremity, and if carefully applied, requires no accompaniment of padding. The degree of force used must be regulated by the case, but in no instance should it be such as to endanger the vitality of the granulations. Unbleached cotton-cloth, or woven open cotton-tissue is the best material for rollers. For the leg of an adult a bandage should be six or seven yards long by two inches and a half broad. Mr. Hunt strongly recommends rollers of somewhat fine Welsh flannel to be used in preference to calico, and when this material can be got, it has undoubtedly many advantages.

Adhesive-plaster, applied so as to cover and compress ulcers, is in many cases the most efficient mode of treating them. The method known as Baynton's consists in applying strips of plaster round the limb, from some way below to a certain dis-



tance above the sore, and combining this with a bandage. Baynton published his method in 1799, and his chief object was, as he tells us, to approximate the edges of the sore by the traction of the strips of plaster. Mr. John Scott, of London, in 1828 published, in his *Treatise on Diseases of the Joints*, in the chapter on "Chronic inflammation," an improvement introduced by his father on Mr. Baynton's method. He recommended the strips of plaster to be begun at the foot—the first strip to be applied from behind the heel, and placed along the sides of the foot—in place of merely below the sore. This plan has been so ably advocated by Mr. Critchett, in his admirable work on ulcers, that, after giving Baynton's description of his method, Mr. Critchett's own words will be taken to explain Scott's modification. Baynton says:—"Take pieces of diachylon-plaster, spread upon calico about two inches in width, and of such length as to encircle the limb and overlap at the ends to the extent of three or four inches; the middle of each piece so prepared as to be applied to the sound part of the limb, opposite to the inferior part of the ulcer, so that the lower edge of the plaster may be opposite to the inferior edge of the ulcer, and the ends drawn over the ulcer with as much gradual extension as the patient can bear. Other strips are to be secured in the same way, each above and in contact with the other, until the whole surface of the sore and the limb is covered, one inch below and two or three above the diseased part. The force with which the ends must be drawn over the limb must be gradually increased, and when the parts are restored to their natural ease and sensibility, as much may be applied as the calico will bear or the surgeon can exert."

The limited and imperfect support, even when a roller is carefully applied from the toes, is the objection which has been made to Baynton's method, and the great argument in favour of the plan thus described by Mr. Critchett:—

"You seat your patient opposite to you, and support his foot on a small stool about a foot and a half in height, and so constructed as to receive the point of the heel and leave the rest of the foot free. You should be provided with strips of plaster about two inches in width and varying in length from twelve to eighteen inches, according to the size of the limb. The best material for this purpose is the simple empl. plumbi of the Pharmacop., spread upon soft unglazed calico and free from resin, which is often introduced to increase its adhesiveness, but which is very liable to irritate the skin. If the plaster be well made, and of the best materials, it will adhere perfectly—I have often found it unmoved for many weeks and even months. It is convenient to provide yourself with a metallic warmer, made with a flat top, upon which you can lay three or four pieces, heated either by hot water or by small lamps, which are better if you require it for any length of time. This form of warmer is far preferable to the circular one ordinarily in use, saving both time and trouble. But to proceed. You then take the centre of the first piece and apply it low down to the back of the heel, and then with the flat of both hands press the plaster along both sides of the foot. This plan is very preferable to taking hold of the ends and endeavouring to apply them, as it ensures a perfectly smooth adaptation of the plaster to the

part, and also because it enables you to regulate that very important point, the amount of tightness you wish to employ. As you proceed with the remainder, you must always remember the principle is to make one portion hold on another; you must therefore alternate them round the foot and leg. Your second piece should be placed in a similar manner underneath the heel, and then carried upwards at a right angle to the last, so as to cover a portion of each malliolus. The third piece should be again applied to the back of the heel, overlapping the first by about one-third. The fourth piece under the foot, and carried upwards; each piece being pushed along so as to allow it to take its own course. This must be continued till the foot and ankle are covered. The strips must then be carried in a similar manner up the leg, increasing in length as the calf increases, and extending as far as the knee, and in some few cases even above this. A calico bandage, about three inches in width and eight yards in length, varying however according to the size of the limb, must now be applied."

"In carrying out this method," Mr. Critchett continues, "we must remember that we have two objects to accomplish; the one is to obtain a healthy circulation through the entire limb, and the other to act upon the dilated capillaries immediately surrounding the wound. Both these objects are frequently accomplished by the general support I have just described; but it sometimes happens, particularly in small ulcers situated in the hollow between the malliolus and os calcis, that the diseased vessels immediately around the wound require an amount of pressure which the rest of the limb would not bear. Under these circumstances, very great advantage is derived from applying, previous to the support I have just described, some pieces of strapping, about six inches in length and two inches in width, in a crucial manner over the wound, so as to extend a few inches above and below it; these pieces, as they do not encircle the limb, may be applied with all the force and tightness the surgeon can exert." Mr. Critchett lays it down as a rule that "in every case in which it is necessary to apply strapping entirely round a limb, it must never be partially applied, but must encompass and support every part of the leg."

If great uneasiness follow the strapping, and become insupportable, notwithstanding elevation, the plaster may be slit up on a flat director on the side opposite to the position of the ulcer; but generally position and sluicing the limb with cold water removes the discomfort, and this process is always very grateful in hot weather, or if there is inflammation present or the discharge abundant. The plaster and bandage are best applied in the morning when the limb is free from the congestion that standing and walking occasion. If desired, holes may be made in the plaster to allow the discharge to escape, but they are seldom of much good. When it is wished to remove the plaster, the whole should be steeped in lukewarm water. Strapping suits best in chronic ulcers with elevated edges, plastic deposits in the cellular tissue, general swelling, and weak circulation—the condition which is most unpromising so far as other methods of treatment are concerned. It is not adapted to acute cases, accompanied with much inflammation, till the acuteness has been removed by appropriate measures. In sub-acute cases we cannot use much pressure at first, though after a few applications it

can be employed with advantage. Experience is of inestimable service in teaching the surgeon to regulate the pressure of the strapping to the case on hand, and his chief guides are the colour of the part and the effects of pressure made with the hand, as showing the state of the circulation. When pressure is applied by the hand, the rapidity with which the capillaries are emptied and refill gives much information; then the amount of swelling and discharge, and also to some limited extent the patient's feelings. Many persons are very much afraid of strangulation, and complain of tightness when there is none, and not a few cannot submit to the uneasiness which at first generally attends the strapping of a limb which has not been before supported, so that the patient's sensations must not be greatly relied on to guide us. The effects of the first application will be a most valuable aid to our further proceedings as regards tightness of application. The benefit to be derived from this method is soon apparent in the disappearance of the high edges from the sore and the swelling from the limb, the reduction of exuberant granulations, the diminution and the more healthy character of the discharge, and the contraction of the ulcer. Whenever the pain and uneasiness, with a feeling of burning, returns, it is time to renew the application. The abundance of the discharge and the state of looseness of the strapping will chiefly regulate this necessity. Sometimes, though rarely, it has to be done daily; sometimes not for weeks. It is an immense advantage that the patient thus treated can continue his employment without hindrance, as he can also, by the plan recommended by Mr. Whately, which, however, is greatly less efficient. It consists of compresses and flannel roller.]

The following is Whately's description of his method:—

"The best width for a flannel roller designed for those who have slender legs is three inches, but for those whose legs are of a large size they should always be three inches and a half in width. They must therefore be at first torn a little wider, that they may be of their proper width when repeatedly washed. It will likewise be found that rollers made of fine, soft, and open flannel will answer much better than those made of coarse hard flannel.

"For those who have full-sized legs, the length of six yards is but just sufficient to answer all the purposes intended by a roller; but in those who have very small legs five yards is a sufficient length. Care should be taken that the rollers be washed in very hot water, and they should be hung up to dry immediately on being washed. If these precautions be not attended to, repeated washing of them will in some kinds of flannel make them as narrow as tape, by which they will be rendered almost useless.

"In applying a roller the first circle should be made round the *lowest* part of the ankle, as near as possible to the heel; the second should be formed from thence round the foot; the third should be passed again round the foot quite to the toes. The roller should then be passed from the foot round the ankle and instep a second time, to make the fourth circle. In doing this it should be brought nearer (but not over) the point of the heel than it was at the *first* time of going round this part. The fifth circle should pass over the ankle again, and not more than half an inch higher up the leg than the fourth circle. The sixth, seventh, eighth, and

ninth circles should ascend spirally along the small of the leg, at the *exact distance* of three-fourths of an inch from each other. Having proceeded thus far up the leg, we may begin to increase the distances of the circles from each other: they may succeed each other upward to the knee, at the distance of from one to two inches, according to the size and shape of the leg. At that part where the calf of the leg commences it is generally necessary to let the upper edge of the roller be once, twice, or thrice turned downwards for about half the circumference of the leg, in order to make the roller lie smooth between the middle of the calf and the small of the leg. When the roller has been thus applied as far as the knee, there will be a portion of it to spare, of perhaps a yard in length; this remainder should be brought down by spiral windings at greater distances from each other than those which were made in the ascent of the roller. The windings should in general be completed in the small of the leg, where the roller should be pinned.

"In many cases it is necessary to apply the roller *over the heel*. It should be brought as low as possible round the ankle, as in the former description. From thence the second circle of the roller should pass from the instep over one side of the heel, and be brought over the other side of the heel to the instep again. The third circle should be passed round the ankle a second time, but still nearer to the heel than the first circle was. The roller should after this be brought back to the foot and passed round it to make the fourth circle. A fifth circle should be again made (though it is not in all cases absolutely necessary) round the foot to the toes. To make the sixth circle the roller should be brought back and passed round the ankle again. The seventh, eighth, ninth, tenth and eleventh circles should ascend spirally at the *exact distance* of three-fourths of an inch from each other, these distances commencing at the sixth circle. The roller should then be carried to the knee, and be brought down again to the small of the leg, as described in the former instruction.

"In applying the compresses it is necessary in every instance to put them on one by one, and not all in a mass, though they be of a proper size and number. They should be crossed in different directions; the largest of them should in no case be longer than just to meet on the opposite side of the leg to which they are applied. I have in many instances seen the compresses applied by the patients of such a length as to go round the leg like a roller, and be fastened together with pins. This method generally wrinkles and blisters the skin, and by no means answers the purpose of making a compression on the part where it is most wanted. I never suffer a pin to be used in the compresses. If the same compresses in any case be applied two days together, they should always be turned on the contrary side at each re-application, in order to prevent wrinkles on the skin." (See *Practical Obs. on the Cure of Wounds and Ulcers on the Legs without Rest*; by T. Whately; 1799.)

[Galvanism has been highly spoken of by some in the treatment of indolent sores. In the *Medical Times and Gazette* for July 23, 1853, Mr. Spencer Wells has well described the mode of using it and the advantages he found from it.

During the progress of a case it is often necessary to vary the applications as the good effects of



that being employed fail. After a time we are able in many instances to return with advantage to the remedy we set out with. So soon as the sore ceases to respond to the application we are for the moment using, we should employ another, and thus by varying the remedy judiciously we advance the cure. The very act of changing the dressings is to some extent stimulating, and should only be repeated more frequently than actual necessity demands when such an action is desired. Great gentleness in manipulation is called for here, as in all surgical interference, and it is especially requisite to avoid injuring the tender granulations in a healing sore. We must renew the dressings so as to obtain cleanliness and to promote the patient's comfort, as well as to ensure the accurate adjustment of the dressings; but we must avoid interfering too frequently, otherwise we will irritate, increase the suppuration, and injure the granulations, and so hinder healing. We should not scrub, or in fact interfere with the surface of the ulcer, when being dressed, further than allowing a stream of lukewarm water (if necessary, from the foulness of the sore, having a disinfectant in solution) to flow over it; then wipe the discharge from the skin round its margin, and apply our new dressings. It is not desired to remove the pus which adheres to the granulations, but the excess merely, and this the gentle stream of water will accomplish.

Various operations have been performed in order to close ulcers which were from their size, position, or nature peculiarly difficult to heal. Plastic operations ("Élkoplasty," as it has been absurdly termed), either by sliding or transposition, have been employed for this purpose; and incisions made parallel to the sore, and at some distance from its borders, have been found useful in allowing the tissues around to be relaxed and the edges of the ulcer approximated. The incision is carried into the plane of sub-cutaneous cellular tissue, and should exceed the ulcer in its length.

When healed, the part where the sore was placed will require careful and methodic support till the new tissues are quite consolidated. If this is not done, the ulcer will readily reappear.

It is occasionally, though rarely, requisite to amputate limbs on account of ulcers which, from their great size and incurability, render life miserable or threaten to destroy it. In old chronic cases of an inveterate character the textures get so disorganised, and the very bones destroyed, that nothing short of separation of the limb can save the rest of the body. Recovery after amputation is then commonly rapid from the rebound after so long and serious a drain.

There exists in not a few cases of old ulcers a strong popular prejudice, with which not a few professional men sympathise, against the closing of old ulcers. The long existence of these sores is thought to beget a claim on the economy which cannot be denied without risk; and in some cases, occurring in old men, they have been supposed to exercise a vicarious action with the urinary secretion. If the whole truth were told, we suspect that in not a few cases the practitioner disapproves of closing the sore more because his applications fail to affect it than from any real objection he has to bring it about. The patient, however, not uncommonly dreads the closure of the sore. The most extensive experience would probably not suffice to give anyone a right to dogmatise on the

point, yet surgeons of the largest experience declare their want of belief in the popular idea. It has certainly never fallen to the lot of the writer, among the very large number of old ulcers he has seen closed, to observe one case of danger arise therefrom, even in old and feeble persons, and when the ulcer was an eczematous one, to which the objection is said chiefly to refer. It is to be remembered that these sores do not, and *cannot* be healed quickly, but, on the contrary, that they are very slow and gradual in their progress of amendment; that their continuance often depends solely on a local cause; and that we have the means of guarding against internal congestions by the management of the diet, maintaining a free action of the bowels, and possibly applying a few leeches. It has been proposed to insert issues near the ulcer (which is the only effectual way of using them for such a purpose), or in some distant part to obviate harm, and we are instructed to re-establish the original drain by applying a fly-blisters in the event of evil threatening. Some of the cases in which it is said internal congestions followed on the closure of old sores were probably mere coincidences, while the pernicious influence of prolonged recumbency (so often seen in the treatment of accidents in the old) had likely more to do in causing the congestion of the lungs than the healing of the ulcer.

Let us now add to the foregoing some remarks on the management of the different classes of ulcers before described.

1. *Healing ulcers*, as a rule, require only protection from the air, cleanliness, the support of the capillary vessels which a bandage secures, and rest. In very many cases, if properly bandaged, the patient can follow his occupation without harm. Water-dressing is especially useful in these cases, particularly when applied, as was before described, by means of strips of lint.

2. *Ulcers failing to heal from excess of action.*—As these ulcers occur in very different and even opposite states of the system—in the full-fed and plethoric and in the starved, overworked, and irritable—the general treatment must vary greatly, and be regulated by the condition of the patient.

If there is inflammation, it must be subdued by appropriate internal, and above all local, antiphlogistic measures—elevation, rest, soothing appliances, such as fomentations or poultices, and possibly leeches (cautiously, however, and only if urgently required, and not close to the sore, but at a short distance); scarifications or punctures in rare cases; cold, too, in the form of evaporating lotions, ice, &c. No constriction or pressure by bandages should be used till the too violent action has subsided. Internally, if the patient be of a plethoric habit, salines, spare diet, &c., will be called for; but if, on the contrary, the local excess of action be but one evidence of an enfeebled vitality, then generous food and tonics will be more appropriate. Any ulcer may become inflamed, and demand the measures above referred to for a time. Opium given freely has a very beneficial effect on these inflamed sores, and should not be omitted. The state of the tongue, pulse, skin, and secretions will guide us as to diet and stimulants.

Poultices made of bruised succulent vegetables, such as raw potatoes, carrots, turnips, leeks, &c., applied cold, are often used in Scotland with advantage in these cases. Hot applications of the

same are generally more efficacious. Bruised seaweed, cold or warm, has a considerable repute; but linseed, arrowroot, alone or mixed with acetate of lead, decoction of poppy-heads or chamomile flowers, belladonna, hyoscyamus, &c., or with catechu, kino, oak-bark, &c., when an astringent action is desired, or with aqueous solution of opium, generally answers best. If the granulations are large and flabby, the poulticing should be withdrawn as soon as possible; and, in fact, whenever the irritation and inflammation have been subdued, they should be given up. Simple or medicated steam is also useful to remove irritation.

The over-stimulation of callous sores occasionally causes them to become inflamed, but more usually it arises from injury or irritating applications, as those which decompose (ointments, oils, &c.), and may be due to gastric derangements, excessive toil, &c. The poor, who cannot afford proper dressings, and must work hard, and who are so curiously careless about their sores, and credulous as to the efficacy of every "saw" which is recommended to them by a neighbour or passer-by, are most apt to suffer from inflammation in their ulcers.

If sloughing or phagedæna attack a sore, decided measures must at once be taken to correct it. It is in syphilitic sores that it is most apt to arise. The reader is referred also to HOSPITAL GANGRENE for much that might be said here. Sloughing arises from excessive inflammation, in which the granulations first disappear and then the edges of the sore. It may be due to any of the causes which establish or aggravate inflammation. Phagedæna again commonly arises from the action of an external poison. The remedies for inflammation already discussed are demanded, and opium, used both internally and locally should not be overlooked. The potassio-tartrate of iron, so useful in syphilitic phagedæna, is also most beneficial in other forms. It should be given in free doses internally and applied to the sore as well. Disinfectants (carbolic acid, sulphurous acid, M'Dougal's and Condy's liquors, chlorinated soda, coal-tar lotions, &c.) should be mixed with the dressings; and if these milder measures fail, then a strong escharotic, of which nitric acid is, in the writer's opinion, the best, should be freely applied to the surface and edges of the sore, following the poisonous agency under the borders and into every sinus and cranny till the whole is destroyed, and then carrot poultices will remove the slough thus formed and give a clean surface, which is afterwards to be dressed according to its requirements. The sore should be well dried with tow, or blotting-paper, before the acid is applied, and a wooden spatula should be used for the acid, so as to have a firm agent to work with. Loose sloughs may be gently chipped away to help their separation. The most scrupulous attention to the hygienic condition of the patient is required,—the air in his room must be freely renewed, possibly fumigations with sulphur or chlorine employed,—his food regulated so as to support his strength and yet not over stimulate him. Tonics administered, and opium given to quiet irritation and obtain rest.

Sores spreading with less acuteness may be well managed by painting dilute tincture of iodine over the surrounding parts, while we apply nitric acid or a strong solution of lunar caustic to the surface, to be followed by a poultice.

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The "irritable" or "neuralgic" ulcer is best treated by having a solid stick of caustic freely applied to its surface and surrounding skin, or using a blister, by either of which means the pain is better allayed than by any other plan. Hemlock or opium dressings afterwards, or, what is better, strapping with plaster from the foot, and put it on as Critchett directs, as firmly as it can be drawn. The general health must be attended to, and the functions of the bowels and uterus especially regulated. Alteratives, purgatives, ferruginous preparations or mineral waters, and an opiate at night will complete the cure.

The "fungous" or "exuberant" ulcer chiefly requires careful compression by strapping and bandages. If the discharge is great, strips of lint may be substituted for the plaster. Alteratives and tonics will also be required, and Sir E. Home strongly advocated arsenic in such sores. Exuberant granulations can be repressed by dry lint or pressure, or by being dusted with powdered sulphate of copper, or powdered rhubarb (Sir E. Home) alone or mixed with powdered opium.

3. *Ulcers failing to heal from defect of action*, as a general rule require stimulation both by the improvement of the general health and the use of local dressings, generous food, malt liquor or wine, tonics, especially quinine and iron, and all invigorating measures, while various stimulant applications are used to rouse the vigour of the sore.

The "weak ulcer," or that which wants healing power, will benefit by the use of Hey's red wash, in a strength fitted for its need, combined with careful bandaging. Sir E. Home put thin plates of lead over the dressings and under the bandages to augment the pressure. A favourite application of his, was a scruple of nitrous acid in eight ounces of water, the strength being increased or diminished according to the requirements of the case. Mr. Paget thinks a mixture of resin ointment and Peruvian balsam, spread on lint, the best local application for weak sores. Galvanism has been had recourse to with advantage, used in the way before referred to.

"Callous" or "indolent" sores require stimulation, but, as a preliminary step, we must get quit of the hard elevated dead edges, and this some do by paring them off with a sharp knife, or peeling them off, which is in many cases readily enough done, for so soon as the hard band is detached at one spot, it can be seized and removed in a continuous piece from the whole margin of the sore. This end, however, is infinitely better attained, and the vitality of the sore revived, by the method recommended by Mr. Syme, viz. covering the whole sore and edges and a considerable portion of the surrounding parts with a fly blister, which effectually accomplishes all that is wanted, and at a wonderfully small cost of pain and annoyance. After the removal of the blister, we have a healing sore usually to deal with, or, at least, one which merely requires a slight stimulant or strapping to heal it. The writer has had ample experience of the exceeding usefulness of this plan. It is greatly more satisfactory than that advocated by some of rubbing over the sore and edges with caustic, then using a poultice, and lastly strapping and bandages. Mr. Skey recommends five grains of the soap and opium pill, to be given night and morning, and others have spoken favourably of hydriodate of potash in



twenty-grain doses, three times daily. Mr. Holt "seals" these sores by covering them from the air with adhesive plaster placed round the edges, and oiled silk glued to the plaster by collodion, changing the covering when the discharge (which is seen through the transparent oiled-silk covering) accumulates so much as to render it necessary. Brainard, of the United States, speaks highly of the stimulating and deodorising effects of the vapour of iodine in these ulcers. His method of applying it will be found in *Ranking's Abstract*, vol. xxxi., p. 139. Tincture of cantharides with decoction of chinchona given internally is also strongly recommended in calous ulcers, and Mr. Erichsen speaks of using liquor arsenicalis in obstinate cases with advantage. There is no doubt but that an opiate at night helps the healing of these and most other ulcers, from the class of persons in whom they are met with.

Of local stimulants for indolent sores some have been mentioned. The metallic washes; weak nitrate of mercury; solution of chlorinated soda, and many other combinations, which it would be useless to enumerate, can be employed to stimulate these ulcers. In all cases, careful bandaging is an important element in their successful management. Plastic operations have been occasionally employed to close these sores when other measures have failed to heal them.

Internally, good food and wine are generally required, and every measure calculated to augment the vigour. The bowels are frequently costive in patients suffering from indolent sores, and in females the menstruation will often be found deficient or irregular. These conditions must be corrected, and tonics or alteratives used as the case may require. Warm clothing, free exercise, warm bathing, &c. are all most useful adjuvants to the local treatment.

4. *Of ulcers failing to heal from peculiarity of action*, the treatment consists in using local and constitutional remedies, according to their general features—according as they belong to either of the classes already described (sores failing to heal from excess or defect of action) *plus* the special remedy which the "peculiarity" demands. Thus the "scrofulous" ulcer requires the employment of all those hygienic measures, as to diet, exercise, country air, sea-bathing, &c. which have so great an influence in controlling the constitutional dyscrasia on which these ulcers depend; together with the administration of alteratives, cod-liver oil, iodine, iron, phosphorus, &c. as is usual in such cases, while the sore itself generally requires stimulation. A wash of chlorate of potash alone or combined with an astringent is frequently useful; as is iodine also, and tannin with red wine, but the constitutional error is the key to the presence and treatment of these ulcers. The digestive organs are usually weak and deranged, and their function must be corrected. If there is bone disease it must be looked to; and if the skin surrounding the sore is much diseased, it is, perhaps, best to destroy it wholly by caustic or a blister, and start with a fresh surface. The deformed and unsightly cicatrices may be corrected by the application of iodine or blistering liquid, carefully watched, so as not to overdo their action, or, what is often better, when circumstances (position, extent, state of surrounding parts, &c.) admit, excise the cicatrix, and bring the lips accurately and

carefully together. Chlorinated washes will improve their colour in many cases.

The "syphilitic" ulcer. The constitutional treatment of secondary and tertiary syphilis is carefully considered in its own place in this work, and to that the reader is referred. The ulcers with which we have to deal are usually accompaniments of the tertiary stage, and thus iodide of potash or iron become the most valuable remedies for internal use, while the local lesion is treated according to its characters. If any inflammation be present, it must be subdued, and then applications of a soothing or stimulating nature employed, according to the need of the sore. If a stimulant is wanted, any metallic lotion is just as good as black wash, to which preference is commonly given from some obscure idea of its peculiar appropriateness to a syphilitic sore. These ulcers are very apt to recur, and the part should therefore be long supported by a bandage, and the vigour of the general system well sustained.

The "vicarious" or "hæmorrhagic" ulcer, if dependent on irregularity in the uterine function, will require such irregularity to be corrected before the local affection can be set right. Beyond this, it demands such measures as its character at the time indicate,—according as it fails to heal from excess or defect of action. For mere bleeding, as from the erosion of a blood-vessel, elevation and compression by proper bandaging is what is required.

The treatment of "cancerous" ulcers is more properly taken up in the Article on "Cancer."

The "glanderous" ulcer is also considered with the constitutional disease of which it forms an important part.

The "mercurial" ulcer requires stimulation locally, according to its degree of want of vitality, and the internal use of tonics, especially iron with the iodide of potash, and every means to improve the general health.

The "gouty" ulcer, besides the internal remedies which the diathesis lacks, will heal best by the local use of a gentle stimulant dressing, but otherwise they must be managed on general principles according to their individual requirements. If there is much local gouty deposit the ulcer will rarely heal till the whole of that material has been extruded.

The "scorbutic" ulcer, besides the remedies addressed to the constitution, will require astringents and stimulants as a rule, together with water strapping and careful bandaging. Sometimes the local treatment is better begun by the free destruction of the sore with nitric acid, especially if it shows a tendency to sloughing; lotions, containing iron, chlorate of potash, citric acid, aromatic infusions, &c. The pulp of the lemon is a favourite application with some, as is animal charcoal with others. These sores will disappear with the general constitutional disease on which they depend, but they are very apt to reappear on any failure of the general health.

The "eczematous" or "dartrous" ulcer must be treated, so far as the sore is concerned, according to its condition and tendencies, but the eczema which surrounds it, and which gives to the affection, when seated on the leg, the common designation of the "weeping leg," is in general, if not very severe, successfully treated by being kept as dry as possible, by the application of some absorbent

powder, such as starch or chalk, dusted over it, and covered with a dry piece of lint and a bandage from the toes. If crusts form by the discharge and powder combining, they should be removed by the application of a poultice for a few hours, or by covering the part with strips of cloth on which the tar ointment has been spread, leaving these on for the night, and removing them smartly next morning, so as to take the crusts off at the same time, and then resuming the dry powder and bandage. The writer has had much to do with these cases, and has (contrary to what is often stated as regards the management of eczematous sores) found more benefit attend the dry treatment than any other, when the affection was not very severe. When there is a very profuse exudation, a strong solution of lunar caustic brushed over the part, followed by careful bandaging, suits well, but wet strapping has, in the writer's experience, generally proved hurtful. Ointments should never be used. It will, of course, be necessary to administer appropriate constitutional remedies in those cases in which the local affection is evidently dependent on a constitutional cause.

"Varicose" ulcers especially require well-adjusted bandaging. The state of the veins on which they depend, may be such as to demand the adoption of some of those many methods which are elsewhere (see "Varix") described as aiming at their occlusion, but such is rarely the case when palliative measures are judiciously employed. Water strapping, or Baynton's method, are especially adapted for these ulcers. Elastic stockings should not be used so long as the sore is open, as the discharge soon destroys their tissue, and unequal pressure is the result, and dressings cannot be applied to the sore without unduly augmenting the pressure there. When, however, the ulcer is healed, and support is required for the veins, then such stockings are very appropriately employed. Our local measures must be regulated according to the state of the sore, combined with such means as will take off the pressure of the column of blood and support the dilated and weak veins. If the sore is irritable and the part swelled, we must keep the patient in bed, and elevate the limb before any bandaging is attempted, and any internal affection which may complicate local matters treated on general principles. The liver and bowels should be unloaded; the menstruation, if irregular or scanty, cared for; and displacement of the womb corrected, and gout or other constitutional state combated.

The limb must be always supported after the healing of these sores, by a bandage or an elastic stocking, and if the latter is employed, the limb should be washed with soap and water, and hard rubbed every night before going to bed, and again douched with cold water and rubbed up towards the trunk while it is kept elevated, before putting on the stocking in the morning.

Sometimes, though rarely, after the long existence of varicose ulcers, the tissues have become so changed, that healing is impossible, and amputation must be performed, if an actual necessity exists for removing the sores, from their having become a source of exhaustion and annoyance.

If an ulcer depends on the presence of any foreign body, such as a piece of dead bone, or tendon, or a ball, these must of course be removed,

and any sinus present opened up and made to heal by granulation.

Ulcers of special parts, such as the tongue, throat, rectum, penis, &c. will be considered under other sections of this work. These sores are usually specific.]

George H. B. Macleod.

Consult *Michael Underwood*, On Ulcers of the Legs, &c. 8vo. Lond. 1783; and *Surgical Tracts*, 3rd ed. 1799. *B. Bell*, On the Theory and Management of Ulcers, &c. ed. 8vo. 1791. *J. Merk*, De Curatationibus Ulcerum difficilium præsertim in Cruribus Obviorum, 4to. Goett. 1776. *G. A. Brambilla*, Delle Ulcere delle Estremità Inferiore, 4to. Milano, 1793. *Baynton's* Descriptive Account of a New Method of Treating Old Ulcers of the Legs, 1799, ed. 2. 8vo. Bristol, 1799. *Whately*, On the Cure of Wounds and Ulcers on the Legs, without Rest. 8vo. Lond. 1799. *Sir Everard Home's* Practical Obs. on Ulcers on the Legs, edit. 2, 1801. *John Bell*, Principles of Surgery, vol. i. 1801. *J. Hunter*, On the Blood, Inflammation, &c. *C. Curtis*, An Account of the Diseases of India, &c. with Obs. on Ulcers and the Hospital Sores of that Country, &c. 8vo. Edin. 1807. *Sir Benjamin Brodie*, On Varicose Veins of the Legs, in *Med.-Chir. Trans.* vol. vii. p. 195, &c. *P. J. Roux*, Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie angloise avec la Chirurgie française, p. 142, &c. Paris, 1815. *Dr. John Thomson's* Lectures on Inflammation, p. 423, &c. Edin. 1813. *Dr. Dewar*, On the Treatment of Sinuous Ulcers, in *Med.-Chir. Trans.* vol. vii. p. 482, &c. *Sir A. Cooper's* Lectures, vol. i. 1824. *C. Rust*, De Ulcerum Diagnosi, et Ætiologia Nonnulla, 4to. Berolini, 1831. *P. Duchâtelot*, Sur la Véritable Cause des Ulcères qui affectent fréquemment les extrémités inférieures d'un grand nombre d'artisans de la ville de Paris; in *Annales d'Hygiène publique*, &c. t. iv. p. 239, 1830. The stages of several cutaneous affections, attended with ulceration, have been excellently described by *William Bateman*, *Alibert*, *Rayer*, and others. *R. A. Stafford*, On the Deep and Excavated Ulcer, 8vo. Lond. 1829. *John Higginbottom*, On the Nitrate of Silver, 8vo. Lond. 1829. *J. C. Spender*, On Ulcerous Diseases of the Leg, 8vo. Lond. 1835. *Fred. Skey*, On the Cure of various Forms of Ulcer and Granulating Wounds, 8vo. Lond. 1837. *Robert Liston*, On Practical Surgery, p. 261. 8vo. Lond. 1837. *P. F. Blandin*, in *Dict. de Méd. et de Chir. pratiques*, art. *Ulcère*. *J. Arstruc*, Traité des Tumeurs et des Ulcères. Paris, 1759. *Bologninus*, De Cura Ulcerum exteriorum, Chirac Dissertation on Wounds, 1759. *Rowley*, Essay on the Cure of Ulcerated Legs, without Rest, 1771. *Boyer*, Maladies chirurgicales, vol. ii. Paris, 1826. *G. M. Scavini*, Sull' Efficacia del Calorico nella cura delle Ulcere. Torino, 1814. *Amard*, Mémoire sur les Ulcères en général. Paris, 1802. *Carrault*, Essai sur les Ulcères de la Peau. Paris, 1819. *Vincent's* Observations on Surgery, Compendium de Chirurgie pratique, par Denonvilliers et Gosselin, vol. i. p. 557, et seq. [*Paget*, in *Holmes' System of Surgery* (1860) and *Lectures on Surgical Pathology*, 1863. *Erichsen's* Science and Art of Surgery, 1864. *Synges* Principles of Surgery, 1863. *Miller's* System of Surgery, 1864. *Critchett*, On Ulcers. Lond. 1849. *Nélaton*, Elémens de Pathologie chirurgicale. Paris, 1844, vol. i. *Vidal* (de Caseis) Traité de Pathol. externe. Paris, 1861, vol. i. *Chelius's* System of Surgery, edit. by South, vol. i. *Rigand*, Des Ulcères en général. Thèse. Paris, 1839. *Pirie*, Principles of Surgery. *Lawrence*, Lectures on Surgery. Lond. 1863. *Nunn*, Varicose Veins and Ulcers. Lond. 1852. *Macleod*, Outlines of Surgical Diagnosis. Lond. 1864, "Ulcers." *Scott*, On Diseases of Joints, by Smith. Lond. 1857, p. 87. *Trastour*, on Iodide of Potash in Ulcers of the Legs. *Ann. de Thérap.* 1860, p. 233. *Hutchinson*, Report on Rodent Ulcer, *Med. Times and Gazette*, Aug. 18, 25, and Sept. 8, 15, and 29, 1860. *Bruce*, on Congenital Ulcer of the Leg, *Edin. Monthly*, Nov. 1861. p. 492. *Houghton*, On Hunt's method of Treating Ulcers; *Brit. Med. Jour.* 1862, vol. i. pp. 91 and 129. *Volkmann*, On Healing of Ulcers under Scabs; *Arch. f. klin. Chir.* iii. p. 272. *Tart*, On the Treatment of obstinate Ulcers by Tinct. of Cantharides; *Prov. Med. and Surg. Journ.* Oct. 1851. *Short*, On same Remedy in Scrofulous Ulcers; *Indian Annals of Med. Science*,



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[**UNGUENTUM ACONITIÆ.**—*R* Aconitiæ gr. viij. Sp. Vini Rect. ʒss. Adipis ʒj. Misce.—A powerful anodyne ointment, used for the relief of neuralgic and other local pains. The intensely poisonous nature of aconitine must be borne in mind, and it should only be used with great caution, and over a limited extent of surface.]

**UNGUENTUM ANTIMONII POTASSIO-TARTRATIS**, vel **ANTIMONII TARTRATI.**—*R* Antim. Tart. ʒij. Adipis ʒj. Misce.—Frequently used for exciting irritation, pustules, and even ulceration of the skin, with the view of relieving diseases in the vicinity of the ulcerated part, as is exemplified in the treatment of some diseases of the eyes and joints, and a variety of indolent swellings.

[**UNGUENTUM ATROPIÆ.**—*R* Atropiæ gr. viij. Sp. Vini Rect. ʒss. Adipis ʒj.—Employed for the relief of local pain, or round the eyelids, to produce dilatation of the pupils, though the solution of atropine is usually preferred for the latter purpose. The powerfully poisonous nature of this alkaloid must always be remembered.]

**UNGUENTUM CETACEI.**—*R* Cetacei ʒv. Cerae Albæ ʒij. Olei Amygdalæ Oct j. These are to be melted upon a slow fire, and then briskly stirred till cold.—This ointment, spread on lint, serves as a simple dressing for wounds, ulcers, &c.

[**UNGUENTUM CREASOTI.**—*R* Creasoti ʒj. Adipis ʒj.—Used as a dressing for foul sores, and for various skin eruptions; especially those of the scalp.]

**UNGUENTUM ELEMI COMPOSITUM.**—*R* Elemi lbj. Terebinthinæ ʒx. Sevi Ovilli præparati lbj. Olei Olivæ ʒij. Melt the elemi with the suet; remove them from the fire, and mix them immediately with the turpentine and oil. Then strain the mixture.—Sometimes employed as a stimulating dressing.

**UNGUENTUM GALLÆ.**—*R* Gallarum Pulveris ʒiv. Camphoræ vel Opii purif. ʒss. Adipis ʒj. Misce.—A common application to piles, after their inflammatory state has been diminished by cold lotions, bleeding, aperient medicines, and leeches. The Unguentum Gallæ c. Opio is made by the addition of ʒss. of powdered opium to the above.

**UNGUENTUM HYDRARGYRI FORTIUS.**—See MERCURY.

**UNGUENTUM HYDRARGYRI BINIODIDI**, vel **IODIDI RUBRI.**—*R* Hydr. Biniodidi gr. xvj. Adipis ʒj.

**UNGUENTUM HYDRARGYRI PROTOIODIDI**, vel **IODIDI VIRIDIS.**—*R* Hydrarg. Prot.-Iod. ʒj. Adipis ʒj.—Both are good applications to many obstinate ulcerations about the face, and in other situations, and especially to those which are of the nature of lupus. They are also applied to scrofulous and cancerous ulcers.

**UNGUENTUM HYDRARGYRI CAM-**

**PHORATUM.**—*R* Unguenti Hydrargyri ʒj. Camphoræ ʒss. Misce.—Often recommended to be rubbed on thickened indurated parts, with the view of exciting the action of the absorbents. Rubbed along the course of the urethra, it is serviceable in the chronic stage of chordee.

**UNGUENTUM HYDRARGYRI MITIUS.**—*R* Unguenti Hydrargyri Fort. lbj. Adipis lbj. Misce.—The weaker mercurial ointment is often rubbed on indurated, thickened parts and tumors, when the object is merely to promote their absorption; and it is not advisable to employ the Unguentum Hydrargyri Fort. lest a salivation should be induced.

**UNGUENTUM HYDRARGYRI NITRATIS.**—This ointment forms an eligible stimulating dressing for numerous sores. It is efficacious in porrigo, lupus, and other cutaneous diseases.

**UNGUENTUM HYDRARGYRI NITRICO-OXIDI**, vel **OXIDI RUBRI.**—*R* Hydrargyri Nitrico-oxydi ʒj. Cerae Albæ ʒij. Adipis præpar. ʒvj. Misce.—This is a common stimulating application to indolent ulcers, and sores in general.

**UNGUENTUM HYDRARGYRI PRÆCIPITATI ALBI**, vel **H. AMMONIO-CHLORIDI**, vel **H. AMMONIATI.**—*R* Hydrarg. Præcip. Albi ʒj. Adipis præparatæ ʒiss. Misce.—Sometimes applied in cases of porrigo, and as a mild mercurial stimulating dressing.

**UNGUENTUM IODI.**—*R* Iodinii gr. xxxij. Potassii Iodidi gr. xxxij. Spir. Rectif. ʒj. Adipis ʒij.—Frictions with it over bronchocele, and glands in the state of chronic enlargement, frequently prove useful.

**UNGUENTUM PICIS LIQUIDÆ.**—*R* Picis ʒv. Cerae Flavæ ʒij.—Applicable to porrigo, and some other diseases of the skin.

**UNGUENTUM PICIS CUM SULPHURE.**—*R* Unguenti Picis, Unguenti Sulphuris, sing. ʒiv. Misce.—One of the most common applications to porrigo.

[**UNGUENTUM PLUMBI ACETATIS.**—*R* Plumbi Acetatis gr. xij. Adipis Benzoat. ʒj.]

**UNGUENTUM LIQ. PLUMBI SUBACETATIS.**—*R* Liquoris Plumbi Sub-Acetatis ʒv. Adipis lbj. Cerae Albæ ʒiv. Melt the ingredients together, and continue to stir them till —This ointment is employed with great advantage as a simple dressing. According to Mr. Dunn, of Scarborough, it is much improved by pouring the liquified mixture, before the lead has been added to it, into cold water. It is then to be rubbed in a mortar, or on a slab, with the liq. plumbi acet. The water occasions a fine white cloudy precipitation, which gives to the composition a better appearance.

[**UNGUENTUM POTASSÆ SULPHURATÆ.**—*R* Potassæ Sulphuratæ ʒss. Adipis ʒj.—Used for the cure of scabies. Must be prepared immediately before use.]

[**UNGUENTUM POTASSII IODIDI.**—*R* Potassii Iodidi gr. lxiv. Potassæ Carbonatis gr. iv. Aquæ Destill. ʒj. Adipis ʒj.—Used for the same purposes as the Ung. Iodi.]

**UNGUENTUM RESINÆ.**—*R* Resinæ Flavæ ʒviij. Cerae Flavæ ʒiv. Ung. Simplicis ʒxvj.—This is a common application to ulcers which stand in need of being gently stimulated.

**UNGUENTUM SULPHURIS.**—*R* Sulphuris Sublimati ʒj. Adipis Benzoati ʒiv.—The common itch ointment.

**UNGUENTUM VERATRÆ.**—℞ Veratræ gr. viij. Adipis ʒj.—Ol. Olivæ ʒss. Put the veratria first with the oil, then mix with the lard.—Veratria ointment was much commended by Dr. Turnbull for neuralgia, dropsy, paralysis, rheumatism, &c.; and is employed with different proportions of the veratria in different cases. In neuralgic affections, sometimes it is applied at once in a stronger form, but, in the generality of cases, eight gr. to each ounce of lard are sufficient to begin with.

**UNGUENTUM ZINCI.**—℞ Zinci Oxydi gr. lxxx. Adipis Benzoatæ ʒj. Misce.—An astringent application, the uses of which are familiarly known.

**URETHRA.**—[Anatomical characters of the male urethra. The length of this canal in the adult has been differently stated, for it varies considerably in different subjects, as it does also in the same individual under different circumstances, since the parts are exceedingly extensible, and may be readily made to correspond to any given measurement. Thus, after death, the parts being removed from the body and moderately extended, the average result of the measurements made by the writer in sixteen adult bodies was as follows :

Total length, from anterior border of uvula vesicæ to meatus urinarius	
externus	8½ inches.
Length of spongy portion . . . .	6½ "
" membranous ditto . . . .	¾ "
" prostatic ditto . . . .	1¼ "
	—
	8½

The greatest measurement was 9 inches, the smallest 7¾ inches. Of the sixteen, no less than 10 presented measurements which did not deviate more than a quarter of an inch from the average, and ranging within ⅞ths of an inch only; that is to say, between 8½ and 8⅝ inches inclusive.

Mr. Briggs, formerly of the Lock Hospital, made numerous investigations upon the living subject, and found the average length of the urethra to be about 7½ to 7¾ inches. I have embraced many opportunities of testing his method, and believe his observations to have been in the main correct.

It will therefore be borne in mind that these two measurements of 7½ inches and of 8½ inches respectively relate to the average length of the urethra in the two conditions of life and death. That this difference exists it will be important to recollect, since all accurate researches into the pathological anatomy of stricture are, of necessity, confined to an observation of the parts *after death*, while, in relation to treatment, the measurement *during life* is that which alone must be remembered.]

Other authors have variously estimated the different divisions of the urethra. Thus, the length of the prostatic part is regarded as measuring from fifteen to eighteen lines (*Boyer*); twelve to fifteen (*Phillips*); six to ten (*Malgaigne*); twelve to fifteen (*Ducamp*); eight to eleven (*Lisfranc*); that of the membranous, or muscular portion, from five to eight lines (*Malgaigne*); nine to ten (*Ducamp*); about twelve (*Boyer*); and seven to eleven (*Lisfranc*). "Its extent is not the same superiorly as inferiorly. Here it is very short, limited in front by the posterior extremity of the bulb, and behind by the prostate; so that supe-

riorly its length is about an inch, and inferiorly, four or five lines" (*Phillips*).

[Next, as to the width of the passage. This it is difficult to reduce to figures, from its natural dilatability in the healthy condition. Anatomists have stated three, four, or five lines as approximate measurements. Surgeons have recorded the passage of calculi through it of three and a half to four lines in diameter, which must of course indicate the amount of *extensibility* enjoyed by the narrowest portions of the canal. The mucous membrane after death is found lying in long, but minute and narrow folds, which are readily obliterated by stretching it in a transverse direction, when laid open, to about double its natural width.

The important point is, that, relatively to each other, different parts of the canal bear certain constant proportions. For example, the external meatus itself is the smallest, except when, as very rarely happens, a congenital contraction exists about a quarter or half an inch from the extremity, and of course within view; next is the point of junction between the membranous portion and the bulb; while the centre of the prostatic portion, and the sinus of the bulb, are the largest. But it should be remembered that the walls of the passage are closely applied to each other in a state of inaction, so that the diameter is only calculable when distension occurs from some cause; and as this has been seen to correspond, within certain limits, to the amount of pressure exerted upon them, any statement respecting it must be liable to some modification. Indeed, the question of the diameter of the urethra must be considered as resolving itself, to a certain extent, into the *measure of its capability of being extended*, and this is of greater practical import than the mere width of its mucous membrane when slit up after death.

In regard to the course or direction of the canal, the spongy portion is the most movable part; its anterior half at least, taking any direction (in the flaccid condition of the penis); which gravity or applied force may give it. As it approaches the pubes, it becomes more fixed; the penis being here suspended by a ligament, and the crura or bases of the cavernous bodies which form it being attached to the pubic rami, while the bulb is closely connected to the deep perineal fascia. The canal now curves to pass beneath the pubic symphysis, and will follow a course varying slightly in direction, according as it lies nearer to, or more distant from, that point: the extreme variations which I have noticed in adults, amounting to about a quarter of an inch, that is to say, the urethra perforates the fascia at a distance below the pubic arch, which varies in different subjects from seven-eighths of an inch to one inch and an eighth.

The membranous portion in the erect position of the body, ascends with a slight curve, which direction is continued through the prostate, until at last the course of the urethra into the bladder is almost vertically upwards.

The practical points to be noted, are—First: That the lowest part of the passage in the upright position of the body is that part which is in contact with the anterior layer of the deep perineal fascia; and that the floor at this point forms, to some extent, a fulcrum upon which the instrument turns, when its handle is depressed for the purpose of carrying the point onwards into the bladder. Secondly; respecting the influence of the perineal



fascia, at its point of contact with the urethra, the anterior layer exerts the larger share in stopping the progress of an instrument; indeed the posterior, from the contiguity of the prostate, can scarcely be supposed ever to become an obstacle. The bulbous portion, which is very dilatable, permits more freedom of motion in the point of a sound here than elsewhere, while the unyielding fascia around the commencement of the membranous part suddenly limits it. Hence this is a point at which the progress of the instrument is sometimes arrested, even when no stricture exists, although the slightest management is usually sufficient to overcome the difficulty. Thirdly; that the urethra follows a curved course beneath the pubic symphysis, and in so doing describes the arc of a circle, whose diameter depends somewhat upon the operation of certain causes which influence its direction. It follows, therefore, that the curves of instruments employed to traverse it may advantageously vary also.

There are many circumstances, however, which exist in a state of health materially to influence this direction.

In spare men, of small frame, the curve of the canal is sometimes more acute; on the other hand, in corpulent subjects, as a rule, the curve is diminished, and the angle which the plane of the bulbous portion forms with that of the prostatic part is more obtuse, as these parts are more widely separated by the intervention of masses of adipose tissue.

There are also certain circumstances which render it desirable to use instruments more strongly curved than those required for the healthy adult male. In childhood the bladder is situated higher behind the pubis, being, in fact as much in the abdomen as in the pelvis. In the enlarged prostate of elderly men the course of the urethra is often greatly curved (see article DISEASES OF THE PROSTATE); and in both classes of cases such instruments are necessary.

The normal direction of the urethra may be interfered with by certain morbid conditions of neighbouring parts. Thus, deformity of either corpus cavernosum from contraction of lymph effused into its substance, may distort the passage by deflecting it to either side. Prostatic enlargement has been alluded to; hypertrophy of the median portion or "third lobe" has been seen to occasion a channel on either side, thus dividing the canal in two. Abscesses, tumors in the course of the canal, most frequently within the pelvis, which may be malignant, hydatid, &c.; scrotal herniæ of large size, and hydrocele, may all occasion some deviation from the usual direction.

Lastly: it must not be forgotten, that while the course which the urethra naturally describes is thus curved, a straight instrument may be passed with perfect ease, without inflicting any injury upon it. The curve is in this case obliterated, by using the portion which is anterior to it as a fulcrum, by which to carry the point closely along the roof of the canal throughout its course. A moderate amount of pressure is at the same time requisite, in order thus to alter the direction of the canal.]

*Henry Thompson.*

URETHRA, FALSE PASSAGES IN.—See STRICTURES OF, TREATMENT BY DILATATION.

URETHRA, DESTRUCTION OF PART OF THE.—The attempts to complete the canal by plastic operations, will be noticed in the article URINARY FISTULA.

URETHRA, STRICTURES OF.—[Stricture may be defined as an abnormal contraction of some portion of the urethral canal. But contraction may be of a permanent character; or it may be only temporary in its duration. It is to the former kind that the term stricture is generally and most correctly applied.

A permanent contraction is due to organic deposit in or around the walls of the urethra, and is accordingly termed organic or permanent stricture.

A transitory contraction may be due either to local vascular inflammation or congestion, causing temporary narrowing of some part of the urethra, hence inflammatory or congestive stricture is spoken of; or, to unwonted muscular action alone, of the voluntary or of the involuntary fibres, in which case it is designated spasmodic stricture. This spasmodic affection of the urethra may exist alone, but in a very large majority of cases it is found to complicate the first and second varieties. Purely spasmodic stricture is very rare, but spasm may complicate and aggravate an existing organic stricture. The term spasmodic has been used to include the few cases in which spasm is the sole or chief source of obstruction. So when inflammation attacks any part of the urethra, anterior to the prostate, and the obstruction is due mainly to it, the term inflammatory stricture has been employed. And finally, when organic deposit around the canal has occasioned permanent narrowing of it, although inflammation and spasm may either or both be also present, the terms organic or permanent are employed because they convey to the mind what are the *essential* causes and character of the contraction of the canal.

Permanent organic strictures present themselves in a great variety of forms. The urethral canal may be obstructed by a thin membranous diaphragm only, stretched across it, with an aperture in the centre, or, as is not unfrequently the case, placed near to any side of it, having an appearance, in relation to the rest of the passage, somewhat resembling that which the pyloric orifice of the stomach bears to the adjacent duodenum. It occasionally happens that we meet with folds of the mucous membrane obstructing the passage at one of its sides only; this may occur above, below, or on either side, forming a crescentic septum, obstructing a segment of the calibre of the canal. Similar folds sometimes run obliquely instead of directly across it, all being, nevertheless, examples of linear contraction. Those instances in which the contracted part is a little thicker and broader than the foregoing description would include, have been termed "annular" strictures, examples which present an appearance as if a piece of cord had been tied round the canal at one point, leaving the remainder free.

But in most cases of confirmed stricture, the induration is seen to extend into the tissues around the urethra, to the depth of half a line or a line; but is nevertheless limited in extent from before backwards, to a space occupying less than half an inch of the canal. The centre of the space is the point at which the contraction is most considerable, so that the affected portion presents a form somewhat resembling that of an hour-glass: and it is

worthy of remark that the induration is generally thicker at the floor than on the upper aspect of the urethra. Such may be regarded as "indurated annular" strictures.

In a few instances, some of the natural rugæ of the urethra seem to be adherent, or even fused together, for the space of a few lines in length. In very rare cases we find something resembling a cicatrix in the form of a patch of indurated tissue, around which the mucous membrane is puckered, in lines more or less radiating from it; the amount of contraction appearing to correspond with the extent of previous loss of substance from some cause or another. But occasionally the contraction extends longitudinally for a considerable distance, and the canal is narrowed, and its walls thickened on all sides, for a length of one or more inches. In these cases the induration extends deeply into the surrounding tissues, involving sometimes the entire substance of the corpus spongiosum, and giving rise to some of the most obstinate and undilatable strictures. In other instances, the urethra is irregularly contracted throughout almost its entire course; and every degree of variation is to be met with, between the condition in which the only obstacle within it is a small fold of mucous membrane, and that in which almost its whole length is more or less affected.

Occasionally several separate strictures may be observed in the same subject. John Hunter records an instance in which he met with *six* strictures in one urethra. Lallemand mentions one with *seven*; Colot saw one with *eight*; Ducamp says there are rarely more than two, but that he has seen *four* or *five*. Boyer thought *three* could exist together. Rokitsky speaks of four, and does not record a higher number as having come under his own personal observation. My own researches have not led me to recognise numerous independent strictures in one urethra. Three, or at the most four, *distinct* contractions is the highest number I have been able to discover, but such instances are very rare. A few examples of urethra greatly contracted, from the meatus externus almost to the membranous portion, are in existence; but these do not exhibit a multiplicity of strictures so much as general thickening and coarctation of the canal.

*The elements and seat of Stricture.*—Their consideration may be advantageously entered upon together. The first effect of inflammation upon the mucous membrane is a swelling or thickening of it, caused by engorgement of the vessels. Then exudation of fluid takes place into its substance and into the tissues beneath, presenting the condition which exists in the mere inflammatory stricture, one of the transient forms of the affection because resolution readily follows. But when the morbid state persists, a firm fibrous tissue is formed in and around the canal, which has the effect of gluing the mucous membrane to the submucous tissue, infiltrating the meshes of the latter, and even involving the investing fibrous coat of the corpus spongiosum itself; while repeated or long-continued attacks of inflammation may cause it to extend throughout the entire thickness of that body, rendering it tough and dense to an extent, in some cases, almost beyond belief. Sir Charles Bell describes the strictured part, in one of his preparations (now in the Museum of the College of Surgeons, Edinburgh, 2169 xxxii. G), as being "as hard as a board."

On laying open a strictured urethra after death, we shall accordingly discover that the structure in which the constriction itself is seated is by no means always the same. It may be in rare cases almost confined to the mucous membrane of the urethra itself, although most commonly a few transverse bands of whitish fibres are seen beneath, encircling the urethra and narrowing it as if it were tied with thread. When these are cut, the mucous membrane is more or less set free; hence it is that a stricture which has been exceedingly narrow during life is often less obvious to the eye when the urethra is laid open after death than would have been anticipated. The mucous membrane at the constricted point then appears narrower than the healthy part, but less so than one might have believed from the small calibre verified previous to the section of the urethral wall.

In more severe cases the meshes of the submucous cellular tissue are seen to be filled with lymph deposit, the presence of which destroys its elasticity and mobility, implicates the involuntary muscular fibres, which can no longer be traced, and extends to the proper fibrous coat of the spongy body.

*False Membranes obstructing the Urethra.*—A widely-differing condition to any of those above described has been referred to by some under the title of stricture. Sometimes, but by no means frequently, an exudative deposit upon the surface of the urethral mucous membrane, it is said, causes occlusion of the canal. Instances of this are certainly very rare. Few are on record, nor are many clear examples to be found in our museums. Rokitsky refers to them as follows:—"In very rare cases we find primary croup occurring on the urethral mucous membranes; it induces a circumscribed or a tubular exudation, according to the intensity of the process, and occurs chiefly in children." (*Path. Anat.* vol. ii. p. 235.) Mr. Hancock states that he has met with two or three instances, but he by no means believes them to be common. M. Alphonse Guérin, chirurgien du Bureau central in Paris, carefully examined 100 cases of diseased urethra after death, of which number about half were affected with stricture, and he asserts that he has never seen the "slightest trace of such tissue upon the surface of the mucous membrane; the plastic process has acted either immediately beneath the mucous membrane, or, in the spongy tissue of the canal." He adds, "that in none of the numerous cases which he has examined has he found any false membrane on the free surface of the mucous membrane."

*Degree of Contraction.*—Speaking in general terms, the degree of contraction is proportioned to the duration of the complaint, and to the extent of the inflammatory action which is set up in the tissues around giving rise to successive deposits within their substance; while the severity of the symptoms, the amount of distress, and the effects on the constitution, are not always, by any means commensurate with the amount of narrowing which exists. It is very rare indeed to find the urethra altogether impervious during life to the flow of urine. However contracted it may be, it still issues either in a very small stream, or by drops. Retention does not depend on absolute organic impermeability. It is easy to conceive that when the canal is contracted to a mere pin-hole, the slightest cause may operate to occasion total ob-



struction; a little tumefaction of the part, a pellet of thick mucus, a flake of fibrinous deposit, or a very small calculus, is quite sufficient to block up the channel; and fatal consequences have been so caused.

But do the walls of the contracted passage ever adhere, and so cause obliteration of the urethra? Never, unless fistulæ have been established, when, although very rarely, this accident may happen in that part of the canal which is anterior to the unnatural opening, and which is thus deprived of its function as an excretory channel. In such instances, obliteration is often of traumatic origin. The urethra may be cut across by a wound in the perineum, and for want of proper attention the urine may pass entirely through the artificial opening, and adhesion seal up the proper passage. But such obliteration is a wholly different thing from stricture, and ought not to be confounded with it.

Organic stricture, when unrelieved, tends to produce, sooner or later, a diseased condition of the contiguous portions of the urinary apparatus. The urethra behind the stricture expands under the influence of the expulsive efforts of the bladder telling on its walls. The urethral ducts and lacunæ are frequently enlarged to many times their size. Pouches are thus formed capable of entangling the point of a sound or bougie; and it is worthy of note that they are generally situated on the floor of the urethra. The sinuses, which lie on either side of the veru montanum, may be considerably deepened, giving that body an appearance of unusual enlargement or development, while the septa intervening between the dilated mouths of the prostatic ducts, present the appearance of narrow fibrous bands crossing each other in all directions, forming a network exceedingly adapted to entangle an instrument, especially after it has been passed through a tight stricture, since the power of manipulating its point with delicacy is diminished by the grasp which the contraction exerts upon it. The urethra may also become ulcerated in these situations, and may even give way altogether, extravasation of urine into the cellular tissue occurring as its result.

As a result of the same pressure, the bladder itself becomes hypertrophied, the subject of chronic inflammation, and often sacculated; sometimes losing the power to expel its contents. The ureters become dilated, and as the pressure of a distended bladder increases, the pelves and calices of the kidneys are expanded, and occasionally are so to an enormous extent. The kidney itself may ultimately be destroyed by atrophy through pressure, and by chronic inflammation.

In the writings of the old anatomists and surgeons, we find the symptoms of stricture attributed to a pathological condition very different from that which greater opportunities of prosecuting researches in morbid anatomy have led modern observers to recognise as their most frequent cause. They supposed that the flow of urine was interrupted by some growth into the urethra, analogous to those found in mucous canals elsewhere, and accordingly they named these supposititious bodies, "*fungi*," "*carinosities or caruncles*," and "*excrescences*," and presented them as the common cause of urinary obstructions.

In a very small proportion of cases these bodies certainly do exist, their extreme rarity, however,

must be inferred, not only from their very infrequent occurrence among the preparations in our Museums, but also in the records of their experience, which later anatomists have left respecting them.

I have met with a few instances of wart-like vegetations on the anterior part of the canal, which are very vascular, and which obstruct, to some extent, the flow of urine; and once I found a small polypoid tumor, more than half an inch long, springing from the veru montanum.

*Locality of Stricture.*—The statements made on this subject by surgeons have differed very materially, and, as it would appear, rather from the want of precise researches respecting it, than from any other cause. Most have given their impressions from passing instruments on the living subject; a few only have closely examined it by post-mortem researches. Thus John Hunter says:—"Every part of the urethra is not equally subject to stricture, for there appears to be one part which is much more liable to them than the whole of the urethra besides, i.e. about the bulbous part. We find them, however, sometimes on this side the bulb, but very seldom beyond it. I never saw a stricture in that part of the urethra which passes through the prostate gland." Sir E. Home:—"Strictures occur most commonly just behind the bulb of the urethra; the distance from the external orifice being six and a half or seven inches." Sir B. Brodie:—"In the majority of instances the disease began in the anterior portion of the membranous part of the urethra, behind the bulb, and in the situation of the triangular ligament of the perineum." Mr. Liston:—"The passage is contracted at various parts; most frequently at about four inches from the meatus, but sometimes much nearer, and even close to it. The urethra is often enough narrowed as it passes through the deep fascia, betwixt its sinus and the apex of the prostate." Mr. Shaw:—"I have not, in more than a hundred dissections which I have made of the diseases of the urethra, seen a stricture or narrowing of the canal posterior to the ligament of the bulb; nor have I been able to find one example of stricture beyond this part among those preserved in the College Museum." Mr. Benjamin Phillips:—"In a hundred and seventy-three cases which I have selected, the disease was seated at the following distances from the orifice of the urethra:—

" In 9	the distance did not exceed 1 inch.
" 8 from . . . .	1 to 2 inches.
" 13 from . . . .	2 to 3 "
" 11 from . . . .	3 to 4 "
" 98 from . . . .	4 to 5½ "
" 40 from . . . .	5½ to 6½ "
" 10 from . . . .	6½ to 7½ ins."

Amussat "finds that the most common seat of the disease is in front of the junction between the bulb and the membranous portion." Leroy d'Etiolles:—"Nineteen-twentieths of strictures exist at a depth which varies from five to six inches, that is to say, immediately behind the bulb, at the commencement of the membranous portion."

I have myself examined all the preparations in the Museums of the metropolis; in that of the Royal College of Surgeons, Edinburgh, as well as a few in Paris, for the purpose of determining, if possible, this question. In doing so I carefully inspected 300 preparations, of which 270 were available for the purpose of enquiry: they con-

tained 320 strictures. All these may be arranged in the three following classes:—

I. *Strictures occurring at the Sub-pubic Curvature.*—The latter term being understood to comprise an inch of the canal before, and three-quarters of an inch behind, that point, thus including the whole of the membranous portion. 215 were situated in this region, or sixty-seven per cent. of the entire number. The precise part which is most frequently affected with stricture is the bulbous portion. The liability to stricture appears to diminish as it approaches the junction of the spongy and membranous portions; while behind it is very rare. Very rarely is a stricture found so far back as the membranous portion.

II. *Strictures occupying the Centre of the Spongy Portion*, i.e. a region extending from the anterior limit of the preceding to within two inches and a half of the external meatus, and measuring therefore about two inches and a half to three inches in length. Fifty-one were situated in this region, or sixteen per cent. of the entire number.

III. *Strictures occurring at the External Orifice, and within a distance of two inches and a half of it.*—Fifty-four were situated in this region, or seventeen per cent. of the entire number.

It should be added that there is not a single case of stricture in the prostatic portion of the urethra to be found in any one of the public Museums of London, Edinburgh, or Paris. I am disposed to believe that some observers have been deceived in reference to it, or that it owes its supposed existence to inferences drawn from the results of examinations of the living body, which can by no means be admitted as evidence on this subject.

One of the earliest symptoms of stricture usually noticed is a little gleet discharge, almost constantly present. Some pain is felt in the urethra, or smarting when the urine is passed. The contents of the bladder are emptied at shorter intervals than has been natural. The stream is altered in form, not having the full rounded character of health, but more or less flattened; it may be twisted, spirting, forked, or even divided, which conditions are caused by the current of water being insufficient in size and force to dilate and extend the lips of the meatus externus. At the same time, it must not be concluded that the existence of such a stream is by any means, *per se*, a proof that stricture exists, since many persons, from a tumid condition of the meatus alone, habitually pass such an one. Then gradually, as contraction increases, or as fresh obstacles occur in other parts of the urethra, it grows smaller, and in time the urine may issue only by drops. Meantime, although the force by which it is propelled, viz. the contractile power of the bladder, is augmented, there is little momentum in the current which leaves the meatus, and the urine cannot be projected to any distance. Generally speaking, the act of micturition is always prolonged to an extent corresponding with the degree of obstruction present.

One of the most distressing symptoms from which the patient suffers is the constant desire to make water, which is almost invariably present in severe cases. Thus the sleep is broken, or almost destroyed, some patients being compelled to rise from bed ten or twelve times in the course of the night, while, in the worst cases, or during temporary exacerbations of the complaint, a great portion of the time is spent in laborious and un-

availing efforts, by change of posture or by straining, to obtain some relief. Co-existent with these conditions there will be a sense of heat, soreness, or smarting experienced about the bladder, especially at its neck, aggravated by an excess of acid in the urine, by cold, or imprudence of any kind telling on the parts. Patients often experience much pain above and behind the pubes, a symptom generally significant of some degree of chronic inflammation affecting the mucous membrane of the bladder. Sometimes a dull aching pain in the perineum, or in the back and loins, is experienced; sometimes severe and darting pains in one or both testicles, extending to the spermatic cord, into the groins, or along the penis. Pain is often experienced in coition; and if the contraction be considerable, the semen passes backwards, in part or entirely, into the bladder, from which it is discharged afterwards, so that the power of fecundating may be lost from the mechanical obstacle to the act of ejaculation; or the erection may be rendered imperfect by effused lymph into the cells of the corpus spongiosum preventing the free circulation of blood through it. Difficult micturition also often occasions protrusion of the mucous membrane through the external sphincter, heat, irritation, and inflammatory thickening; so that prolapsus of the mucous membrane of the rectum is by no means an unfrequent consequence of a long-continued or tight stricture of the urethra. Some patients rarely attempt to pass water without visiting the water-closet, from their inability to prevent the escape of the contents of the rectum, through the efforts required for that purpose. Even herniæ of the intestine have sometimes occurred from the muscular exertions made use of to effect micturition.

Sometimes the first indication of the presence of stricture is the occurrence of complete retention of urine. The contraction has previously been insufficient to call the patient's attention to it; but either by exposure to cold, or after some unusual irregularity, or by too free indulgence, either in the use of alcoholic drinks, in sexual intercourse, or in both together, on the attempt to comply with an urgent desire to empty the bladder, which may have become rapidly full from the action of stimulus on the kidneys, the individual is astonished and alarmed to find himself unable to evacuate more than a few drops.

In a few instances the most prominent symptom throughout is retention. There may be but little irritability of bladder, and the stream of urine, when passed, is not necessarily very small; a No. 6 or 7 catheter may pass through the urethra; but the patient is very liable to retention, and finds no relief but from catheterism; attempts at dilatation are always followed by inability, more or less prolonged, to pass water, until an instrument of very large size has been reached.

Closely related to this condition is another, accompanying some forms of the disease, chiefly those of long standing, the prominent symptom of which is a tendency to rapid recontraction of the stricture after dilatation. It may be very amenable to this treatment, instruments of medium or even of full size may be introduced, sometimes in two or three sittings, but after a few days of cessation from treatment, the narrowing is as complete as ever, and a small instrument only can be passed. The symptoms are often severe, and find



a very temporary palliative in dilatation. These phenomena seem to arise from elasticity in the materials of the constricting tissue itself, which appears to possess almost the mechanical properties of india-rubber.

The urine itself also exhibits a tendency to change, which becomes more marked in proportion as the case advances without relief being afforded. Owing to the retention of a portion of urine in the bladder, from a deficiency of power on the part of the organ to empty itself, partial decomposition of the secretion follows, which in consequence irritates the mucous membrane with which it is in contact; and thus urine, cloudy, emitting a pungent ammoniacal odour, and depositing, as it cools, a quantity of pus and mucus, the products of inflammation of the bladder, is not an unfrequent accompaniment of stricture. This is the origin of the slimy tenacious deposit found adhering to the bottom and sides of the vessel containing it, and which is exceedingly characteristic. The urine is then alkaline, and usually deposits the triple phosphates. But in almost all cases some pus, however small in quantity, is present. Hæmaturia is also one of the occasional concomitants of stricture, although it is rare, except in advanced disease of the mucous membrane of the bladder.

As the case advances, attacks of complete retention become more frequent, leaving the stricture narrower than before. The urine is at length discharged by drops, so that a stream cannot be said to exist; sometimes it passes away involuntarily during the unconsciousness of sleep; and at length the patient loses the power to retain it altogether. This condition is often described, but not very correctly, as one of "incontinence." The symptoms on the contrary indicate that the bladder is distended, and that the *surplus only* runs off in the manner described, while the organ is constantly filled with the staler and more noxious portions of the urine, unless it be frequently emptied by the catheter. Thus it is a state of engorgement of the bladder with urine rather than of incontinence. The extent of dullness on percussion over the pubes will indicate not only that this condition exists, but what is the size of the tumor formed by the distended viscus. Under these circumstances, disease of the bladder is increased, and disorganisation more readily induced both in it and in the urethra than before. Thus the occurrence of extravasation and the formation of abscesses are favoured. (See URINARY ABSCESS, ETC.)

*Causes of Stricture.*—Most writers of eminence agree in considering organic stricture as the result of a previous inflammation of the urethra. Among these may be named Home, A. Cooper, Abernethy, C. Bell, Lawrence, Brodie, Liston, Civiale, and Leroy d'Etiolles. I have made some researches on the subject, and some years ago collected 220 carefully observed cases of urethral stricture, with the following results. Inflammation of the urethra, most commonly gonorrhœal, was the chief and prominent cause. Next came injuries producing traumatic stricture; these were usually blows on the perineum, occasioning rupture or bruising of the canal. Cicatrices following chancres at or near to the orifice of the urethra were not unfrequently causes. Caustic injections also, when producing inflammation; the judicious employment of weak astringent solutions, on the other hand, in

controlling and subduing inflammation, may certainly be regarded as prophylactic against stricture. In some few cases the affection has appeared to be almost congenital; that is, a strong disposition to discharge and inflammation of the urethral mucous membrane has been observed from childhood.

*Spasmodic Stricture.*—It is an open question whether any temporary narrowing or occlusion of the urethra, which is not due to a permanent deposit of organised material, in and around the passage, should be comprehended under the term stricture. It has been the custom, however, to use the term spasmodic stricture to denote temporary narrowing caused by abnormal muscular action, and hence the term has still been employed here. These cases are certainly very rare, and the student will do well to bear in mind that the great majority of cases of stricture consist in organic and permanent obstruction to the passage, and very few in mere muscular spasm. Further, that there are many instances of difficult or impeded micturition which are not due to stricture at all, and which may be erroneously regarded as the effect of spasm. Thus, many are caused by enlarged prostate gland (see PROSTATE GLAND, DISEASES OF); others are due to inflammation of the urethra; others to want of tone or power in the bladder to empty its contents; in some the cause is calculus in its interior; and in some the difficulty is due to tumor, or to other affection of the viscus itself.

All authorities, however, have recognised the fact that, any degree of organic stricture existing, the urethra is liable to be the subject of variation in its calibre from two complicating circumstances; viz. muscular contraction, and inflammatory action. And these two act conjointly, not often altogether alone. It is the former which we have now to consider. John Hunter believed muscular action of the urethral muscles sufficient in some few cases to occasion retention of urine (*On the Venereal*, 2nd edit. p. 229). Sir B. Brodie says,—“Instances are not wanting of persons who have been for a considerable time liable to occasional attacks of retention of urine from spasmodic stricture of the urethra, although in the intermediate periods there was no perceptible diminution of the stream of urine, and hence we are justified in the conclusion that a spasmodic stricture may exist independently of any actual organic disease. At the same time it must be acknowledged that the existence of a purely spasmodic stricture is of rare occurrence.” (*Urinary Organs*, 4th edit. p. 6.)

Modern anatomical researches, especially those of Kölliker and Mr. Hancock, have established the fact that the whole urethra is surrounded by muscular tissue, which may have some share in accounting for the spasmodic action referred to. But the main seat of such narrowing is, undoubtedly, the membranous portion which is habitually closed by the voluntary muscles of the part (constrictor urethræ), and which may be more firmly closed under the influence of irritation, either direct or reflex, so as to produce the abnormal obstruction denominated spasmodic stricture. The treatment must depend mainly on the cause which has occasioned the obstruction. If the urine is unduly acid or irritating, or loaded with lithates, we should act without delay on the liver and bowels; administer diluent drinks, small

doses of the nitrate with the citrate of potash, and if there is pain or straining, full doses of tincture of hyoscyamus, as from half a drachm to a drachm, pretty frequently repeated. But if retention is present, catheterism must be resorted to, and a well-warmed silver catheter, of moderate size, such as 7 or 8, may be slowly and gently passed, avoiding as much as possible the production of any unnecessary irritation in the manner of applying it. But in most cases a well-curved gum catheter is better borne, and especially if the urethra is irritable or in any degree inflamed. As adjuncts to other treatment, and to render unnecessary, if possible, frequent recurrence to the use of the catheter, hot fomentations to the perineum, or hot hip-baths, and linseed poultices to the hypogastrium, may be usefully employed. In some constitutions, the preparations of opium are more useful, either by mouth or rectum, but especially in the form of suppository, than any other means, to allay spasmodic action about the urinary passages.

*Inflammatory Contraction.*—When the mucous membrane of the urethra is the seat of acute inflammation, it becomes tumid, and the calibre of the canal is narrowed to some extent. In ordinary attacks, however, although the stream of urine is on this account a little smaller than in health, the alteration is not the most prominent symptom, and therefore attracts little notice on the part of the patient; moreover, it usually disappears with the subsidence of the acute symptoms. But if, by the application of too irritating injections applied in the early stage, the force of the inflammation is augmented; or if a profuse discharge be suddenly stopped, the affection is prone to extend more deeply, and stricture of a temporary kind and inflammatory in its character is the result. The distressing pain which accompanies these attacks marks the nature of their cause. Mere spasmodic closure of the canal *may* at first be attended with no pain, the patient not suspecting his inability to micturate until the attempt to do so is made. But when inflammation is the chief agent in producing retention in the manner described, a considerable amount of suffering precedes it. There are present unusual heat, sense of fulness and tenderness of the perineum; the stream of urine is at first gradually narrowed, and so painful is its passage to the exquisitely sensitive urethra, that the patient is wont to compare it to that of "boiling water or melted lead" trickling through it. It is then ejected in small and short jets with great force, at gradually lessening intervals, until the straining becomes almost constant, and it soon ceases to pass at all. The treatment of inflammatory contraction may be considered for the most part the same as that just described under the head of spasmodic stricture, with this distinction, that the remedies more adapted to subdue active inflammation are those on which most reliance must be placed. Thus also leeches or cupping to the perineum may be employed, sometimes with great relief. But, generally speaking, inflammatory contraction first comes under the surgeon's care when producing retention of urine, and under that head the subject of treatment will be further pursued. (See URINE, RETENTION OF.)

*Examination of the Urethra for Stricture.*—*Diagnosis.* The symptoms of stricture, however well marked, do not afford all the information re-

quired. It is necessary to ascertain whether a permanent obstruction exists, and, if so, at what part of the canal; whether it consists of one contraction only or of several; whether it involves a small or a large portion of the canal.

In order to do this, instruments of various forms and compositions may be used; some soft and pliable, others elastic, others inflexible and solid. Some surgeons use curved and some straight instruments for the purpose. Either may be readily passed into the bladder, but when solid instruments are employed the former are generally better, and it appears advisable to adopt a form which corresponds somewhat to the natural curve of the canal through which it is designed to pass. When bougies are very flexible, like the extremely useful soft black bougies, chiefly made in France, the straight instrument passes quite as easily as one which is curved. It finds, in fact, its own way in following the course of the urethra.

In introducing the curved silver catheter, it is desirable to follow a uniform plan; such a practice leads sooner to perfection in the art than can be attained when indifference to method exists. First, as to the position of the patient. It is usual in most cases to place him with his back against the wall. In this case, the heels should be eight or ten inches apart, and about four or five inches from the wall, so that the nates rest lightly against it behind, the toes turned a little outwards; in this manner a relaxed condition of the parts is favoured. An appropriate instrument having been selected, it should be warmed, and smeared with oil or lard. In introducing it, the handle should be lightly held between the thumb and the fore and middle fingers of the right hand, the concavity of the curve looking towards the left groin of the patient. The penis is now to be gently raised with the left hand, while the point of the instrument is inserted into the urethra and slowly carried onwards until four or five inches have disappeared, the handle being gradually brought to the middle line at the same time, and maintained close to the patient's abdomen until it has reached the perpendicular, when it is to be lightly depressed; and as the point is felt to traverse the sub-pubic curve, the handle is gradually brought down towards the operator, until it sinks beneath the horizontal line, when the opposite extremity will be free in the bladder. The more quietly, gently, and unostentatiously these manipulations are accomplished, the more credit will the operator obtain for the possession of a light and easy hand; a credit, let it be remarked, which is generally appreciated by the patient. Whatever obstruction is met with, no force is to be used. If difficulty occurs in the act of depressing the handle, just after this has reached the perpendicular, it very probably arises (supposing no organic constriction to exist) from making this alteration in its course too soon; and if the instrument be replaced in the perpendicular position and pushed onwards a little farther, before depression is made, very likely all will be right. If a solid sound of good size be used, and the urethra be healthy, its own weight is almost sufficient to carry it through the canal; or at all events a very slight pressure from the fore-finger upon its handle will be amply sufficient, if additional impetus be required. It is never to be forgotten that a lever of a very powerful kind is in action when depression of the handle is made, the extremity of which lever is in the



operator's hand; the fulcrum at the convexity of the curve, the resistance being the structures upon which its point impinges, and which may be perforated if undue force be applied.

For cases of difficulty, I prefer the patient in a recumbent position. The head and shoulders should be slightly elevated by pillows, the knees a little raised and separated from each other; in this manner a relaxed condition of the muscles of the abdomen and perineum is favoured. The operator should then stand on the left side of the couch or bed, hold the catheter as before directed, the handle being in the horizontal direction; he should support the penis with the left hand, holding it lightly either between the thumb on one side and fore and middle finger on the other, or in the following manner, which is, perhaps, better. The left hand is in this case applied, the palm being upwards, so that the middle and ring fingers hold the penis just behind the corona glandis; the index finger and thumb are then at liberty to be applied for the purpose of retracting the prepuce if necessary. The beak of the instrument having been introduced, it should be remembered that, during the first two inches, it is to be maintained against the inferior wall of the canal for the purpose of avoiding any hitching at the outset in a lacuna on the roof, sometimes considerably developed, an accident which gives the patient pain, has an awkward appearance, and sometimes disconcerts a young operator not a little. The fingers of the left hand gently draw the penis over the instrument as it glides easily on to the bulbous part, the handle still being horizontal, or nearly so; arrived at which, if some obstruction seems to offer, the instrument should be withdrawn an inch or so, and again passed, taking care not to elevate the handle so soon; after which, by gently raising it and causing it to describe a curve along the middle line, the extremity will probably glide slowly upwards into the bladder as the handle sinks towards the interval between the patient's thighs. If this manœuvre is not sufficient to ensure success in passing the sub-pubic curve, the operator may make gentle pressure with the fingers of the left hand on the curved part of the instrument, as felt through the soft parts in the perineum, guiding it after he has withdrawn the point, and as he again applies it to the seat of the obstruction. He is now also conveniently situated for subsequently using the left fore-finger in the rectum, or otherwise, as occasion may require, the catheter being still held in the right hand.

In exploring the urethra, especially if the symptoms are not such as to render the suspicion that a stricture is present more than probable, we are not hastily to conclude, because a little obstruction presents itself in the passage, that an organic constriction is of necessity the cause. The part is extremely sensitive, and resists any but gentle efforts to traverse it, the more so if it be the first time an instrument has been introduced. In such cases no violence may be used: any attempt to force a passage would only increase the difficulty. Gentle pressure steadily maintained, without rapid movements of the point, will sooner or later overcome opposition and carry the instrument through.

Arrived at the neck of the bladder, we may here encounter an obstacle, and still no stricture be present; indeed, it is not very uncommon to find the point of an instrument stopped just at the moment

the operator thinks all difficulties surmounted. This is more likely to occur with a small instrument than a large one, and with one which is slightly than one which is strongly curved. The floor of the canal at the point named, of which it is difficult to say whether it most belongs to the urethra or to the bladder, may now and then be found somewhat elevated, the uvula vesicæ projecting unduly into the internal meatus, or occasionally a band of mucous membrane appears a little prominent, stretched transversely across the opening. Either of these obstacles, it is conceived, would be especially likely to entangle a sound which is not large enough to dilate the passage and ride over such an obstacle, or possesses a form so little curved as to travel too closely along its floor. For these cases, I have often found a full-sized elastic catheter, which has been kept some time on a strongly-curved stilet, succeed when a metal one has failed. It should be removed from the stilet and used at once before the curve unbends.

*Urethral Exploration.*—The size of an instrument to be used in exploring the urethra for the diagnosis of stricture is by no means a matter of indifference.

As a rule, we should always commence, when prosecuting diagnosis, whatever statements the patient may make, with a full-sized sound or catheter, that is to say, not smaller than No. 7 or 8, with a blunt, not conical, extremity, as such will afford far more certain indication of the situation of the obstruction than smaller sizes, which might indeed pass through a slight constriction altogether. If the instrument be graduated in inches and fractions of inches, as all metal instruments ought to be, so much the better, and the exact situation of the stricture should be recorded in the case-book, on more than one occasion.

Suppose then that an obstacle is encountered at any spot by the instrument described, and it is found that gentle pressure accomplishes no progress, let this be increased a little, and if the penis retreat before it, being evidently pushed backward "*en masse*," there can remain little question as to the existence of organic constriction, the unyielding, semi-resilient nature of the obstruction, a sensation which is communicated intelligibly enough to the practised hand, but which can scarcely be described in words, leaves no doubt whatever on the surgeon's mind. A smaller instrument may now be chosen with which to determine the calibre of the stricture; if this enter the contracted part, it is at once obvious by its being "*held*," i.e. it has entered a narrower passage which fits closely to and retains it. A trial of several instruments may be necessary, until at last one which is sufficiently small to pass the constriction is arrived at, always bearing in mind that the smaller the instrument the more careful and the more sparing of force must the operator be, since, as must be obvious, such will more easily inflict a wound than those which are larger and blunter, the concentration of that force being in the inverse ratio to the size of the instrument.

This may now be carried on by way of search for another, especially if the first be in the anterior part of the canal. It may, however, be so firmly grasped there, and its freedom of motion be so interfered with, that it is not easy to judge accurately with respect to any obstacles situated deeper in. If so, another kind of sound may be used

with advantage, viz. one of small size, having a bulbous or olive-shaped extremity two or three sizes larger than the stem, which also should be graduated; this being made to pass with some little difficulty through the stricture, it will be apparent enough when the bulb becomes free on the farther side, and by observing the graduations, the length of the strictured part is also arrived at. Carrying it deeper still, the existence of another contraction will in the same manner be more readily diagnosed than with an ordinary sound: and in withdrawing the instrument, we check the conclusions obtained during its introduction, by noting the obstruction felt in withdrawing the bulb through the narrowed portion or portions.

*Treatment.*—To accomplish the removal of permanent stricture, two indications are presented, which may be thus briefly stated:—

1st. To restore the natural calibre of the canal, or at least so far as shall be consistent with the safety and comfort of the patient.

2nd. To maintain the adequate patency of the canal afterwards.

We have already seen that strictures may vary in degree, i.e. in amount of contraction; in extent, i.e. in length from before backwards; in dilatability, in disposition to return, in local sensibility, in liability to manifest sympathy with other parts of the body through the agency of the nervous system, and in other minor particulars. Hence various modes of treatment are necessary, appropriate to different cases. Hence innumerable inventions for the fulfilling of the above indications have been described, and modes of treatment proposed. This fact shows both the frequency and the importance of the affection, and the want, either of an efficient mode of treatment, or of a rational and systematic application of our present appliances to suitable cases, or perhaps, to some extent, of both.

All these plans, however, may be resolved into three classes. The opposing tissue of the stricture is either dilated, which usually involves the removal of some of its component elements by absorption, as the result of pressure, or it is wholly or partially destroyed by chemical agents, or it is divided by some cutting instrument; and of course all these processes may be more or less combined with certain general or constitutional treatment.

*The Treatment of Stricture by Dilatation.*—As this is the mildest, so it is the most desirable treatment to employ whenever the case admits of it. At the same time it is by far the most generally applicable, as being that which is beyond all question best adapted to cure a very large proportion of all the cases presented to our notice. It is the method which most surgeons agree to use as the rule, availing themselves of other means when its action is either not effective on account of the impermeability of the stricture, or insufficient to maintain patency of the canal, from the unyielding nature of the obstruction when passed, or impracticable from the acute sensibility of the urethra, and the consequent pain which results from and follows the operation. The records of surgery show also that it has borne the test of experience longer than any other plan of treatment, having been employed for the destruction of "carnosities" in the time of Galen, and never having been laid aside since, although num-

berless additions to our means and appliances of cure have been subsequently both invented and forgotten.

Usually a solid sound or a flexible bougie, as large as the stricture will fairly admit, should be passed and removed at once. I am quite satisfied that nothing is gained by permitting its stay in the canal, even for a single minute, while irritation is often occasioned. If an instrument is permitted to remain at all, it should be for a time of thirty-six or forty-eight hours, or more: this treatment will be discussed under the head of *Continuous Dilatation*.

The instrument is then to be withdrawn with as much care and gentleness as was employed in introducing it: a note of the size should be recorded, and the patient desired to come again in three days. The same sound may then be passed, and probably with greater ease than before; if so, it is to be withdrawn at once, and the next size larger introduced. The visit should be repeated generally in three days, or it may be in two (but not sooner), if neither pain, nor bleeding, nor much smarting in micturition, follow and continue after the operation. Sometimes a fit of shivering occurs, or the patient may be faint or sick, which are not unfrequent effects of the passage of an instrument, more especially when experienced for the first time. If any of these phenomena take place and are repeated, let the interval be lengthened a day or two, and inquire into the general condition of the health. If there be reason to suspect that the stomach and bowels are loaded, an active aperient may be prescribed, after which the administration of two or three grains of quinine, twice a day, will often prevent their recurrence.

If he complains of smarting or soreness of the urethra, and that micturition is painful, the state of his urine should be ascertained, as it is perhaps unduly acid, which will make it desirable to regulate his diet and habits so as to promote a healthy character in the secretions generally. At the same time, if it be so, he will generally derive benefit by taking a few doses of the bicarbonate or the citrate of potash, together with hyoscyamus, if there is irritability of the bladder.

Or, the alkali may be given in decoction of uva ursi, or infusion of buchu, or decoction of triticum repens, if the latter symptoms predominate. Irritability of the urethra, however, is much allayed by the gentle and careful use of instruments. Even when much suffering is produced at the first attempt, it usually becomes notably less at every succeeding passage of the sound. Most commonly, a wax bougie or other flexible instrument is more easily borne than metallic sounds, and will then be more efficient. Proceeding by gradual steps, we should go on to No. 10, 11 and 12; or, speaking generally, any instrument which the external orifice of the urethra will admit, without appearing to be overstretched, may be safely employed.

In all cases, however, the maximum point of dilatation reached, whatever it may be, should be maintained for a short time, the largest sized instrument employed being used at gradually increasing intervals of time, in order to maintain the ground which has been won. Thus the treatment may be relaxed by degrees, making one or two weekly, one or two fortnightly, and finally one or two monthly trials of the instrument.



In many cases, I think we are bound to instruct the patient to pass an instrument for himself, when the urethra has become patent, and the passage of a sound through it is tolerably easy. The faculty of thus maintaining the canal in fair condition is often of extreme value to him, and may be easily acquired.

When, however, after some one or two trials, we have been unable to penetrate the stricture, other means must be employed. It will be desirable to see the patient make water; if the stream is small, the size of the instrument should correspond with it; if it is not, the contraction cannot be very considerable, and some fold of membrane, or perhaps a false passage, has entangled the point, in which case also the sound to be tried next should be as nearly as possible of the size of the stream. In introducing it we should generally endeavour to avoid the floor of the urethra, as well as any lateral deviation in its course, the sides, and particularly the floor, being, as already seen, favourite situations for artificial passages. Failing of success in this direction, we should next cautiously carry the point towards each of these situations in succession, trying patiently for a short time to insinuate it either above, below, or on either side of the passage, if the slightest sensation of its being "held" suggests a probability that the orifice exists in any of these directions. And when the instrument has thus become a little grasped, we should endeavour to facilitate its progress by patient, continued, and moderate pressure, the precise amount of which should be proportioned to the degree which the patient will bear without much complaining. Frequently when the obstruction is situated far back, the introduction of the left fore-finger, previously oiled, into the rectum, will facilitate the progress of the instrument, either by permitting its point to be raised to some extent, or by enabling us to judge more precisely of its exact locality and relation to the parts around. Whether or no, should fifteen or twenty minutes have elapsed, and success be still wanting, further attempts may be postponed until another visit. A longer period than this, however, may be expended, and often with advantage, provided the manipulation has not caused pain or bleeding, and that it has been conducted in that careful and gentle manner which alone is ever admissible, or indeed conducive to success. Some three or four days may elapse before the next trial, when we shall know what instrument to use at first, and commence at once by adopting the same gentle plan.

The employment of continued pressure on the face or commencement of an indurated and not very sensitive stricture, is sometimes successful, either by inducing absorption, or by mechanical action upon the yielding materials of the obstruction. The operator, however, should be certain that he is really acting on the contraction, and not following or making a false passage. It is important to remember, as an invariable rule in relation to these attempts, that when the instrument is tightly grasped, the operator may infer that its point is safe within the strictured part; but that when the point feels free, movable, and capable of being withdrawn without appreciable effort, it is certainly not in the stricture; it may be, in such circumstances, in a false passage. If after being grasped or "held" it advances suddenly for

a short distance under pressure, and becomes movable, it is very probable that a false passage has been made and the urethral walls perforated; after which unfortunate occurrence all further efforts must be given up, at least for several days, and the employment of instruments, when again resorted to, must be conducted with vigilant care, to avoid any re-opening of the lacerated part.

Occasionally we meet with circumstances still more difficult and embarrassing than any yet mentioned. The stricture may be complicated with false passages previously made, or the patient's general health may be greatly deteriorated. In the latter condition we should not commence instrumental treatment until we have, by every possible means, promoted a good state of the general health, and a normal condition of the secretions, by constitutional means hereafter to be referred to. After the lapse of a few days since any preceding attempt, we may now avail ourselves of other aids in the endeavour to pass a catheter. Instead of permitting the patient, even if he is able, to leave his house for treatment, it is desirable to visit him, and of all seasons I prefer to do so when he is in bed, with the skin warm and moist from ample coverings. A hot hip-bath just before the visit is sometimes advantageous. When introducing the instrument, it is necessary that there should be no chill: all unnecessary exposure should be therefore carefully guarded against. Premising that the precise situation of the stricture has been carefully verified beforehand, a small silver catheter should be selected, the size of which should be little less than that of the stream of urine. Sometimes then an advantage appears to be gained by injecting some warm oil into the urethra before commencing; in fact, filling the urethra well with it, by means of a glass syringe. The smallest catheter may now be introduced, and made to traverse the urethra—at all events, as far as to the stricture—with very little difficulty, and when arrived at the stricture, the instrument, if adapted in size, may gradually pass through it; or, at least, the probability of its doing so is greatly increased. The narrowed channel has not only been thoroughly lubricated, but somewhat distended, by the mechanical pressure of the column of oil; and this sometimes occurs to an extent which affords no inconsiderable amount of aid to the operator.

When the stricture has been passed, considerable care is necessary in guiding onwards the point of a very small catheter through the canal behind, to prevent its becoming engaged in the enlarged lacunæ which are commonly found in the dilated urethra behind an old stricture. Sometimes the orifice of the stricture does not lie precisely in the axis of the urethra, but is to be found above or below, to the right or to the left of it; a fact not difficult of appreciation by the practised hand.

It was a recognition of these variations as often constituting the difficulty in cases of obstinate stricture that led Sir B. Brodie to recommend an instrument whose point is made to deviate from the axis of the adjacent parts, as figured in his well-known work. Leroy d'Etiolles also used some very small gum-elastic bougies, possessing points twisted somewhat into the form of a corkscrew. He recommends that these should be turned in every direction, until chance guided the point through the devious passage, and he claimed to have achieved a considerable success from their

application, a result which appears to be natural. If such an instrument is not soon successful, I prefer a very delicate silver catheter, the stem of which is increased a little in size to afford it the requisite solidity. With such an one I confess I have never yet been foiled in discovering by gentle and prolonged manipulation, sooner or later, the true route into the bladder. The ability then to draw off some urine is the necessary proof that the instrument is safely placed.

The existence of false passages has been alluded to. They form undoubtedly one of the most perplexing complications which the operator can have to deal with, inasmuch as the difficulty of getting into the right opening is greatly increased by the readiness with which the instrument enters the wrong one. It is advantageous, however, to bear in mind, when engaged in the management of such cases—first, that false passages most frequently commence on a level *below* that of the proper opening; and, secondly, that the operator's finger when in the rectum, near to which the false passage is almost certain to run, will communicate information as to the route which the catheter is taking, whether it be too close to the gut or deviating to the right or left of the median line: it will, moreover, be serviceable in assisting him to guide the point in the true direction.

On the subject of instruments it may be remarked that of the two leading varieties, metallic and flexible, each have their special uses, and each their special advocates among practical men. In general terms, when the operator wishes to have the advantage of guiding or directing his instrument in any given course, and this in many cases will be his object, he will select an inflexible instrument. In cases of difficulty, and extreme narrowness of the stricture, a slender silver catheter must be considered, in light and accomplished hands, the best instrument to employ, always remembering *that force in its use is never admissible*. Such an instrument is only to be insinuated through the stricture; and the advantage of its being hollow is that the surgeon can verify the fact of its arrival at the bladder by drawing off the urine. But if, in any given case, he finds that the best method of discovering the passage is by an attempt to hit by chance the narrowed point, a slender gum-elastic instrument will probably answer his purpose best. It will often succeed, and it will inflict no injury. But, on the other hand, in dilating a stricture in which little or no difficulty is encountered, it may be immaterial whether metal or flexible instruments are employed; although the operator may generally discover in each case which instrument passes with the greatest ease, and produces the least uneasiness to the patient, and the result should determine his choice.

For ordinary cases the scale of catheters generally employed in this country, numbering from 1 to 12, furnishes sufficient means for our purpose. It is often, however, useful to have a few bougies of the larger sizes made conical in form. The point may be equal to No. 6, gradually increasing to 8 or 9. Another may be  $7\frac{1}{2}$  at the point and increase to No. 10. These form cheap and very serviceable instruments, and three or four of them will make a full set. For the small sizes I do not recommend these instruments. But there are not a few cases for which the intervals between each instrument in our ordinary catheter scale are too

considerable; and in order to dilate these strictures successfully we must progress slowly, and employ only the most gentle augmentations of size. The French surgeons have therefore long habitually employed a scale of instruments in which the progressive steps are much more gradual than ours, and these I have for many years adopted with success for the cases referred to. The Nos. 1 to 12 of our scale are nearly equivalent to the Nos. 3 to 21 of theirs; they have two numbers smaller, viz. 1 and 2, and nine larger, viz. 22 to 30 inclusive. These numbers also are not arbitrary, but have the advantage of expressing the circumference in millimètres, so that the number of the instrument conveys the exact measurement of its calibre. For example, the No. 18 (which is about  $10\frac{1}{2}$  of our scale) is eighteen millimètres in circumference, and consequently six millimètres in diameter. I am in the habit of using these in the flexible form, and rarely now employ metallic bougies or catheters, except under the conditions alluded to above.

A good deal has been said and written about the use of "model bougies," which are supposed to enable the operator to take a cast of the face of a stricture, and to employ his instruments according to the indications so furnished. I believe I express the opinion of nearly all practical surgeons of the present day, in saying that these contrivances, however theoretically promising, are quite useless to any man who has learned to handle a catheter with gentleness and facility.

*Treatment of Stricture by Vital Dilatation.*—This method was so named by Dupuytren, and it consists in placing the point of a small instrument in close contact with the stricture, and leaving it fixed, so that a degree of pressure is maintained against the obstruction for a few hours. For this purpose, if the obstruction be situated far back, he employed a short gum-elastic catheter, say about No. 1, from which the stilet has been removed, in order that it may be retained in the bladder for a few hours, when it has penetrated so far. Not more than an inch and a half should appear externally, and at this extremity should be fixed two rings, through which two strips of narrow tape should be carried down by the sides of the penis, and there fastened with adhesive plaister. This plan is available equally for those cases in which no penetration has been made, and for those in which, although some degree of it has been accomplished, still the stricture cannot be passed; but, of course, it is inapplicable where a false passage exists, as any sojourn of the instrument there could only be productive of serious injury. It has sometimes proved successful where a good operator has failed by ordinary manipulation.

*Continuous or Permanent Dilatation.*—Among the various means, not of carrying an instrument through an obstinate stricture, but of dilating it, when that necessary preliminary has been accomplished, one of the safest, and at the same time most expeditious, is that of retaining the catheter in the urethra for twenty-four, forty-eight, or even seventy-two hours at a time, without removing it. Especially when great difficulty has been encountered in its introduction, and there is reason to believe equal difficulty would be found in replacing it were it withdrawn, this plan of treatment is frequently of very great value; so also, if false passages exist; if ordinary dilatation produces little result; if, owing to extreme sensibility of the canal, each



introduction of an instrument be attended with so much pain and distress to the patient, and keeps the passage in a state of irritation so great, that the intervals necessary for its subsidence are undesirably long. This treatment is, perhaps, one of the best that can be adopted. In putting it into execution, a week or two of confinement within-doors must be reckoned upon by the patient.

Having succeeded in carrying a catheter into the bladder, the next step is to fasten it by one of the several methods which are adopted. Few are better than that just described, or if preferred, it may be secured by tapes to a bandage passed round the waist. A little peg must be neatly fitted to the orifice of the catheter, for the purpose of preventing the constant escape of urine; or a piece of india-rubber tubing may be attached to the end of the catheter. This instrument should not be permitted to project into the bladder, as its point may then injure materially the coats, and produce inflammation, or, at least, much distress. It is borne much better, and for a longer period, when the point just reaches the neck of the bladder and requires to be pressed in for half an inch whenever the patient desires to pass water. Catheters which are not quite so long as those usually employed answer the purpose rather better, since the instrument lies more securely and more easily to the patient, when a short portion only projects from the external meatus.

If the catheter is silver, the patient lies on his back, with the shoulders a little elevated, the knees raised, and inclining outwards. If it be of gum-elastic, which is generally much better borne, and is equally serviceable, he may lie in any position, and even sit up for a change. The length of time the instrument is permitted to remain will depend much upon the ability of the patient to retain it. If necessary, we should alleviate irritation by giving opium by mouth, or suppository; also by freely administering diluents, as barley-water, rendered either alkaline or acid, as the case may require. If, however, the pain is severe after a few hours, it will be safer to withdraw it, and after resting a day or two the instrument may again be tried.

Sometimes an attack of orchitis results, as occasionally happens also after the mere passage of a sound, or its retention for a few minutes only. The cause must be first removed, and the affection combated in the usual way. An attack of rigors may supervene within an hour from the introduction of an instrument, in which case hot blankets and bottles should be applied to the body, and a full dose of opium given; if they then continue or become severe, it will be necessary to take out the catheter at once, although, especially if much obstruction be presented in effecting its passage, it will be undesirable to remove it on account of a slight attack of shivering, which may be only a transient effect of that operation. Also, when the urine becomes deeply tinged with blood, as it sometimes does after forty-eight or seventy-two hours, it is advisable to remove the catheter, and discontinue the treatment for a few days.

But all these are exceptional results. Generally speaking there is little or no pain, and after the lapse of twenty-four or thirty-six hours, a purulent discharge is seen around the instrument, which soon becomes loose in the canal, and, if not properly tied in, may readily slip out, although

when first introduced it was firmly retained by the stricture. Speaking in general terms, for it will be obvious that no positive directions as to time can be given, in about thirty-six hours from the time of introduction it may be withdrawn and replaced by another a size or two larger, which will probably enter easily. If the discharge continues profuse, and the urine flows by the side of the catheter, it may be again exchanged for a larger. Usually, however, after three or four days, it is prudent to let the patient rest awhile. A good-sized stream will most likely now be passed, accompanied by some smarting along the canal. He should be permitted to enjoy undisturbed sleep for a night or two, after which the catheter may be again tied in for thirty-six or forty-eight hours more; the discharge will become again profuse, and the canal more patent. The exact time which it is desirable to carry on the process must depend upon the patient's general condition, the absence of symptoms of cystitis, and the progress made in dilating the stricture. Nos. 8 or 9 having been reached, as will probably be the case in a few days, the patient may be allowed to move about. The introduction of an instrument must now be regularly resumed, at first every day, and then every second or third day, in order to secure permanency in the results already obtained, gradually lengthening the intervals as before described, but not wholly discontinuing the use of the sound for a considerable period; for it must not be forgotten that the subsequent tendency to contract is at first strong, although in this manner it may generally be obviated.

The great secret of conducting continuous dilatation with ease to the patient, and with success, is not to increase materially the size of the elastic catheters employed. Much augmentation of size when the catheter is changed is not necessary, and if insisted on often produces pain. I have found by experience that the smallest catheter, say No. 1, if maintained in the stricture for a sufficiently long period, say five or six days, dilates it almost, if not quite as much, as if the instrument had been exchanged for larger ones. It is the fact of the catheter being there, and not its size, which effects the dilatation of the stricture.

It can scarcely be necessary to say much of forcible catheterism for the treatment of stricture, except for the purpose of discountenancing all such attempts. Formerly it was the custom among some surgeons to force a way through the opposing obstacle, either by means of a succession of catheters rapidly following each other, or by one or two large conical sounds pressed with considerable violence until some obstructing part gave way. Severe inflammation often followed these attempts, while false passages were very commonly produced. Only a small proportion, indeed, of the force employed was expended on dilatation of the stricture, most of it telling on the sides and submucous connexions of the urethra, which were dragged downwards towards the bladder in these efforts. Hence, in order to supersede these clumsy and dangerous proceedings, various forms of apparatus have been at different times devised to dilate carefully, but efficiently, an obstinate stricture. Among these is the plan by sliding tubes, several times applied both in this country and abroad during the last sixty or seventy years, but sys-

tematised more recently by Mr. Thomas Wakley. In the treatment of a narrow stricture by this method, a very small catheter is first carefully passed into the bladder. Into the end of this a small steel rod is screwed, and the whole forms what is termed the urethral guide, which serves as an axis over which another instrument, consisting of a straight silver tube, is passed through the stricture; so that the route being at first correctly taken, all future efforts will to a certainty be made in the same direction, and with greater ease than if the first, or "urethral guide," were not present.

The same principle directs every step of the dilating process, each succeeding instrument being slipped through the stricture over that which had been originally introduced. The names of Desault, Hutton of Dublin, and Buchanan of Glasgow, are associated with the early history of this plan.

An objection has been generally admitted to lie against all the instruments at present described, on the ground of that abrasion of the urethral mucous membrane, which the passing of a sound or catheter through a stricture with any degree of difficulty must tend to produce; and it equally applies to the sliding tubes just described, however accurately and smoothly they may be finished by the maker, since with all some amount of force is necessarily expended in a longitudinal direction on the walls of the canal, and a proportional degree of effect must be produced. Hence it has occurred to many surgeons to contrive apparatus which, being introduced with ease into the contracted part, should admit of being expanded there, and thus act by eccentric dilatation only, without the risk of injuring by friction. Among them Dr. James Arnott may be named as endeavouring to accomplish this by fluid pressure. He constructed a varnished silk tube, lined with gut, and having passed it through the contraction, distended it with air, water, or mucilaginous fluid, by means of a syringe connected with it.

Mr. Luxmoor attempted, nearly half a century ago, to supply the desideratum by employing a metallic instrument with four blades, which, by means of a screw, were made to expand, *in situ*, to any extent required, in four opposite directions. Many years later, Leroy d'Etiolles adopted the same principle in the construction of some dilating instruments; and, more recently, M. Perrève, of Paris, attempted to fulfil the same object by an instrument formed of two blades united at the extremity, which, by means of a screw, can be separated from each other after they have passed into the stricture. By these and by similar methods the attempt to gradually dilate the urethra from within outwards has been at various times attempted.

Of late years Mr. Holt has employed Perrève's instrument to treat a tight stricture by forcible instantaneous rupture of the contracted portion of the urethra. His mode of proceeding is as follows:—Having introduced the apparatus through and beyond the stricture, which may be supposed capable at most of admitting a No. 3, he at once slides down a tube of the size of No. 10, which, with the expanded blades, opens the stricture to at least No. 12. This operation often requires very considerable force. The instrument is then withdrawn, and a No. 10 catheter is readily passed

into the bladder, and at once removed. Some bleeding takes place at the time, and continues for a few hours, rarely more than twenty-four, but only to a slight extent. The stream is at once considerably improved; and there appears to be rarely any subsequent fever. Mr. Holt passes a No. 10 on the second day after the operation; on the fifth or sixth; then once a week for two or three weeks; then once a fortnight; and, lastly, once a month. The plan has now been largely tried; it has been proved to give rise very rarely indeed to fatal consequences, and the primary results are unquestionably good. How far it will compare in durability of result with other means has yet to be shown.

Believing the principle of dilating from within outwards to be the best under certain conditions, I have myself adopted it in the following manner. The principle of its application is, that organic stricture is ordinarily situated in that part of the urethra (the bulbous) which is naturally the largest, its calibre being double that of the external meatus. Hence no dilatation which is limited by the meatus is adequate to restore the calibre of the strictured part. Using an instrument composed of two blades, a given part of which may be separated to any extent by means of a screw, I am enabled to distend or rupture the strictured urethra, and not the remaining part of the urethra, up to its original size, nearly closing the blades again before they can be withdrawn. I think, on the whole, that a combination of this proceeding—or that of rupture, if preferred—with a previously made slight incision of the part performed, as will be described under the head of INTERNAL URETHROTOMY, affords perhaps the most efficient and permanent treatment for a really obstinate stricture.

In concluding this section of my subject, I am compelled to add that, after all, by far the greater number of strictures, even of the most troublesome and obstinate forms, are quite amenable to carefully managed dilatation, either simple or continuous, and that it is very rarely incumbent on us to resort to operative procedures of any kind. It is necessary to attend to the health and to the external condition of the patient, but with such precautions, with care and gentleness of manipulation, and the use of the most unirritating kind of instrument, a very few cases only will require other treatment. Sometimes we are aided by the use of anodynes and sedatives. Occasionally the influence of chloroform has facilitated the passage of a catheter or of a bougie through the urethra, especially when it is more than ordinarily sensitive, and the pain occasioned by instrumental interference produces uncontrollable and involuntary efforts of resistance on the part of the patient. But it is not for the purpose of permitting the instrument to be used with greater force than before, but in order to produce relaxation of the muscular tissues, both of the voluntary and involuntary kinds, that the chloroform is administered, and it must, of course, be given to a sufficient extent to ensure this result.

After all, however, a few cases exist for which dilatation is an inadequate treatment. Either the contraction re-appears, and that so rapidly, that in order to maintain a canal sufficiently patent, an instrument must be passed every other day, or even oftener, and thus the patient is subjected to perpetual treatment, and to the discomforts conse-



quent thereupon; or the urethra is so acutely sensitive that existence is rendered inexpressibly miserable by the torture which the patient has constantly to endure, and the introduction of sounds, instead of producing any beneficial effect, increases the evil, and exaggerates the symptoms.

The question is therefore unavoidably presented: what further resources does surgery offer for these cases? This leads to other sections of the subject: the employment of caustic agents in the treatment of strictures.

Various active agents have been employed at different times during the last three centuries, for the purpose of destroying, as it was supposed, by their caustic power, obstinate strictures of the urethra. They were described by A. Veni, A. Lusitanus, A. Lacuna, De Vega, Diaz, and others; subsequently by A. Paré, and by R. Wiseman. Antimony, verdigris, quicklime, arsenic, savine, and many other active bodies were thus used. John Hunter brought the practice into note in this country at the latter part of the last century, using first red precipitate, and then nitrate of silver, and applying the latter by attaching a small portion to the softened end of the wax bougie. Following him, Sir Everard Home pursued the same method, but employed it much more extensively, not restricting it to the few and exceptional cases to which alone it had been applied by Hunter.

After this, in 1804, Mr. Whateley published a small volume, in order to advocate the superiority of the potassa fusa, as a chemical agent, to the nitrate of silver. He believed that "caustic in any form or quantity ought not to be used, till a bougie, a little larger than one of the finest size, can be passed through all the strictures into the bladder," lest retention should be caused; and makes this proceeding an indispensable prerequisite to the operation, stating, "that in the worst and most contracted strictures he had ever met with, he had sooner or later almost uniformly succeeded in procuring a passage into the bladder by means of fine bougies." At no time is the particle of caustic potash to exceed in weight the twelfth of a grain.

He also appears to be the first who systematically applied caustic to the inner surface of the stricture, which he did by applying to the end of a bougie of the smallest size, first a little glue, and then some finely-powdered nitrate of silver; after which "it may," he says, "be readily passed into, or a little beyond, such strictures as are extremely narrow." Subsequently, Dr. James Arnott improved upon his practice, employing more complicated and more perfect apparatus for applying the same agent.

In France, the employment of caustic was revived in modern times by Ducamp, who in a work on *Retention of Urine*, published in 1822, advocated Dr. Arnott's treatment at considerable length, although without acknowledging the author, and made some very slight additions to his own. Subsequently, Lallemand, Segalas, and others, have suggested numerous modifications of the instruments.

The late Mr. B. Phillips advocated in this country, at a more recent period, the use of nitrate of silver in stricture, always advocating its introduction within the narrowed part, and reprobating its application to the face of an obstruction to which instruments had been unsuccessfully applied. Subsequently he retracted his advocacy of

this agent, and declared that after further experience he preferred dilatation. (*Med. Gazette*, 1843.)

At the present time Mr. Wade chiefly has practised the use of the caustic potash, and has expressed himself very strongly in its favour. He applies it after the mode recommended by Whateley, which has been already fully described, but in larger quantities, varying, according to circumstances, from an eighth of a grain to one grain, most commonly employing about a sixth for the purpose.

Several other surgeons have recorded favourable opinions of this agent, but mainly recommend it for those instances in which they have been unable to introduce an instrument into or through the stricture by any other means. This condition of so-called impermeability is, however, now admitted by most to be extremely rare, and is safely resolved by careful and gentle instrumental manipulation, without other means, in nearly all, if not in all, examples of the disease. Hence on this ground the indication for the use of the caustic potash must be regarded as extremely limited. Claims have been also made on behalf of its utility in cases where the stricture has been unusually irritable or non-dilatable. Little evidence in support of this view appears to exist, while it is quite certain that a degree of risk of exciting inflammation of the urethra, or of producing sloughing of its walls, as I have had occasion to observe myself is incurred by its employment.

Respecting the nitrate of silver, little need be said, since in modern surgery it scarcely finds an advocate either in this country or abroad. The confidence formerly placed in agents of this nature has of late years diminished, especially as the success of other means has rendered recourse to caustics less frequent. For myself, I have no hesitation in believing their employment to be wholly useless, and therefore undesirable.

#### *The Treatment by Incisions — Internal Urethrotomy.*

—At a very early date (15th or 16th century) internal incisions were employed, but were generally associated with escharotics, for the cure of stricture.

About a century ago, the perforation of a stricture, supposed to be otherwise impassable, was accomplished by means of a trocar (Chopart). Lanceted stiletts were employed for the same purpose by Physick, of Philadelphia, in 1795. At the commencement of the present century, the Bells and others describe modifications of these instruments. In 1827 the practice was revived, and subsequently perfected by Mr. Stafford, who for many years adopted and advocated cutting instruments for stricture; not only perforating from before backwards, but dividing them in some cases from behind forwards. Mr. Guthrie and others have since employed them in this country; while in France innumerable forms of the urethrotome, and many modes of employing them, have been in favour during the last thirty or forty years. The principal of these have been known as the proceedings of Ducamp, Amussat, Leroy, Civiale, Sedillot, Ricord, Bonnet, Mercier, Reybard, and Maisonneuve. It is impossible, and indeed it is unnecessary, to describe them all. But it is not difficult to select one or two as typical methods, premising that the remainder are modifications of minor importance.

By one method the stricture is cut "from before backwards." In this proceeding, a grooved guide of some kind exists, by which the blade is directed through the narrowed portion, so as to divide it to a certain depth on one side, usually on the floor, of the urethra. This guide may be a fine grooved sound or catheter on which a cutting instrument glides down after the former has been introduced into the bladder. The requisite division having been made, a full-sized catheter is passed into the bladder, either upon the guide or after it has been removed, and tied in for two or three days, so as to carry off as far as possible the urine without contact with the cut surface. Subsequently a bougie is passed every day, or every other day, until the urethra is soundly healed, and then less frequently: a practice which is necessary for a considerable period of time.

According to another proceeding, the stricture is divided by a blade, which must first be passed beyond the stricture, and being then exposed, is made to divide the obstruction in the act of its withdrawal by the operator. This is termed "division from behind forwards," and is generally considered the more certain and safe of the two methods. It requires, however, that the stricture should not be very narrow, or if it be so, that it should previously be dilated to some extent so as to admit the cutting instrument to pass through it. In the former method a slender guide only need be passed through: in the latter an instrument of the size of No. 4 at least must generally be admitted. One of the best modes of performing this operation is that of Civiale, whose instrument has a bulbous extremity containing the blade. This is passed beyond the stricture, the blade directed downwards, on the floor of the urethra, and made to project to a certain predetermined distance, arranged by a mechanism in the handle. It is then drawn steadily outwards so as to divide all the obstructing tissue, involving in most cases an incision of an inch in length; the blade is then sheathed and the instrument removed. A gum catheter of the size of No. 9 or 10 is then introduced as after the method described above, and tied in for two or three days; after which a full-sized metallic instrument is passed daily for three or four weeks.

It has been objected to all the proceedings by incision which require for their performance a previous dilatation of the stricture to the calibre of No. 4 or 5, that they must be unnecessary, since then the obstruction can, or ought to, be successfully treated by dilatation. This, however, is not the case. Certainly in no instance should we resort to incision until all the resources of dilatation have been tried and found wanting. It is however an error, but a very common one nevertheless, to regard the *narrowness* of a stricture as the main indication for the use of these exceptional means of cure. It is not narrowness, but *non-dilatability*, or *extreme contractility*, which renders their application necessary. A stricture may be so narrow when first presented to the surgeon, as not to admit even a No. 1 catheter, but it may be, and usually is, easily dilated in the ordinary manner with care and patience, or even with great rapidity by tying the catheter in, that is, by continuous dilatation. On the other hand, a stricture which habitually admits No. 5, 6, or even larger sizes, is occasionally found, sub-

jecting its possessor to constant attacks of retention, rendering his life miserable, and even producing the most dangerous risks to life. It is useless to dilate it, for repeatedly as this has been done, the general consequence is an aggravation of the symptoms, or if relief is afforded, it is of the most temporary kind, and the symptoms return as severely as ever in a few days. Such are the cases in which the surgeon is driven to employ some more potent means, and in such it is easily seen that the size of the urethrotome forms no objection whatever.

Strictures situated in the middle region of the corpus spongiosum, that is, from  $2\frac{1}{2}$  to 4 inches from the external meatus, more commonly exhibit these obstinate characters than the strictures which are situated in the bulb. Strictures at or near to the meatus itself, also, are particularly rebellious to mere dilatation. Such are very easily divided, being within sight of the operator, or nearly so. A simple mode of accomplishing the object is to pass a director through the stricture, and then in its groove a straight narrow bistoury. A convenient little instrument is made for the express purpose, on the principle of the "*bistourie cachée*," which I prefer to any other, its action being instantaneous and certain.

The objections still urged by some against internal urethrotomy in general are that it may occasion at the time of the operation severe hæmorrhage, abscess, fever, extravasation of urine, or pyæmia. I have had the opportunity of witnessing its results abroad, and in my own practice at home, for those difficult cases, for which, in the hands of others as well as my own, dilatation had utterly failed to alleviate the patient's condition, and I am bound to say I have never seen a dangerous, much less a fatal, result. It is true that where reckless incisions have been made—I may refer to the instrument of Reybard, of Paris, for example—deaths have not infrequently occurred; but this method, once and recently celebrated by its obtaining the valuable "*Prix d'Argenteuil*," is now, and justly, reprobated and disused. In this country it never for a moment found an advocate. But in the application of internal incision to stricture situated at from 4 to  $5\frac{1}{2}$  inches from the external meatus, by the method last described, I have myself operated in upwards of 100 cases, all examples of the worst and most obstinate kind. In none was the hæmorrhage dangerously severe; in two it was continued and troublesome; in four or five shivering and fever succeeded the operation; in two the rigors were severe. There was no case in which I had reason to regret the performance of the operation; and in almost all the relief was so considerable as to have rendered the result equally satisfactory to the patient and to myself. Periods of eight to ten years since the performance of the operation have demonstrated the permanence of the benefit.

Certainly then the instances in which this operation need be performed for a stricture situated in the bulbous part of the urethra are rare; but I have no hesitation in saying that when performed with care and in suitable cases, it is a valuable addition to our resources against the suffering and danger resulting from obstinate and unrelieved stricture of the urethra. It has been said, but without the slightest authority for the statement, that urethrotomy is followed by subsequent in-



creased tendency to contract at that part of the urethra which has been divided. My experience is in direct opposition to this altogether. Having now had under my care many cases in which division has been made from five to ten years previously, I can state that the divided part is much less contractile than before; and, indeed, were it not so, the adoption of any method of cutting would be an evil rather than a benefit. Furthermore, I have dissected the urethra in three cases at considerable periods of time (several years) after previous operations by the knife, and have in each case found it difficult to discern traces of a cicatrix, much less any narrowing resulting from the incision made.

*External Urethrotomy.*—Various operations for the cure of stricture have been performed in the perineum, by means of incisions carried through the tissues between the skin and the urethra, and into the latter itself in the contracted portion. Wiseman describes a proceeding of this kind which he witnessed in 1652. Subsequently, Solingen, a Dutch surgeon, operated in this manner at Livourne. François Folet, in the seventeenth century, employed it at Paris, but only for retention of urine. Colot and others resorted to it in the worst and most complicated case of stricture. J. L. Petit and Ledran did so subsequently, but most commonly only when retention was present, and only very rarely as a curative means for the stricture alone. In 1783, John Hunter performed the operation at St. George's Hospital, now known as perineal section; it was done for the *cure of stricture and perineal fistulæ*, and not for the relief of retention or extravasation. Having failed to pass the stricture with the finest bougies, and having used caustic subsequently without success, Hunter proceeded as follows:—"A catheter was first introduced as far as it would go, as a director, and all the sinuses were laid open to that catheter, which exposed near an inch in length of that instrument; then the catheter was in part withdrawn, to expose that part of the urethra which was laid bare. The blood being sponged off, the orifice in the stricture was next searched for, and when found it was dilated. The catheter was now pushed on to the bladder, although with some difficulty." It was tied in, the fistulæ ultimately healed, and he passed "rather a full stream" of water by the urethra afterwards. (*Treatise on the Venereal*, 2nd edit., p. 146.)

The application of this proceeding appears to have been limited, for many years, to those cases in which several perineal fistulæ co-existed with obstinate stricture. Thus it was advised, but for these cases only, by Sir Charles Bell, about a quarter of a century afterwards. Its employment in cases of retention appears to have been adopted in this country at the commencement of the present century. The first published account of its performance appeared in 1815, in a work by Mr. Grainger, of Birmingham, who related several cases in which he had done it, both in the central line of the perineum, and by the side of the raphé. John Bell briefly suggested it for cases of retention, but had not performed it (1806). Sir Charles Bell also published a recommendation of the practice in 1816, which he had before given orally in his lectures. In 1811, Mr. Thomas Chevalier read a paper at the Medical and Chirurgical Society, in which he related a case of obstinate

stricture of the urethra, where he made an incision into the urethra behind the stricture, only not during retention, mainly in order to withdraw the urine from the diseased parts by giving it a new course, since he had observed much benefit to accrue in this way in cases in which the bladder had been punctured.

The first record, as far as I am aware, of perineal section, as applied to the relief of impassable stricture, unaffected by retention or fistula, is to be found in a valuable paper by Mr. Arnott, then of the Middlesex Hospital, read at the Medical and Chirurgical Society in June, 1822 (*Trans.*, vol. xii. p. 351). A case is related in which the author, being unable, after repeated efforts, to pass any instrument through the stricture from the external meatus, had operated with the most satisfactory results, and advocating an adoption of the same method in similar cases. In this instance, having cut upon the point of a sound carried down to the stricture, Mr. Arnott succeeded in passing a very small grooved probe through, and in dividing the contraction upon it. A silver catheter was then carried into the bladder, and retained there, being withdrawn at occasional intervals only, and the wound was allowed to heal over it. The patient experienced a complete cure; for during six or seven years subsequently, during which he remained under Mr. Arnott's observation, there was no return whatever of the complaint.

*Mode of Performing Perineal Section.*—The best mode of performing this operation is as follows:—The patient should be placed, in a good light, on a table, and be secured as for lithotomy. The bowels should have been previously cleared by an enema. The perineum having been shaved with a scalpel, a catheter is to be passed as far down the urethra as the obstruction will permit, and held firmly in that position by an assistant, who at the same time draws the scrotum forward. An incision through the skin and cellular tissue is now made, directly in the middle line of the perineum, along the raphé, from over the point of the catheter to within a short distance of the anterior margin of the anus, if the stricture be at or near to the bulb of the urethra, and the point of the catheter is to be exposed by a shorter and deeper incision. The sides of the opening are then to be carefully held apart as widely as possible with hooks, by an assistant on each side, so as to give the operator as clear a view as possible of the contracted opening; and this object is further to be promoted by a diligent sponging of the part; or better still, as Mr. Avery first suggested and practised, a loop of thread should be passed through each margin of the urethral incision, including the mucous membrane close to the stricture, so as to open out the passage, and dispense with hooks or fingers, which might intercept the view. This done, the operator, who should be provided with two or three grooved silver directors of the smallest size, should endeavour to carry one of them through the contraction, and if he be successful in accomplishing this, the division may be made with ease and safety. But if one of the directors cannot be introduced, either partially or entirely, no alternative remains but to dissect through the structures in the median line, endeavouring to follow the urethral canal as closely as possible. In either case, as soon as the continuity of the passage has been restored, the catheter first employed is then to be

carried onwards into the bladder, and secured in the usual manner.

Now as to the applicability of the operation of perineal section, whatever may be said of it in circumstances of retention, the case must be had indeed in which we are compelled to resort to it as a means of cure. All surgeons have regarded it at best as a dangerous remedy. The uncertainty which must attend an attempt to divide, by mere dissection from the surface of the perineum, an inch or more of contracted urethra, whose calibre has been reduced to what is almost a capillary bore, especially if the tissues are unnaturally thickened and condensed, will be admitted by all; and few, perhaps, would undertake to assert, unless a grooved director can first be passed, that an accurate division can be insured, or, indeed, that it is ever made. Thus Sir B. Brodie says:—"Even under the most favourable circumstances it cannot be otherwise than doubtful whether the stricture be properly divided, that is, whether the incision has passed through the narrow canal in the centre, or through the solid substance on one side of it. I suppose that no surgeon would recommend such an operation except as a last resort, where no instrument could be made to pass through the stricture by other means." (*Op. cit.* p. 67.) Every chance of getting an instrument through the stricture that can possibly be derived from the employment of rest and constitutional treatment, in addition to the most careful and repeated manipulations, should be exhausted before we consent to employ it, failing in which, its necessity and utility may be admitted as a last extremity.

*Division on a Grooved Staff.*—Another external operation upon the urethra has within the last few years been advocated by Mr. Syme, of Edinburgh, but the cases to which he applies it are not those in which it had been the custom to operate by external incisions. Previously, both in theory and practice, it had been held to be an axiom among all surgeons, that when a sound of any size can be passed through a stricture into the bladder, division of the stricture from the surface of the perineum is certainly contra-indicated.

Mr. Syme, however, holds, and few surgeons now maintain a different opinion, that all strictures, however severe, chronic, or irritable, will admit an instrument to be fairly passed through them into the bladder, if only the instrument be sufficiently small and be passed with care. If the urethra is obliterated, as occasionally, but very rarely, happens, of course no instrument can be fairly passed. Such a condition, however, is not one of *stricture*, but of *obliteration*. In other words, then, there is no such thing as impermeable stricture; it is not impermeable if urine passes through it; and if it is permeable by urine, it is also permeable, granting time and patience, by a sound, if it is of a size corresponding to that of the contracted part. Thus it by no means follows that in retention of urine a catheter can always be passed, although most commonly it may be; but, that in the absence of such urgent conditions, no stricture should be regarded as impermeable, but should be rendered amenable to catheterism after at most a few patient and persevering trials. If in any case of stricture, then, dilatation has been found to fail in affording anything like a tolerable amount of relief; and that in spite of its most careful application, aided by all the influences

which promote its success, viz., rest, improvement of the secretions, diminishing local inflammation, &c., Mr. Syme advises that a small grooved staff should be passed through the stricture, and that the whole of the diseased tissue should be divided upon it from the perineum. This is done in the following manner.

*Mode of Performing the Operation.*—The operator should first make himself quite familiar with the situation of the stricture he proposes to divide, in this manner. He must know how many inches it is from the external meatus, and what is its extent; which is easily determined by a small bulbous sound passed through the contraction and withdrawn. The staff to be employed has a shoulder; that is, it suddenly increases in its diameter just above the curve, which latter alone is grooved, so that while the slender part of the instrument has passed through the stricture, the larger part stops at its anterior limit, and is easily felt by the forefinger through the tissues, as an accurate guide to the situation of the contraction, provided the staff is maintained steadily in its position. For my own use, I have had a staff constructed with a channel throughout, by which the urine issuing when it arrives at the bladder, the operator knows that the slender point is in its proper place, a satisfactory assurance when false passages exist, and render the right route rather difficult of access.

The staff having been introduced, the patient is placed in position and secured as for lithotomy, on a table of convenient height, over the edge of which the nates are brought. An assistant holds the staff upright, and draws up the scrotum with the left hand. The operator, seated, makes an incision in the line of the *raphé*, from above downwards, about two inches long, and steadily follows the direction of the median line, through the structures intervening between the skin and the staff, the line of which he feels for with the left forefinger, as he approaches it. He can now distinguish the thick end of the shoulder, and by that is guided to the position of the stricture, when, taking a sharp straight bistoury in his right hand and the staff itself in his left, which he holds firmly against the stricture, he engages the point of the knife in the groove of the staff about an inch below the shoulder, and cuts upwards to the extreme upper end of the groove, which penetrates into the thick portion of the staff for a short distance. It is necessary to take pains to cut the stricture entirely, in the anterior direction especially, for when the knife has reached the upper end of the groove, the tissues are apt to be pushed before the blade and not cut, even when it is sharp. If the stricture has been properly divided, the shoulder of the staff may now be passed downwards through the incised part with the greatest freedom: if so, it may be withdrawn, and a catheter passed in its place. Since, however, the point of a catheter sometimes catches in the wound, and does not go readily into the bladder, perhaps from the urethra occasionally collapsing at the posterior limit of the incision, I prefer to introduce through the wound, before withdrawing the staff, a concave curved director along the convexity of the staff, into the bladder. The staff being withdrawn, the catheter on arriving at the wound, glides securely and certainly along the director into the bladder. Now it is a matter of no small importance, that no por-



tion of the stricture should remain uncut. If, therefore, the catheter used (which should not be smaller than No. 10) be obstructed in its passage, or be obviously grasped after it has been passed, we may rely upon it there are a few fibres yet requiring division, which will occasion future relapse, if they are not incised; they must, therefore, be so treated at once.

If the bleeding is free, as it may be in exceptional cases, perfect safety is insured by plugging the wound. The catheter being secured in the usual way, a piece of india-rubber tubing is attached to it, and one end placed in a vessel. The patient lies on his back in bed, the legs supported by a pillow under each ham, and at the end of forty-eight hours the catheter is removed.

Two or three days after a full-sized instrument should be passed and be at once removed; this may be repeated every three days, and finally be employed once a week or ten days for a considerable period of time. Subsequently, the patient should continue to pass one at a much longer interval, such as every four or six weeks, or thereabout.

*Results of the Operation.*—A certain amount of danger attends every operation which requires a section of the erectile tissue of the urethra, especially that of the bulbous portion, where it is abundant and highly vascular. Whether the incision is from within or from without, it cannot be regarded as entirely free from risk, this, other things being equal, being generally proportioned to the extent of the divided tissue. The risks are— hæmorrhage, constitutional derangement from absorption of urine, and pyæmia; probably all, but particularly the two latter, are more likely to be encountered in feeble and unhealthy subjects than in those who are comparatively sound.

Hæmorrhage may occur at the time of the operation; it is rarely considerable; but if it be so, the ligature of any artery obviously divided; or if it issues generally from the cut surfaces, close plugging of the wound from the bottom with fine strips of lint, and the application of a pad in the perineum over this, will arrest it. If it is merely oozing, but continuous and obstinate, a bladder of ice, and cold water dressing to the wound, suffice without the plug.

Constitutional symptoms of a severe kind sometimes show themselves. These arise probably from the absorption of a very small quantity of urine, and consist of severe rigors, vomiting, muscular pains of a very acute character in the head, back, and often in the shoulders and legs, with depression of the pulse; the rigors are succeeded by a hot skin, great thirst, and restlessness; and these by sweating, which is more or less profuse. The patient remains weak, but in thirty-six to forty-eight hours gradually returns to his natural state. I have never seen a patient succumb after such an attack. The application of local heat and the administration of stimulants are desirable during the first stage; abundant and refreshing drinks should be given during the second; and mild nutriment as soon as the stomach is able to bear it.

Pyæmia, and inflammation of the kidneys, supervening on pre-existing organic disease of those organs, but most frequently the former, are the causes of the fatal result when it does happen. The mortality, deduced from past experience, is, however, small, especially when the extremely bad

condition of many of the patients operated upon is taken into the account. In 219 cases carefully collected by myself, from numerous operators, the deaths from all causes amounted to barely over six per cent.

Concluding here the subject of urethral stricture and its treatment, it may be remarked that varied means are to be employed in the different circumstances in which the disease is presented to the surgeon; and that it is undesirable to limit our resources to the employment of any single method. Of one thing I am convinced by large and increasing experience of this subject, that the more familiar we become with it in all its forms the less necessity appears for what may be termed operative measures in contradistinction to carefully managed dilatation.]

Henry Thompson.

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URINARY ABSCESES, URINARY EXTRAVASATION, and URINARY FISTULÆ.—[As a result of severe, long-continued inflammation of the urethra, whatever the cause, abscess may be formed in its vicinity. But by far the most common cause is a narrow stricture of the urethra. When much irritation exists in the canal behind the stricture, when proper treatment has been neglected, or where violence has been used, abscess not uncommonly takes place. It is by no means always, it is probably even rarely, produced by some slight extravasation of urine beneath the mucous membrane of the urethra; but occurs as a result of inflammation in the cellular tissue. The most common situation is the perineum, after this

in the scrotum, and rarely they occur in the groins or thighs, but are always associated with some fistulous canal connected with the urethra. Occasionally acute urinary abscess in the perineum is met with, but this is rare; generally they are very slow and chronic in their course.

Acute abscess is not to be confounded with extravasation, the signs of which are quite different. (See EXTRAVASATION OF URINE.) When acute abscess is in process of formation, shivering and other marks of general fever usually announce the fact. The symptoms of prostatitis have usually preceded this form of the complaint. (See PROSTATITIS, ACUTE.) Add to this, excessive pain and difficulty in micturition are experienced; the perineum is tense and hot, the prostate extremely tender. If the matter shows any signs of coming forward it should be evacuated by an incision at once. But in the case of chronic perineal abscess, the swelling slowly increases and points, frequently bursting by itself, since it is often not very painful before the surgeon sees the case. Matter is discharged, and not until two or three days afterwards urine passes through the opening, at first in small quantities, subsequently more is passed, and at each time of making water, and thus a urinary fistula is established.

The treatment consists in rest and poulticing, and in dilating the stricture which has occasioned the abscess. This done, in almost all cases the opening gradually ceases to discharge pus, and soundly heals.

Some perineal abscesses communicate with diseased prostate, and result from disease of that organ instead of from stricture of the urethra. These are far less amenable to treatment, and generally resist it, becoming fistulous passages, which will be presently referred to.]

#### URINE, EXTRAVASATION OF.

[This accident is apt to happen during retention of urine from stricture which is permitted to remain unrelieved during a considerable period of time. The urethra behind the stricture ulcerates and gives way, permitting the distended bladder to drive its contents into the cellular interspaces of the scrotum and abdomen. The urine does not in these cases pass downwards into the thighs, or backwards into the perineum, unless the rupture takes place behind the anterior layer of the deep perineal fascia, which is extremely rare, but upwards into the cellular tissue under the skin of the abdomen, since the junction of the fasciæ at Poupart's ligament prevents its descending in the directions named. The consequences of extravasation are extremely disastrous. Inflammation is set up in the track of the urine, and the areolar connections of the skin and subjacent tissues are broken up; it is an unpropitious sign if the corpus spongiosum have become infiltrated: a dark spot on the glans penis marks its occurrence, and the progress of the gangrene which has resulted; when this happens, there have usually been circumstances of great neglect. The general condition is always depressed, and unless speedy relief be afforded, a fatal result must inevitably and rapidly follow. The principal local signs are considerable distension of the parts involved, discoloration of the integument, the hue of which varies between dusky red and purple, and, in an advanced condition, pressure on

the surface by the finger occasions emphysematous crackling, from the presence of gaseous products in the interstices of the cellular tissues. At a late period the patient is frequently in a state of low muttering delirium, with black tongue, and pulse almost indistinguishable.

In these circumstances no time may be lost. Free incision must be made into the distended parts, on each side the median line, in order to give vent to the extravasated urine, and provide for its future passage from the bladder. Fœtid urine, puriform matter, and decomposed tissues come away, and sometimes in surprising quantity. Immediate interference with the stricture is unnecessary, and no catheter need be passed for a day or two. Stimulants, morphia, and good fluid nourishment are generally required in full quantity.

However favourably the patient progresses, a considerable amount of sloughing must often take place; and often a large portion of the scrotum is lost, exposing one or both testicles. During this process the removal of the products of decomposition and the cleanliness of the parts must be provided for. Antiseptic applications frequently changed, as yeast, or beer-ground poultices, linseed-meal poultices, with a few drops added of the chlorides of lime or soda, or of the permanganates, promote these indications.

If the extravasation have taken place between the two layers of the deep perineal fascia, a firm, hard, and deep-seated swelling may sometimes, but not always, be detected in the perineum. This is to be at once freely opened. If it occur behind the fascia altogether, but this is very rare, the urine finds its way upwards around the base of the bladder, and a fatal result is inevitable.]

#### URINARY FISTULÆ.

[A urinary fistula is an abnormal passage leading from some part of the urinary track to the external surface, and transmitting, at times, more or less urine. The external openings of the fistulæ are generally seen at the surface of the perineum and scrotum, which parts are often traversed by them in circuitous routes; less frequently they appear in the groins, the upper part of the thighs, the nates, and even above the pubic symphysis. In most cases they are due to previously existing urinary abscess, or to lesions produced by extravasation of urine. Under the term of Urinary Fistulæ all these conditions are commonly included; some of them may be regarded as simple and easily cured, others as complicated, and requiring much time, care, and perseverance, in order to attain a successful result. Some are merely narrow channels through nearly healthy parts; others pass through structures greatly indurated, augmented in size and density by repeated deposits of plastic matter, and more or less deformed; and sometimes connected with cavities secreting pus and detaining in their interior some quantity of the urinary secretion. The external orifices of the fistulous passage may be few or numerous; in the latter case being the outlets of sinuous and branching channels springing in process of time from the original track, and giving exit to a number of small streams when the act of micturition is performed; and lastly there is a class of unnatural passages or openings into the urethra, which have their origin in loss of substance by sloughing from



extravasation, or phagedænic ulceration, or as the consequence of violent injury to the parts; and these abnormal conditions are quite distinct in character, results, and in relation to the treatment required, from the two preceding classes.

1. *Simple Fistulæ*.—The first class embraces those cases where, in connection with stricture of the urethra, one or more fistulous passages exist, by which the urine traverses the perineum or scrotum, the surrounding parts being not much altered from their natural or healthy condition. In this category may be classed the great bulk of the cases ordinarily met with. These openings are the result of Nature's mode of affording relief in cases of narrow stricture,—they form safety-valves to the dangerous pressure which is being exerted upon important organs behind the obstructed point; while they nevertheless form fresh complications of the original complaint. Thus we may often see patients, with large fistulous passages in the perineum giving exit to all their urine, enjoying extremely good health for years together.

*Treatment*.—With regard to simple fistulæ, as a rule, nothing else is required than to dilate fully the urethra. The urine will flow by the natural channel, and the fistulæ will heal of themselves, if we ensure a free passage from the bladder. There need be no meddling with the fistulæ themselves; the less they are touched the better. Those patients who form the exceptional instances to this rule are for the most part weak in constitution, have little reparative power, or are subjects of some chronic disease in addition to stricture of the urethra.

2. *Fistulæ with Induration*.—Those cases in which the fistulæ pass through tissues which are more or less indurated and deformed by repeated deposits of inflammatory exudation; such being often connected in some part of their course with cavities, the sacs of former abscesses secreting thin or sanious pus.

*Treatment*.—First the stricture must be adequately dilated. In most even of these cases this is sufficient to enable the surrounding parts slowly to improve, and, finally, the fistulous passages to take on the healing process. The dilatation, however, having been made and maintained for some time, and little or no benefit having resulted, it may be necessary either to stimulate the walls of the fistulæ themselves, and so bring about adhesion of opposing surfaces; or to lay them open, in order to produce recent and healthy wounds, so that they may heal up soundly from the bottom. But associated with such treatment, it is of the highest importance at the same time to attend closely to the patient's general health, seeking to maintain the secretions and excretions in a natural condition. Various agents have been employed for the object first named. One of the most useful is the concentrated tincture of cantharides, applied on a camel's-hair brush, or on a probe armed with lint, or a fine syringe. Solutions of the sulphate of zinc or copper, and of the nitrate of silver, have been introduced by means of a syringe, sometimes with apparently good result. One of the best modes we can employ is to introduce carefully, as far as it is possible, a small and flexible silver probe, coated with nitrate of silver. If the external orifice of the sinus is smaller than any other part of it, it is advisable to apply a little caustic potash, for the purpose of enlarging it, and

so facilitating the removal of the discharge, which is essential to success.

The application of compression to the fistulæ has been tried several times, and success has been claimed for it in two or three cases. M. Diday of Lyons, not long ago communicated a case at some length to the Société de Chirurgie, of Paris, in which he states that he obtained a successful result, all ordinary means having failed, by making the patient apply firmly to the perineum an india-rubber ball, inflated with air, on every occasion before making water, and for some minutes afterwards. This plan was studiously followed during fifteen days, when the opening had soundly cicatrized. Four months after the patient was perfectly well. (*Bull. de la Soc.*, vol. v. 1855, p. 45.)

The cure of obstinate urinary fistula has often been attempted by introducing a catheter, and permitting it to remain in the urethra for days together, on the principle of ensuring, as it has been supposed, the passage of the urine through the instrument, and thus preserving from irritation the fistulous passages. Little, however, is thus gained by this method, for experience shows, that however large the instrument may be, and however closely it may fit the urethra at the present moment, before twenty-four or thirty-six hours have elapsed it will lie loosely in the canal, and urine will pass by its side. I have, however, been enabled to cure some of the most obstinate fistulæ, by teaching the patient to pass for himself a gum catheter easily, and then making him pass it on every occasion to micturate, for a period of four, six, or eight weeks. The withdrawal of the whole of the urine by this means is essential to success, and the result usually rewards the patient for his trouble.

Free incisions through the fistulæ, down to their origin in the urethra, or nearly so, are sometimes successful in inducing a new and healthy process of granulation from the bottom of the wound, and thus in ultimately producing complete closure of the unnatural passages,—provided always, however, that the stricture, if any, is kept perfectly open, otherwise no such measure can be of any service. In some cases in which external division of the stricture on a grooved staff is indicated, this operation may be performed in such a manner as to include the fistulous opening in the incision, in which case a successful result may generally be reckoned on.

An obstinate species of fistulous opening, communicating with the prostatic part of the urethra, is that which in a few exceptional cases follows the operation of lithotomy. The introduction of a heated iron wire has appeared to me the best means of obliterating it.

A fistulous passage is sometimes prevented from closing by the presence of a small calculus in some part of its course. This may occur either by the lodgment of some small concretion which has escaped from the bladder, or from the deposit and production of such a formation from unhealthy urine while passing through the sinus. Most commonly, I believe, the condition is present in fistula which is connected with diseased prostate, or in connection with calculous formations there. These have been discharged by nature through such passages, or have been removed artificially by enlarging them, and extracting the foreign bodies which

sometimes exist in considerable number in this situation. Fistula associated with the prostate may, however, exist in the absence of any of these causes; such as those which are sometimes connected with prostatic abscess, and which are generally exceedingly obstinate and irremediable.

Fistula is not necessarily a complete or continuous passage from the urethra to some other surface; it may have an opening at one end only, and have a blind or cæcal extremity for the other.

Hence "blind urinary fistula" has been described. A small tumor, originally formed by a collection of matter, with thickened walls, and having a communication with the urethra, constitutes the general form. Its origin has been variously accounted for. Some observers connect it with stricture. Others with inflammation of the mucous follicles of the urethra. Sir B. Brodie takes the latter view. Sir Charles Bell attributed it to inflammation and suppurative of Cowper's gland when situated close to the bulb. A firm small swelling is felt externally, and its contents are sometimes to be evacuated into the urethra by pressure. Ordinarily, there is more or less constant oozing of these from the meatus, giving rise to what is called a gleety discharge.

This will not disappear until the tumor is opened externally, when it becomes a fistula of the ordinary kind, requiring treatment already indicated.

Urethro-rectal fistulæ sometimes occur as a consequence of stricture, and more rarely, perhaps, vesico-rectal. In either case the patient notices the passage of liquid in an unusual manner and quantity by the anus, and that habitually, while a diminished quantity is observed to come by the natural passage.

It is not an easy matter to close these openings, unless of very small size, but the actual cautery, and particularly that heated by the galvanic current, affords the best chance of success. It may be applied through the rectum, a speculum having been first introduced, and a full-sized sound carried into the bladder. Both of these are afterwards removed. On the day before the operation the bowels are to be freely purged and cleared by an enema an hour or two before the application of the cautery, after which they must be prevented from acting for two or three days. The cautery is to be re-applied two or three times at intervals of about ten days, if necessary. Sometimes a plastic operation similar to that for vesico-vaginal fistulæ may be adopted successfully.

3. *Fistulæ with Loss of Substance.*—This class of urinary fistulæ comprehends those cases in which unnatural openings into the urethra exist, not necessarily depending, like those belonging to the preceding classes, upon stricture of the canal, but upon actual destruction of substance from the walls of the urethra and superjacent parts. The common causes of these are, sloughing from extravasation of urine, simple and phagedænic ulceration, and mechanical injuries of various kinds.

These openings are for the most part larger, although not invariably so, than any of those already referred to. Generally a portion of the floor of the urethra is destroyed, as well as the structures which have intervened between it and the external surface, so that in many cases more or less of the mucous membrane of the upper aspect of the canal is visible from the outer orifice. As

a consequence, the whole, or nearly the whole, of the urine passes by the artificial channel in a full stream. The cure of these openings can only be accomplished by some well-planned and well-executed plastic operation.]

*Urethroplasty.*—[Under this term will be comprehended those operative measures, of a plastic kind, which have for their object the closure of artificial openings into the male urethra, which are not amenable to any other method of cure.

All these abnormal openings may be regarded, with this view, as occupying two distinct divisions or classes.

(a.) Those which exist before the scrotum, or in the penile portion of the urethra, sometimes called ante-scrotal or urethro-penal fistulæ; and

(b.) Those which are found in or behind the scrotum, known simply as scrotal and perineal fistulæ.

A distinction exists between the cases of each division. Ante-scrotal urethral openings are the most difficult to close. The coverings of the urethra are thin, possessing substance insufficient to furnish an amount of granulations adequate to close any but the most insignificant aperture. For the same reason, it is difficult to obtain from their immediate neighbourhood a flap endowed with sufficient vitality to preserve its existence after the process of transplantation. And further, owing to the extreme mobility of the member, it is difficult to maintain that perfect steadiness of position so desirable in a part which is the subject of an autoplasmic operation; while the alteration in size and form which this organ is especially liable to exhibit, through the occurrence of erections which are often quite uncontrollable, may impair, or sometimes render almost impossible, the success of the best-planned and most skilfully executed operation. Nevertheless, with all these difficulties, in addition to that formidable one, the contact of the urine before referred to, such openings, even when large, are not now by any means to be regarded as beyond the reach of surgical skill.

*Treatment of Ante-scrotal Fistulæ.*—Dieffenbach, to whom this branch of surgery is so much indebted for its progress, was accustomed to use a peculiar suture to close an ante-scrotal opening which was too large to be obliterated by the application of nitric acid and a concentrated tincture of cantharides to its edges. This, which he called "the lace suture" (*schürnaht*), may properly be considered here. The margin of the unnatural opening, as well as the surrounding skin for a short distance, must be frequently touched during the day previous to the operation with the concentrated tincture of cantharides. Before proceeding to use the suture, the loose epidermis raised by the blistering fluid is to be removed by scraping, a sound introduced into the urethra, and made to pass below the opening. The operator is then directed to take "a small curved needle, sharp at the point, but not at its edges, with a stout silk-waxed thread, and by means of a needle-holder to introduce it beneath the skin at about three lines from the border of the fistula." The point of the needle is to be carried deeply, but not into the urethra, and made to emerge at another point, about three lines from the margin of the fistulous opening. By three or four of these stitches, the thread is to be carried round the opening, until it finally emerges



at the point at which the needle was originally entered. The thread therefore now lies deeply in the cellular tissue around the fistula, at about three or four lines' distance from it.

The two ends are then to be drawn together gently and slowly, so as to tighten the thread, and gradually approximate the borders of the fistulous orifice until it is obliterated. Lastly, the ends are to be fastened by a knot, which, when fastened, sinks into the cellular tissue, and disappears. A piece of wet lint is to be applied to the part, the sound withdrawn, and the patient directed to pass urine, when requiring to do so, by the natural passage. In three or four days the ligature may be divided, and drawn away. "Even," says Dieffenbach, "if the first application does not quite close the opening, this is rendered smaller, and the succeeding operation is easy, and certain to succeed."

But when the opening is too large for such treatment, it is necessary to resort to a plastic operation for its cure. Such proceedings are comparatively of recent date; the first on record, which I have been able to discover, being one designed and successfully performed by Sir A. Cooper in 1818. A man, *æt.* 56, had an ante-scrotal opening, half an inch in length; the margins of this were pared, and a flap was dissected from the scrotum, leaving a broad attachment. It was kept in place by four sutures and by plaister. Adhesion was ultimately perfect. Another case followed in the practice of Mr. Earle, of Bartholomew's, in 1819. Here the opening was perineal; the first operation failed, but the second, also by flap, in the following year, completely succeeded. In these two cases the plans of proceeding were totally different: in them we have the germs of those modes of operating since adopted in other countries.

In dealing with the ante-scrotal fistulæ which were too large to be remedied by the "lace suture," such, for example, as would permit the introduction of a full-sized catheter, Dieffenbach proceeds as follows:—A large catheter having been introduced into the bladder, the rounded orifice of the fistula is converted into a lozenge-shaped one, by the removal of a small piece of skin above and below it. A longitudinal incision through the skin was then made on each side, at the distance of about half an inch, or a little more. The point of a fine scalpel is next to be carefully carried, by successive strokes, beneath the skin which intervenes between the two incisions, so as to detach it from the subjacent parts, and form what Dieffenbach called "a bridge," for the purpose of permitting urine to escape from the fistulous opening at the lower extremity of either incision: the borders of the fistula are also to be revived.

Although sometimes failing, this method may be regarded as affording a fair chance of success, provided that the aperture is not too large. It is based, as will be observed, upon the principle of bringing into contact, *not mere edges of thin tissue*, the adhesion of which cannot be expected to take place, but broad surfaces freshly cut, and maintained in apposition by light compression. It may be laid down, however, as a general rule, that success is not to be expected by this operation if applied to openings that measure more than the third of an inch in any direction.

Since the introduction of the lead plate and silver suture fastened with shot or lead clamps, for the vesico-vaginal fistula, I have twice employed it for the male subject; in one case for a large ante-scrotal opening, in the other for a perineal one. In the former case it was most successful; in the latter it failed. The patient should be previously made proficient in passing the catheter, so that he may withdraw all his urine easily for 10 or 14 days after the operation. This has also been accomplished in another way. M. Ségalas adopted the method of diverting altogether the course of the urine by an artificial perineal opening during the process of healing in the anterior wound. He did this successfully in 1839, for a patient the subject of scrotal and perineal fistulæ, dilating the latter by the bistoury, at the same time that he operated on the former; a catheter being maintained afterwards in the bladder, but through the perineal fistula. ("Lettre à Dieffenbach." Paris, 1840. P. 48.) Jobert, on the other hand, thinks the perineal opening unnecessary; and opposes it on the ground of the presumed dangerous nature of the operation.

This plan was adopted by Mr. J. Lane in St. Mary's Hospital, in the case of a child with a fistulous opening just in front of the scrotum, resulting from an incision made to extract an impacted calculus. The urethra was opened in the perineum, and an elastic catheter was retained in the bladder through this opening while the fistula was healing. The edges of the fistula, having been denuded, were brought together with silver sutures fastened through a leaden plate. Immediate and firm union was obtained, at the end of ten days the catheter in the perineum was dispensed with, and the perineal opening quickly healed. In Mr. J. Lane's opinion, the lead plate is of great value in a case of this kind, by keeping the wound uniformly on the stretch in the longitudinal direction, and preventing the gaping caused by the penis falling down upon the scrotum.

In several cases, published at great length in his work, which M. Jobert treated by transplantation of a flap (this being maintained in its new position with sutures in the usual way), the exit of the urine was provided for by maintaining constantly in the passage a gum-elastic catheter, but the union was often totally wanting, and was never otherwise than incomplete at first. The flow of urine outwards through the wound could not be prevented, and the track by which it issued was always marked by non-union. Consequently repeated operations were frequently necessary on the same individual. Generally speaking, it is, as before said, the wisest plan to teach the patient himself to pass the catheter before commencing any operation, and not to undertake it until he is able to do so with perfect ease. He must also be sufficiently interested in the successful issue of the proceedings to undertake the task of drawing off the urine by catheter on every occasion, night or day, whenever it is requisite; and that for a period certainly of some weeks. If this be accomplished the operation has a fair chance of succeeding.

It is necessary, in order to complete this part of the subject, to allude to Dieffenbach's method for closing openings into the urethra immediately behind the glans, in the situation of the frænum. Such are usually the result of chancreous ulcerations. It is scarcely possible to describe the various and

rather complicated proceedings which he advises for these cases without diagrams. The student who requires further information should therefore consult Dieffenbach's work itself, *Die Operative Chirurgie*, 1845, Vol. I.; or *The Dublin Journal*, Vol. X., 1836; or it may be found in a work *On Stricture and Perineal Fistula* (which contains illustrative drawings of the steps of the operation), by the writer of this article.

*Openings in the Perineum.*—As regards the treatment of these openings, depending on loss of substance, much must depend on the necessities of each individual case. Generally speaking, such openings, requiring plastic operation, are rare; the soft parts are naturally abundant, the urethra is deeply placed, and thus more active agents than the cautery, in some one of its various forms, are not often necessary. This is to be applied at first to the bottom of the sinus, close to the urethra itself. Little by little, adhesion, contraction, and, finally, closing in of such passage may be accomplished in this manner. Perhaps the most efficient means of applying it is the galvanic apparatus of Mr. John Marshall, of University College Hospital. Its advantage consists in the power which the apparatus possesses to maintain in the cauterizing wire an exceedingly high temperature, nearly that of white heat, during all the time required for the process of application; and in the illuminating power of the current. In passing the heated wire to the bottom of a deep sinus, a clear view of the parts around is easily obtained, the utility of which may be readily understood.

Where the loss of substance has been so considerable as to render attempts by the cautery hopeless, a flap is to be transplanted from the neighbouring parts, the edge of the opening pared, and good approximation, without making any strain on the flap, ensured by fine harelip pins, or by the silver suture. The urine is to be withdrawn as usual by catheter.]

Henry Thompson.

[*A. Cooper*, Surgical Essays, Lond. 1819, part 2. *H. Earle*, Pract. Observ. on Surgery, Lond. 1823. *Dieffenbach*, Oppenheim's Journal, Hamburg (translated in Dublin Journal, vol. x. 1836): *Die Operative Chirurgie*, Leipzig, 1845, vol. i. *P. F. Blandin*, Antoplastie, Paris, 1836. *A. J. Jobert* (de Lamballe), Traité de Chir. Plast., Paris, 1849, vol. ii. *J. Roux*, Quarante années de Prat. Chir. Paris, 1854, vol. i. *Trans. Med.-Chir.*, Lond. 1845, *Gazette Méd. de Paris*, 1834, p. 348. *Gazette des Hôpitaux*, 1852, August, 1834, March. *Ségalas*, Lettre à Dieffenbach, Paris, 1840. *H. Thompson*, Stricture of Perineal Fistula, Lond. 1869.]

**URINARY CALCULI.**—A true explanation of the nature of urinary calculi must have been quite impossible until chemistry had made considerable progress, and the methods of analysis advanced far towards perfection; and, as will appear in the course of this article, all the valuable knowledge which now exists upon this interesting subject is in reality the fruit of modern investigations. It is to be regretted, however, that our information on many points is far from being settled or complete, as any impartial and judicious reader may soon convince himself by a reference to the able and scientific views, entertained by Dr. Prout, of various questions, relative to the formation of gravel and calculi, and the treatment of such cases in all their varieties. (See *An Inquiry into the Nature and Treatment of Gravel and*

*Calculus, and other Diseases connected with a deranged Operation of the Urinary Organs*, 3vo. Lond. 1821.)

Mechanical deposits from the urine are divided by Dr. Prout into three classes:—1. Pulverulent or amorphous sediments. 2. Crystallized sediments, usually denominated gravel. 3. Solid concretions, or calculi, formed by the aggregation of these sediments.

*Pulverulent or Amorphous Sediments*, are described by Dr. Prout as almost always existing in a state of solution in the urine before it is discharged, and even afterwards until it begins to cool, when they are deposited in the state of a fine powder, the particles of which do not appear to be crystallized. Their colour is for the most part brown or yellow; and, generally speaking, they consist of two species of neutral saline compounds; viz. the lithates of ammonia, soda, and lime, tinged more or less with the colouring principle of the urine, and with the purpurates of the same bases, and constituting what are usually denominated *pink* and *lateritious* sediments; and, secondly, the earthy phosphates, namely, the phosphate of lime, and the triple phosphate of magnesia and ammonia, constituting for the most part sediments nearly white. The two species of sediments are frequently mixed together, though the lithates generally prevail.

*Crystallized Sediments*, or *Gravel*, are commonly voided in the form of minute angular grains, or crystals, composed, 1. Of lithic acid, nearly pure; 2. Of triple phosphate of magnesia and ammonia; and, 3. Of oxalate of lime. The crystals of lithic acid, which are by far the most frequent, are always more or less of a red colour. Those composed of the triple phosphate of magnesia and ammonia are nearly white; while others, composed of the oxalate of lime, which are extremely rare, are of a dark, blackish green colour. (Prout, *Op. cit.* p. 79, &c.) [Calculus concretions of oxalate of lime may be dark in colour, but the crystals, which are now well known, are transparent and colourless, and of very common occurrence.]

*Solid Concretions*, or *Urinary Calculi*, arising from the precipitation and consolidation of the urinary sediments, may be formed in any of the cavities to which the urine has access; and hence they are met with in the kidneys, ureters, bladder, and urethra. Most of them are believed to be originally produced in the kidneys, from which they afterwards descend with the urine. To this statement, however, the cases in which calculi are formed upon foreign bodies introduced into the bladder through the urethra, an accidental wound, or some ulcerated communication between the intestines and the bladder, are manifest exceptions. In the centre of urinary calculi, bullets, splinters of bone, pieces of bougies, and wood, pins, needles, nuts, &c., are frequently observed; and it would appear that a very minute substance is capable of becoming a nucleus; a mere clot of blood, or a little bit of chaff, if not soon voided, being sufficient to lead to the formation of a stone in the bladder. A needle that had been swallowed, insinuated itself into the bladder, and became the nucleus of a calculus. (See *Dublin Journ. of Med. Science*, No. 1.) Many instances are recorded of calculi containing hairs, which doubtless were the original nuclei of them. Such



concretions are termed by French pathologists *calculs pilifères*, a subject adverted to by M. Jules Cloquet. (*Pathol. Chir.* p. 101.) Lithic acid is itself very commonly the nucleus, even where the whole calculus is not of the same material.

That many urinary calculi are originally produced in the kidney is certain; first, from the severe pain which the passage of such foreign bodies down the ureter always excites; and, secondly, from their being often discovered in the infundibula and pelvis of that viscus after death. This last fact is well illustrated in the first plate of Dr. Marcet's interesting *Essay on the Chemical History and Medical Treatment of Calculous Disorders*, 8vo. 1817. The engraving is taken from a preparation in the Museum of Guy's Hospital. In this instance, there were several calculi closely pressed against each other; but in another example, drawn from a specimen in Mr. Abernethy's museum, the renal concretion was composed of a single mass, which represented a complete cast of the pelvis, and part of the infundibula of the kidney. In this form of the disease, the kidney loses at last all vestiges of its natural structure, and is converted into a kind of cyst, filled with the extraneous substance. When so complete an alteration of the structure takes place, the secretion of urine must of course be entirely carried on by the other kidney. However, in some instances, the inconvenience thus produced is so slight that it almost escapes notice; and sometimes even both kidneys are diseased in a very great degree, and yet life is preserved for a considerable time. (*Op. cit.* pp. 3, 4.)

Calculi are sometimes found in the ureters, especially at the upper part; but it is not supposed that they are originally formed there; an event not likely to happen, unless there were some cause retarding the descent of the urine through those tubes. The common belief is, that all calculi found in the ureter are first produced in the infundibula and pelvis of the kidney, from which they afterwards descend with the urine.

The generality of calculi, however, which leave the kidney are of small size, and, consequently, after a time, and exciting some pain and inconvenience, they usually pass into the cavity of the bladder. Indeed, as Dr. Marcet remarks, the bladder is the most frequent seat of calculi: not only because all urinary concretions, or their nuclei, formed in the kidneys, tend to fall into that organ; but, also, because a stone may be, and probably often is, originally formed in the bladder itself.

Renal concretions vary considerably in their number, size, and shape. In some cases, a single small calculus has been found occupying one of the foregoing situations; while, in other instances, an innumerable collection of calculous substances are observed filling the whole of the cavity of the pelvis and infundibula of the kidney, distending its parietes, and even obstructing the passage of the urine out of this viscus, which is converted into a sort of membranous cyst. Lastly, a single stone in the kidney may acquire a very large size there; or a great number of small calculi, in the same situation, may become cemented together, so as to form one mass of enormous dimensions, and the shape of which invariably corresponds to the

space in which it is, as it were, moulded. Hence, renal calculi often present a variety of odd, irregular figures, resembling those commonly observed in specimens of coral.

Great disorder of the stomach, frequent vomiting, and great irritability of the bladder are common effects of a calculus in the kidney. Sir A. Cooper met with a case, in which the chief pain was at the anterior superior spinous process of the ilium.

It has been already remarked, that urinary concretions of large size very often exist in the kidney, without their presence being indicated by any external circumstances, or attended with any symptoms sufficiently unequivocal to constitute a ground for suspecting the importance of their cause. On the other hand, it is very usual for renal calculi, of middling dimensions, to excite serious and alarming complaints. The reason of this difference becomes obvious, when it is recollected that smallish concretions are readily carried with the urine into the ureter, and become fixed in the narrow portion of the tube. But very large calculi can be contained only in the upper part of this canal, where its parietes are more yielding, and the space in them more capacious.

Calculi of middling size, in their passage through the ureter, cause, at first, a feeling of heaviness, or an indeterminate sense of uneasiness, and an obtuse pain in the region of the corresponding kidney. These complaints occur at intervals of greater or less duration. At length, the pain grows more urgent and annoying, attended with flatulence, heart-burn, frequent vomiting, painful retraction of the testicle, and sometimes acute fever. As Sir A. Cooper has remarked, it is at the period when the calculus is passing over the lumbar plexus, that a great deal of pain is felt in the groin and in the course of the anterior crural nerve, just as the spasmodic contraction of the cremaster arises at the time when the calculus is descending over the spermatic plexus. The patient makes water frequently, and in small quantities at a time; and the urine is high-coloured and bloody. The patient cannot sit upright, his body being bent forwards towards the affected side. These symptoms may have more or less duration, and then suddenly cease. They may also subside, and recur several times, at intervals of some days. In the latter case, the pain is felt at each attack to be situated lower in the track of the ureter. Lastly, when the symptoms have entirely disappeared, the urine is more abundant, not so high-coloured, and easily discharged, the stream sometimes bringing out with it the urinary concretion, after its entrance into the bladder.

Suppuration of the kidney, and an abscess in the lumbar region, in consequence of renal calculi are not very common events. However, these are the only cases of the kind in which the interposition of surgery can be useful. By adverting to previous circumstances, and the irregularity of the pain about the kidney, the practitioner may suspect the nature of a phlegmonous tumor in the situation of this viscus. Whatever may be his conjectures, however, he must carefully abstain from the use of his lancet, until purulent matter is plainly under the integuments. He may then safely make an opening, from which urine and pus will be discharged, and through which the calculi themselves may sometimes be felt and extracted.

If they cannot be readily touched with a probe, let not the surgeon rashly conceive, that he is justified in endeavouring to discover them with his knife. Their situation may be such as to baffle all his endeavours, and the operation itself might cause a most dangerous hæmorrhage, and other fatal mischief. The opening of an abscess of the kidney may remain a long while fistulous, and, indeed, warrant the conclusion that the healing is prevented by the presence of some extraneous substances; but a prudent practitioner will never think of performing any operation for their extraction, unless they can be distinctly felt, and nature has brought them tolerably near to the surface. (See NEPHROTOMY.) Sir A. Cooper, in his lectures, mentions a singular case, in which Mr. Cline was able plainly to feel, in a very thin patient, a calculus situated in the kidney. He adverts also to another example, in which a great deal of purulent matter had been voided from the bowels before death, and, on opening the body, a calculus was found lodged in the ureter, between which tube and the colon an open communication existed, through which the abscess of the kidney had discharged itself into the intestines. In one particular case, related by the same experienced surgeon, a calculus, fixed in the ureter, gave rise to a renal abscess, which burst into the cavity of the abdomen, and the patient's death quickly followed.

Urinary calculi, which form upon foreign bodies accidentally introduced into the bladder, and acting as nuclei, are always single, unless the number of foreign bodies themselves happen to be greater. It is curious also to find, from the observations of Mr. Murray Forbes (*On Gravel and Gout*, p. 74, 8vo. Lond. 1793) and Dr. Marcet, that, in such instances, the deposition most frequently, if not always, consists of the earthy phosphates, and especially of the fusible calculus. Thus, in the collection of Mr. R. Smith, of Bristol, there is a pin, a piece of bougie, and four pieces of stick, coated with fusible matter. (See *Med. Chir. Trans.* vol. xi. p. 11.) But when calculi originate from a particular diathesis, there may be many of them lodged in the bladder at the same time. Several distinct nuclei may descend successively from the kidneys, and each may increase in a separate manner. Sometimes, however, calculi in the bladder, which are at first distinct and unconnected, become afterwards cemented together, so as to make only one mass.

The magnitude of calculi in the bladder is generally in an inverse ratio to their number. Some hundreds have been found in one bladder; but they were not larger than a pea. One very remarkable instance has lately been recorded, in which 393 calculi, from the size of a pea to that of an olive, were found in the bladder after death. By analysis, they were found to consist of phosphate of lime, phosphate of magnesia, and uric acid. (*Mag. der Ausländischen Literatur, Hamb. Jan. Feb. 1822*; and *Journ. of Foreign Med.* No. 15.) It is observed by Sir Astley Cooper, that when a great number of calculi are found in the bladder, the circumstance is generally attended with an enlargement of the prostate gland, directly behind which a sacculus is formed. In cases of diseased prostate gland, the bladder can seldom be completely emptied; and this partial stagnation of the urine in the sac, here alluded to, is supposed to facilitate the production of calculi. From their

number and collision against each other, their surfaces are generally smooth, and their shape is commonly roundish. (See *Med. Chir. Trans.* vol. xi. p. 359; and *art. PROSTATE GLAND*.) Other calculi have been met with of so large a size, that they were more than six inches in diameter. In Fourcroy's museum, and in that of the École de Médecine, at Paris, may be seen some calculi, which filled the whole cavity of the bladder; and, in the *Phil. Trans.* for 1809, the late Sir James Earle described an enormous stone which he extracted, after death, from the bladder of the late Sir David Ogilvie, who had been unsuccessfully cut for it. This calculus, which was of the fusible kind, weighed forty-four ounces, and was of an oval shape, its long axis measuring sixteen inches, and the shorter fourteen. The average size of vesical calculi may be compared with that of a chestnut, walnut, or a small hen's egg. Their size depends very much upon their composition, the largest being of the fusible phosphatic kind. Their weight differs from a few grains to upwards of fifty ounces; but, on an average, it is from two to six ounces. Their weight is not always proportioned to their size; for substances of different qualities enter into their composition, and diversify their heaviness.

The urinary salts, in calculous patients, are not continually precipitated in the same quantities: in some cases, indeed, the process appears to be even suspended for a considerable time. Hence, a stone of middling size, already formed, may increase but very slowly; and it has actually happened that a calculus, which could be plainly felt with a sound, has remained more than ten years in the bladder, and yet, after all this time, been only of a moderate size.

According to Dr. Marcet, the form of urinary calculi is mostly spheroidal, sometimes egg-shaped, but often flattened on two sides, like an almond. (P. 50.) Sometimes the calculous matter, which descends from the kidneys, is in the form of minute spherical grains, which have a singular tendency to unite either to each other, or to calculi already lodged in the bladder.

When there are several loose calculi in the bladder together, they seldom lie long in contact with each other while their size is diminutive, but are incessantly changing their position, as the patient moves about, or alters the position of his body. Hence their increase is at first regular and uniform; but when they have attained a more considerable size, or by their numbers compose a large mass, their relative situation is more permanent, and many of their surfaces being in this manner usually covered, no longer receive any additional depositions. Every other part of these calculi, however, goes on increasing. It is thus that stones, with surfaces corresponding to those of other stones, are produced, and which are aptly denominated by the French writers *pierres à facettes*.

Dr. Marcet has likewise taken notice of the angular shape of certain calculi, and remarked the rare occurrence of their being sometimes almost cubic. His work contains the engraving of a species of calculus, which somewhat resembles a pear, with a circular protuberance at its broader end, apparently moulded in the neck of the bladder.

The same intelligent writer has also particularly



considered the variety in the colours and surfaces of calculi, which often afford indications of their chemical nature. "When they have a brownish or fawn-colour, somewhat like mahogany wood, with a smooth, though sometimes finely tuberculated, surface, they almost always consist of lithic acid. When cut open, they appear to be formed of concentric layers, sometimes homogeneous, sometimes alternating with other substances. The colour, however, cannot be considered as a certain criterion, since other kinds of calculi may often be coloured in the bladder in a similar manner, by bloody mucus, or other vitiated secretions.

"When calculi are white, or greyish-white, they always consist of earthy phosphates: this is particularly the case with the species called fusible. And when they are dark brown, or almost black, hard in their texture, and covered with tubercles or protuberances, they are generally of the species which has been distinguished by the name of *mulberry*, and consist of oxalate of lime.

"Calculi have sometimes an uneven, crystalline surface, studded with shining transparent particles. This appearance always denotes the presence of the ammoniaco-magnesian phosphate." (*Marcet*, p. 52.)

A large calculus, especially when it has a rough irregular surface, produces a great deal of irritation of the bladder, which contracts more closely round it. The contact, however, is remarked to be particularly exact at the transverse line which extends between the terminations of the two ureters in the bladder; a part of this organ which generally becomes more thickened than the rest. Sometimes, indeed, the cavity of the bladder is nearly effaced, and the urine can be retained only a very short time; or, if it be not evacuated, it spreads uniformly round the calculus, especially above and below the above-described transverse projection, which is less yielding than other parts of this organ. Hence the surface of the stone, towards the orifices of the ureters, does not enlarge so fast as the other sides of it; and a circular groove is produced, giving the foreign body the shape of a calabash. Such calculi are generally very large, and sometimes even of enormous size. In the latter circumstance, the foreign body fills the cavity of the bladder so completely, that there is no space left for the lodgment of the urine there, which fluid then generally passes along a sort of groove, situated in a line reaching from the lower termination of the ureter to the neck of the bladder. This state is, of course, accompanied with a complete incontinence.

Urinary calculi are not always loose and moveable in the cavity of the bladder, being sometimes fixed in various ways to certain points of the circumference of this organ; a subject which has been noticed in the article *LITHOTOMY*.

When the bladder protrudes from the abdomen, so as to form a hernia, a stone is occasionally situated in the displaced portion of it. This circumstance has the same effect as a sacculated bladder; for the foreign body is thereby fixed, and it cannot be propelled towards the neck of the bladder at the period where the urine is discharged. Also, in cases of prolapsus uteri, when the bladder is drawn downwards, a stone has sometimes been found lodged at the lowest part of it. The possibility of the complication of a calculus, with such displacements of the bladder, ought to be well

remembered, since, if the nature of the case be detected, its treatment becomes materially simplified.

Various local causes, as blows on the loins, which injure the structure, or derange the function of the kidney, are enumerated by Mr. Crosse as often giving rise to calculous deposits; and so may inflammation of the pelvis of the kidney, or increased mucous secretion from the urinary passages. Strictures of the urethra, and enlargements of the prostate gland, by detaining the urine in the bladder (see *PROSTATE GLAND*, and *URETHRA*, *STRICTURES OF*), have a powerful tendency to produce disease in that organ, and thus promote the formation of calculi. (See J. G. Crosse, *On the Formation, &c. of Urinary Calculi*, &c. 4to. Lond. 1832.)

The symptoms of a stone in the bladder having been detailed in the article *LITHOTOMY*, the enumeration of them need not here be repeated. They are all so equivocal, and bear so great a resemblance to the effects of several other disorders, that they cannot be depended upon, and consequently no well-informed surgeon will venture to pronounce positively that there is a calculus in the bladder, unless he can distinctly feel it with a sound. (See *LITHOTOMY* and *SOUNDING*.)

If a foreign body be introduced into a cavity to which the urine has access, whatever may be the nature of the immersed substance, it always becomes after a time incrustated with calculous matter, though it undergoes no chemical change in its composition. In such cases, it is found (see Forbes, *On Gravel and Gout*, 8vo. Lond. 1793; and Marcet, *On the Chemical Hist. &c. of Calculous Disorders*, 8vo. Lond. 1817) that the concretion mostly, if not always, consists of the earthy phosphates. Here the operation of any particular diathesis is beyond all suspicion, because the foreign body which forms the nucleus would lead to the production of a calculus in all descriptions of patients.

There are some countries where patients with calculi are tolerably numerous; and other parts of the world where the disease is rare, or never met with; and yet the difference cannot always be accounted for by any geographical circumstance which is constant, or any definable peculiarity of constitution, climate, diet, or mode of life.

Urinary calculi are said to be very uncommon in Spain and Africa, though patients with gravel are numerous in Majorca, which lies between them. (Magendie, *Récherches sur les Causes, &c. de la Gravelle*, p. 31, 8vo. Paris, 1818.) The usual belief is that calculi are most frequent in damp, cold countries, like England and Holland, but that in such other parts of the world as are either very hot, or cold, the disease is rare. However, in every estimate of this kind, the number of the inhabitants of the countries, or districts in question, is always an essential thing for consideration, because the proportion of stone-patients, in a given number of individuals, is invariably rather small; and therefore, in referring to the rarity of such patients in very cold countries, it is to be considered whether the fact may not be, in some measure, ascribable to the fewness of the inhabitants. The state of medicine and surgery, in the countries from which the information is transmitted, is likewise another thing for contemplation, inasmuch as patients are not likely to be reported as suffering from or dying of stone, where the

nature of diseases is not scientifically observed, morbid anatomy is uncultivated, and the operation of sounding never attempted. However, as our East India native regiments are furnished with excellent surgeons, I consider it well proved that, in those regiments, the disease is uncommon; for, otherwise, the statement would no doubt have been contradicted by them.

[Later experience has shown that this idea is erroneous. According to Mr. Brett, the great frequency of the disease in India is now well established, as many as 100 cases having occurred to him during his abode there. He attributes it to the errors in diet of the natives, especially children, who are permitted to devour various kinds of unwholesome rancid sweetmeats, and particularly coarse unleavened bread, at all hours of the day. (*On Surg. in India*, p. 183.)]

Mr. R. Smith, of Bristol, has published an interesting statistical inquiry into the frequency of stone in the bladder in Great Britain and Ireland, though, strictly, it is a comparative estimate of the number of operations for stone in different parts of the kingdom in given spaces of time, and not of the number of calculous patients. (See *Med. Chir. Trans.* vol. xi.) So far as I can judge from the facts stated in Mr. Smith's paper, and from what I know about the average number of operations for stone in London, not more than 180 can be fairly reckoned as the annual total in Great Britain and Ireland, which is about 1 for each 100,000 of the population, taken at 18 millions.

Most frequently the tendency to these diseases is connected with some unknown causes, peculiar to certain districts or countries as, for example, the district of which Norwich may be considered the centre, in which more calculous cases occur than in the whole of Ireland or Scotland. In such instances, the water, diet, temperature, &c. of the district, has been each accused, in its turn, of being the exciting cause; but (says Dr. Prout) the circumstance, I believe, still remains unexplained.

With regard to the chemical nature of urinary calculi, there was nothing known until 1776, when Scheele published, on the subject, in the *Stockholm Transactions*. He there stated, that all the urinary calculi, which he had examined, consisted of a peculiar concrete substance, now well known by the name of *lithic*, or *uric* acid, which he also showed was soluble in alkaline lixivium. Scheele further discovered, that the lithic matter was, in some degree, capable of being dissolved in cold water; that this solution possessed acid properties, and in particular that of reddening litmus; that it was acted upon in a peculiar manner when boiled in nitric acid; and lastly, that human urine always contained this substance in greater or less quantity, and often let it separate in the form of a brick-coloured sediment, by the mere effect of cooling.

The discovery made by Scheele was confirmed by Bergmann and Morveau, and the investigation of the subject was afterwards prosecuted by others with redoubled ardour. At length it was fully ascertained that there existed others besides those composed of uric acid; and our knowledge of them was much extended by the researches of Pearson, Wollaston, Fourcroy, and Vauquelin. Several important facts were also established by the talents and industry of some other distinguished men; viz. Dr. Henry, of Manchester; Professor Brande, of the Royal Institution of London; Dr.

Marcet, late of Guy's Hospital; and Dr. Prout, of London. The facts and considerations of the latter writer showed, however, that the common opinion of pure lithic acid being contained in the urine is not exactly correct; but that this acid "in healthy urine exists in a state of combination with ammonia, and that, in reality, this fluid contains no uncombined acid at all." (*On the Nature, &c. of Gravel and Calculus*, c. 13.)

The credit which is due to Dr. Wollaston for his valuable and original discoveries respecting urinary calculi is very considerable; a truth which I have particular pleasure in recording here, since his merits have not been fairly appreciated by the French chemists. Indeed, as Dr. Marcet observes, it is the more desirable that his claims should be placed in the clearest point of view, as the late celebrated M. Fourcroy, both in his *Système des Connoissances Chimiques*, and in his various papers on this particular subject, has in a most unaccountable manner overlooked Dr. Wollaston's labours, and in describing results exactly similar to those previously obtained and published by the English chemist, has claimed them as his own discoveries. Yet Dr. Wollaston's paper was printed in our *Philosophical Transactions* two years before Fourcroy published his Memoir in the *Annales de Chimie*, and three years before he gave to the world his *Système des Connoissances Chimiques*; and he discussed in these works a paper of Dr. Pearson on the lithic acid, published in a volume of the *Philosophical Transactions* (for 1798) subsequent to that which contained the account of Dr. Wollaston's discoveries! (See *Marcet's Essay on Calculous Disorders*, p. 60; also *Murray's Syst. of Chem.* vol. iv. p. 636, ed. of 1809.)

It would appear then, that Scheele first discovered the nature of those urinary calculi which consist of lithic acid; but that Dr. Wollaston first ascertained the nature of several other kinds, some of which have also been described at a later period by Fourcroy and Vauquelin. On the whole there are five species of concretions, whose chemical properties were first pointed out by Dr. Wollaston, and no less than four belong to the urinary organs. These are, 1st. Gouty (lithic or uric acid) concretions. 2ndly. The fusible calculus. 3rdly. The mulberry calculus. 4thly. The calculus of the prostate gland. 5thly. The cystic oxide, discovered in 1810.

[Urinary Calculi may be conveniently divided into:—

1. Those arising out of the uric (or lithic) acid diathesis, which are of three kinds; viz. the uric acid, the urate of ammonia, and the uric or zanthic oxide calculus.

2. Those arising out of the oxalic diathesis; the oxalate of lime or mulberry calculus.

3. Those arising out of the phosphatic diathesis. These are of three kinds; viz. the triple phosphate of ammonia and magnesia, the phosphate of lime, and the mixed or fusible calculus.

4. The carbonate of lime calculus.

5. The cystic oxide calculus.

6. Fibrinous and other pseudo calculous substances deposited in the bladder.]

Dr. Prout investigated, with considerable talent, the comparative prevalency of the different forms of urinary deposits, and the order of their suc-



cession. His data are taken from the examinations, made by Professor Brande, of the calculi in the Hunterian Collection; by Dr. Marcet, of those at Norwich and Guy's Hospital; by Dr. Henry, of those at Manchester; and by Mr. Smith, of others preserved at the Bristol Infirmary. The whole number of calculi examined was 823; of these, 294 were classed under the name of lithic acid, 98 of which were nearly pure; 151 were mixed with a little of the oxalate of lime, and 45 with a little of the phosphates; 113 consisted of oxalate of lime. Three were of cystic oxide; 202 were phosphates, of which sixteen were nearly pure; 84 mixed with a small proportion of lithic acid; 8 consisted of phosphate of lime nearly pure; 3 of triple phosphate nearly pure, and 91 were fusible or mixed calculi; 136 were alternating calculi, or those whose laminæ varied, but consisted of lithic acid, oxalate of lime, and phosphates; of these, 15 consisted of lithic acid and oxalate of lime, the first being in the greatest proportion; 40 of the oxalate of lime, in the greatest proportion, and lithic acid in the least; 51 of the lithic acid and the phosphates; 49 of the oxalate of lime and the phosphates; 12 of the oxalate of lime, lithic acid, and the phosphates; 1 of fusible and lithic; 2 of fusible, and oxalate of lime; and 16, the composition of which was not mentioned.

Of compound calculi, whose composition was not specified, there were 25. (See *W. Prout's Inquiry into the Nature, &c. of Gravel and Calculus*, p. 94.)

The proportion of *lithic acid calculi* is somewhat more than one-third of the whole number. But, as this acid is the common nucleus round which other calculous matter is deposited, Dr. Prout computes the proportion of calculi, originating from it, to be at least two-thirds of the whole number. According to the experiments of the same physician, the red crystalline calculus is composed of nearly pure lithic acid; and the earthy, amorphous one consists of lithic acid, more or less ammonia, generally a little of the phosphates, and sometimes a small portion of the oxalate of lime. The lighter the colour, the greater in general the proportion of lithate of ammonia and the phosphates. (P. 17.)

*Oxalate of lime calculi* form one-seventh of the whole number, without any regularity, however, in different museums.

*Cystic oxide calculi* are so rare, that the proportion found was only 1 in 274.

*Calculi, composed of the phosphates*, made about one-fourth of the whole number.

*Alternating calculi* amounted to between one-fourth and one-fifth.

#### URINARY DEPOSITS AND CALCULI DEPENDING UPON THE URIC OR LITHIC ACID DIATHESIS.

Dr. Prout believed that at least two-thirds of the whole number of calculi originate from lithic acid; for, as it forms by far the most common nucleus, round which other calculous matter is subsequently deposited, if such nuclei had not been formed and detained, two persons at least out of three who suffer from stone would never have been troubled with the disorder. (*On Gravel, Calculus, &c.* p. 95.)

Lithic or uric acid is naturally contained either in a free or combined state in the urine of man,

and all other animals which consume a great deal of food abounding in azote, as flesh of every kind, fish, shell-fish, eggs, &c. Whenever the urine will reddens the tincture of turnsol, Magendie infers, with the generality of chemists, that it contains lithic acid, the proportion of which, he says, varies according to the quantity of substances abounding in azote taken as food. And Magendie further observes, that when animals live altogether on flesh, their urine is full of uric acid, and even may be entirely composed of it, as is proved, with respect to birds, by the experiments both of Dr. Wollaston and Vauquelin. Here Magendie cannot mean free uric acid, but this acid in a state of combination; for, as Dr. Prout has observed, there is no instance known in which lithic or uric acid is secreted in a pure state: birds, serpents, &c. always secrete it in combination with ammonia; in the gouty chalk-stone it is secreted in combination with soda. (*On the Nature, &c. of Gravel and Calculus*, p. 13.) On the contrary, if animals live on vegetables, as is the case with the herbivorous class, Magendie states that there is no appearance of lithic acid in their urine. In a series of experiments, communicated by Magendie to the Academy of Sciences in 1816, this distinguished physiologist exemplified that, if a carnivorous animal be deprived of all nutriment containing azote, and be fed with sugar, gum, oil, and other substances considered to be nutritious, and having no azote in their composition, the urine, in three or four weeks, will contain no lithic acid. (See *Mém. sur les Propriétés nutritives des Substances qui ne contiennent pas d'Azote*. Paris 1817.) A dog, allowed only sugar and distilled water, soon began to grow lean, and died, apparently starved, on the 32nd day from the commencement of his diet. The inference which Magendie draws from his experiments, and from some cases which he has detailed, is, that the quantity of uric acid in the urine, and, of course, the tendency to gravel and calculous disorders, depend very much upon the kind of food. However, he takes into consideration the relative proportion of the uric acid to the urine itself, because, if this be also abundant, the liability to calculi is counteracted. It would appear, also, from his observations, that the urine not only becomes impregnated with a great proportion of uric acid in animals, which eat a large quantity of flesh, but is also scanty; and that, on the other hand, a vegetable diet always promotes the secretion of a large quantity of fluid from the kidneys, as well as checks the formation of the acid in question.

However, Magendie himself is not so partial to his theory as not to confess that it is liable to objections; for, says he, individuals are met with every day, who, from their age, manner of living, and habits, appear to be subjected to every condition calculated to produce gravel, and yet they remain free from it. Magendie might also have recollected that some birds which live entirely on vegetable matter, as several singing-birds kept in cages, void a good deal of the lithate of ammonia. Nevertheless, as a general rule, it may be said that a vegetable diet tends to prevent the formation of lithic acid calculi, while eating large quantities of nitrogenous food has the opposite effect. Magendie refers to examples of gravel being always produced in certain individuals after any unusual exertion, and in other apparently healthy

subjects, after any difficulty of digestion, flatulence, the eating of salad, raw fruit, &c. With regard to the dyspepsia, frequently attendant on calculous disorders, and other chronic diseases, Magendie sets down the complaints of the stomach and of the urinary organs, as probably only two effects of the same cause, and not mutually productive of each other. (See *Recherches, &c. sur les Causes, &c. de la Gravelle*, 8vo. Paris, 1818.)

On this last point M. Magendie is probably incorrect. It was formerly supposed that pure lithic acid was dissolved in the urine; but Dr. Prout proved that such acid is nearly insoluble, and "that under ordinary circumstances it exists only in the form of lithate of ammonia, which is a very soluble salt. In very cold weather, the urine, as it cools, deposits the lithate of ammonia, blended with some other animal matter. It is the lithate of ammonia, also, which forms the principal part of the soft, or uncrystallised sediment deposited in the vessel by the urine of persons who labour under dyspepsia, and some other bodily ailments, &c. The presence of another acid in the urine causes the lithic acid, even in the bladder, to be precipitated in the form of a red sand. Whatever the kind of acid may be that produces this effect, whether the muriatic, or phosphoric, or another, we find that those who are liable to the formation of acid in the stomach are especially liable to the deposition of red sand. If the digestion be weak, and the food in consequence remains in the stomach long enough to become aced, the red sand is generated. If the food be indigestible, or if it be taken in too large a quantity, the same effect may be produced in the most healthy person. The free use of fermented liquors, and especially of those which contain acid already, such as punch and champagne, or sugar, which may become acid in the stomach, leads to the same result. Persons who lead a sedentary life, and who never take exercise, so as to produce perspiration, are also especially liable to the formation of red sand. (Sir Benjamin Brodie on *Diseases of the Urinary Organs*, ed. 2, p. 167.)

It is a common belief that there is a close connexion between gout and the formation of stone in the bladder. Thus, Sir Benjamin Brodie observes, that when the urine contains a superabundant acid, which precipitates the red sand, or lithic acid, it is usually bright and transparent, and of a copper colour, resembling in appearance Madeira wine. In general, the patient is troubled with dyspeptic symptoms, and frequently he is liable to gout. The same peculiar constitution, the same luxurious diet, the same inactive life, which makes him subject to the one, makes him also subject to the other. The red sand is composed of crystals of lithic acid in its pure state; while chalk-stones, which are formed in the *hursæ* and cellular tissue of gouty patients, are composed of the same acid in combination with soda. In the better classes of society, the deposit of red sand takes place chiefly in adults; but in the lower classes principally in children. These facts are accounted for by Sir Benjamin Brodie by the following considerations:—Adult persons in affluent circumstances, for the most part, lead a more luxurious and indolent life than their children; while, among those of lower condition, the diet of the children is frequently unwholesome, and little attention paid to disorder of the digestive organs. (*Op. cit.* p. 169.)

Mr. Crosse, of Norwich, joins many writers in considering the prevailing source of urinary calculi to be dyspepsia, leading to the generation of acid in the stomach, and to the superabundance of lithic acid in the urine. That disease, however, so often exists without the production of urinary concretions, that he deems it necessary, for the origin of the latter, that it should be united with other exciting causes, as want of sufficient exertion, variable climate, peculiar diathesis, or local disease in some part of the urinary organs. (*On Formation, &c. of the Urinary Calculus*, 4to. Lond. 1835.)

With respect to *amorphous sediments*, the circumstances which Dr. Prout has observed to produce a lithic acid diathesis in persons subject to slight dyspepsia, but in other respects healthy, are:—1. Simple errors in diet. 2. Unusual or unnatural exercise, either bodily or mental, particularly after eating, and the want of proper exercise at all other times. 3. Debilitating circumstances. (*On Gravel, Calculus, &c.*, p. 113.) An unusually heavy meal, especially of animal food, or bread, he says, is *invariably* followed by a deposition of the lithate of ammonia from the urine. Heavy, unfermented bread, and compact, hard-boiled, fat dumplings, or puddings, he finds particularly apt to produce such an effect.

*Crystallised sediments, or gravel*, consisting of nearly pure lithic acid, Dr. Prout ascribes to a free acid being sometimes generated in the kidneys, and combining with the ammonia, with which the lithic acid is previously united, so as to precipitate the latter in a pure crystallised state. According to the investigations of Dr. Prout, the precipitating acid is not constantly the same, though generally the phosphoric, and sometimes the sulphuric. (Pp. 127, 128.)

The same intelligent writer represents the circumstances which promote the formation of urinary sediments in general, as being either *natural* or *acquired*. "With respect to those of the first description (he says), it cannot, I think, be doubted that certain individuals are much more liable to these sediments than others. This tendency is not infrequently inherited; thus, I know a family where the grandfather and father have actually lithic calculi in the bladder, and where the grandson, a youth of twelve or thirteen years of age, has a very strong tendency to the same disease; his urine depositing frequently very large quantities of lithic acid, both in the form of amorphous and crystallised sediments. On the other hand, the disposition to generate these sediments in excess is, like gout, or rather simultaneously with gout, but too frequently acquired by indolent habits and excess in eating and drinking.

I have, in one or two instances, seen a fit of lithic gravel induced in the predisposed by sitting on a damp, cold seat for some hours. Sometimes also a tendency to lithic calculus is evidently connected with local injury, or disease of the kidney. (P. 133.)

The difficulty of tracing the causes of the formation of calculi is increased by the fact that, except when the urinary organs are much diseased, the patient may appear to be in perfect health. Indeed, persons of the strongest constitutions are often troubled with the stone, quite independently of the entrance of any foreign body, as a nucleus, into the bladder; and it is now universally



admitted, that lithic acid itself constitutes by far the most common nucleus, even when other calculous matter is deposited round it. (See *Prout on Gravel*, p. 95.) It is sometimes conjectured that the female is less liable than the male sex to calculi; but whether this is the fact, or whether the circumstance can be satisfactorily explained on another principle—viz. the facility with which lithic acid sand, and any calculi of moderate size, are generally discharged through the short and capacious meatus urinarius—are questions perhaps not yet completely settled.

Infants and children to the age of twelve or fourteen are very liable to stone. However, it is asserted by Delpech that, at this period of life, relapses are unfrequent; that is to say, an entirely fresh stone is hardly ever formed again; and, if a return of the complaint happens, the quickness of its recurrence, and an attentive examination of the calculus, will mostly prove, either that the second stone has formed round a fragment of the first, left behind, or that it existed when the former one was taken out, but was not discovered. I am not inclined to put much faith in this statement, because it is hardly credible that the calculous diathesis of childhood can be at all diminished by the circumstance of there having already been one calculus, and of the patient having had the bladder opened for its removal.

Dr. Marcet thinks that the disorder is frequent only among the children of the poor classes; and that, in those of the higher ranks, or even of the lowest classes, *provided they are well fed*, the same frequency is not observed. "In the Foundling Hospital, for instance, within the last twenty-seven years, during which 1,151 children have been admitted, only three cases of stone have occurred, all of which were among children while at nurse in the country; and in the Military Asylum at Chelsea, which contains about 1,250 children, and into which upwards of 6,000 of them have been already admitted, no more than one single case of stone has occurred." (See *Marcet's Essay on Calculous Disorders*, p. 36.)

In the period of life between the age of twelve or fourteen, and that of forty, the liability to stone in the bladder is much less than in infancy, childhood, or old age; and, no doubt, many of the cases which do present themselves in adults, or middle aged individuals, either began at an earlier period of life, or are owing to some extraneous nucleus.

According to Delpech, in old men who are particularly subject to calculi, the disposition to the return of the disease always continues during life; and hence, in their relapses are frequent. (*Précis des Mal. Chir.* t. ii. p. 193, &c.)

[Sir H. Thompson gives a table showing the prevalence of stone, at different ages, in 1,827 cases of lithotomy in certain London and Provincial Hospitals. (*Practical Lithotomy and Lithotripsy*, p. 269.) This table has been conveniently re-arranged by Mr. Poland, who shows that 51.45 per cent. of the whole number of cases occur before puberty, i. e. from one to thirteen years of age; or 25.89 per cent. from one to five years, and 25.56 per cent. from six to thirteen years. At puberty, and during early manhood, i. e. from fourteen to twenty-six years, 12.47 per cent.; from twenty-seven to thirty-six years, 4.37 per cent.; from thirty-seven to forty-nine years, 6.95

per cent.; from fifty to seventy years, 22.65 per cent.; from seventy to eighty years, 2.70 per cent.

Mr. Coulson remarks that tables "showing the number of calculous persons at different periods of life do not show the liability of individuals to be attacked at these different ages." It is necessary to distinguish between absolute and relative numbers of persons living at the several periods of life enumerated. Calculated in this manner, the tables would show that children and young persons are less liable to calculous disorders than has been commonly supposed, and that from twenty years and upwards the tendency goes on increasing in a remarkable manner to the end of life. (See *Holmes's Syst. of Surg.* vol. iv. p. 443.) Or, as Sir H. Thompson says—"The proportion of elderly calculous patients to the existing population at their own ages is larger than the proportion of children afflicted is to the number of existing children."

#### *Characters of Lithic Acid Deposits and Calculi.*

—Pure lithic acid is a perfectly white substance, but the lithic acid sand deposited in the urine will be found to consist of crystals of an amber or orange-red colour, from being impregnated or combined with the colouring matter of the urine. The more ordinary forms of these crystals are modifications of the rhombic prism, in the shape of flat rhombic plates, often with the obtuse angles rounded off; or in lozenge-shaped plates convex on both sides. Or they may appear as sections of lozenge-shaped cylinders of considerable thickness. Another form is in thin oblong rectangular plates, this form being said to be most frequent when the urine is neutral or only slightly acid. The crystals are often very minute, and only discoverable by the aid of the microscope; but the larger ones are distinguishable by the naked eye, and the coarse forms will be found to consist of an aggregation of many crystals adhering together. For representations of the appearances presented by lithic acid deposits, the reader is referred to the works of Golding Bird, Lionel Beale, Thudichum, and others who have written special treatises on the subject.

Lithic acid is soluble in the alkalies or alkaline carbonates. It is nearly insoluble in cold water, sparingly soluble in hot. One part requires for solution from 1,800 to 1,900 parts of boiling water, and 14,000 to 15,000 parts of water at 68°. The watery solution faintly reddens litmus paper. It is slightly more soluble in hydrochloric acid than in water; and soluble in strong sulphuric acid without decomposition. (*Thudichum, Pathol. of the Urine*, 1868, p. 79.)

Lithate of ammonia, the most frequent of all urinary deposits, occurs as a fine amorphous powder, or sometimes, according to Dr. Golding Bird, in minute spherules with crystals of uric acid projecting from their surface. It varies in colour from pale yellow to pink, red, and brick-dust colour. It is more soluble than lithic acid, and also much more soluble in warm than in cold urine. Hence urine which is clear when passed may deposit a large quantity of lithates when it cools, which will be dissolved again readily by heat. This latter test is of great practical value, as it at once distinguishes lithates from deposits of pus or of phosphates, for which the paler varieties might possibly be mistaken. The addition of an acid to urine containing lithate of ammonia separates the ammonia, and causes the acid to be deposited in crystals.]

*Lithic acid calculus* forms a hard, inodorous concretion, of a yellowish or brown colour, similar to that of wood, of various shades. According to Professor Murray, calculi of this kind are in fine, close layers, fibrous or radiated, and generally smooth on their surface, though sometimes a little rough. They are rather brittle, and have a specific gravity, varying from 1,276 to 1,786, but usually above 1,500. When it has been dissolved in boiling water, small yellowish crystals are deposited as the fluid becomes cold. Lithic acid calculi blacken, but are not melted by the blowpipe, emitting a peculiar animal smell, and gradually evaporating, until a small quantity of white ash remains, which is alkaline. They are soluble in the cold, in a solution of pure potassa, or soda, and from the solution a precipitate of a fine white powder is thrown down by an acid. They are so in nitric acid when assisted by heat; and the residue of this solution, when evaporated to dryness, assumes a remarkably bright pink colour, which disappears on adding either an acid or an alkali. In many of these calculi the lithic acid is nearly pure; in others there is an intermixture of other ingredients, particularly of phosphate of lime, and phosphate of ammonia and magnesia; and, in almost all of them, there is a portion of animal matter, which occasions the smell, when they are burnt, and the loss in their analysis. (See *Murray's Chemistry*, vol. iv. p. 640; and *Marcet's Essay on the Chem. and Med. Hist. of Calculous Disorders*, 8vo. Lond. 1817.)

Fourcroy described a species of urinary calculus composed of the urate or lithate of ammonia. Dr. Wollaston, Mr. Brande, and Dr. Marcet did not, however, satisfactorily ascertain the presence of this substance in any of the concretions which they examined. The investigations of Dr. Prout, however, establish the reality of the lithate of ammonia calculus.

*Lithate of Ammonia Calculus*, according to Dr. Prout, is generally of the colour of clay. Its surface is sometimes smooth, sometimes tuberculated. It is composed of concentric layers, and its fracture resembles that of compact limestone. It is generally of small size, and rather uncommon; but the lithate of ammonia very frequently occurs, mixed with lithic acid, forming a mixed variety of calculus. Under the flame of the blowpipe it usually decrepitates strongly. It is much more soluble in water than the lithic acid calculus, and always gives off a strong smell of ammonia on being heated with caustic potash. *The lithate of ammonia is also readily soluble in the alkaline subcarbonates, which pure lithic acid is not.* (Prout on Gravel, &c. p. 83.)

*Uric or Xanthic Oxide Calculi.*—Dr. Marcet met with two specimens of urinary calculi, entirely different from any which have hitherto been noticed. One of these he named *xanthic oxide*, from *ξανθος*, yellow, because one of its most characteristic properties is that of forming a lemon-coloured compound when acted upon by nitric acid.

[A similar calculus was met with by Stromeyer, a portion of which is now in the museum of Guy's Hospital. It appears to be of extremely rare occurrence, and not to be deposited in the urine in a crystalline form. It is supposed to arise from deficient oxidation of the materials from which uric acid is formed. It differs from this latter substance, and also from urate of ammonia, in not be-

coming red on the addition of nitric acid. This calculus is of a more yellow or salmon colour than those of uric acid or urate of ammonia. It assumes a shining waxy appearance when subjected to friction.]

*Treatment of Uric Acid Deposits and Calculi.*—The stone being a severe affliction, and the operation hazardous and painful, a variety of experiments have been instituted for the purpose of discovering a solvent for urinary calculi. Hitherto, however, all the remedies and plans which have been tried have been attended with very limited, and by no means unequivocal success, notwithstanding many persons may have been deceived into a contrary opinion.

The dissolution of stones in the bladder has been attempted by *lithontriptic medicines*, as they are termed, and by fluids injected into this viscus. At the present day, practitioners direct their endeavours very much to the correction of those particular diatheses, or states of the constitution, on which the formation of various calculi depend; and more confidence seems to be placed in this aim, than in any schemes for the dissolution of urinary concretions. It is certain that, in the latter project, many difficulties present themselves, and amongst these some of the most serious are the great variety in the composition of calculi; the impossibility of knowing the exact ingredients of a stone while it is concealed in the bladder; and, lastly, if the right solvent were ascertained, as calculated upon chemical principles applied to urinary concretions out of the body, it is obvious that any medicines, taken by the mouth, are liable to so many changes in the alimentary canal, and in the lymphatic and vascular system, that it must be exceedingly difficult to get them in an unaltered state and effective quantity into the bladder; while, if this were possible (as it is in the way of injection through a catheter), the bladder itself might be incapable of bearing the application, and the patient lose his life in the experiment.

As Dr. Prout well observes, a calculus in the bladder may be considered a substance placed in a solution of various principles in a certain quantity of water. If any of the more insoluble of these principles exist in this solution in a state of supersaturation, the calculus will afford a nucleus, round which the excess will be deposited. But if none exist in a state of excess, of course none can be deposited, and the calculus will not increase in bulk.

Whoever studies the chemical properties of the urine, says Dr. Marcet, will learn that "if any alkali (a few drops of ammonia, for instance) be added to recent urine, a white cloud appears, and a sediment, consisting of phosphate of lime, with some ammoniaco-magnesian phosphate, subsides, in the proportion of about two grains of the precipitate from four ounces of urine. Lime-water produces a precipitate of a similar kind, which is still more copious; for the lime in combining with the excess of phosphoric, and perhaps also of lactic acid, not only precipitates the phosphate of lime, which these acids held in solution, but it decomposes the other phosphates, thus generating an additional quantity of the phosphate of lime, which is also deposited.

"If, on the contrary (observes the same author), a small quantity of any acid, either the phosphoric, the muriatic, or, indeed, even common vinegar, be added to recent healthy urine, and the mixture be



allowed to stand for one or two days, small reddish crystalline particles of lithic acid will be gradually deposited on the inner surface of the vessel.

"It is on these two general facts that our principles of chemical treatment ultimately rest. Whenever the lithic secretion predominates, the alkalies are the appropriate remedies; and the acids, particularly the muriatic, are the agents to be resorted to when the calcareous or magnesian salts prevail in the deposit." (Pp. 147-148.)

Alkalies taken into the stomach reach the urinary passages through the medium of the circulation; and it is also suspected that the acids likewise do so, though this circumstance is still a question. Unfortunately the quantity of either alkalies or acids, which thus mixes with the urine, is so small that no impression is made upon calculi of magnitude. The researches of Dr. Marcet, Dr. Prout, and others have clearly proved, however, that such medicines are often capable of checking a tendency to the formation of stone, and sometimes of bringing on a calculous deposit depending upon the altered state of the system. Indeed, Dr. Marcet expresses his decided opinion that, even supposing not an atom of alkali or acid ever reached the bladder, still it would not be unreasonable to expect that these remedies may respectively produce the desired changes during the first stages of assimilation; in one case, by neutralising any morbid excess of acid in the primæ viæ; and, in the other, by checking a tendency to alkalescence, or otherwise disturbing those affinities which, in the subsequent processes of assimilation and secretion, give rise to calculous affections. (P. 153.)

The best way of taking alkalies is by drinking soda-water as a common beverage. It was asserted, however, by the late Sir G. Blane, that when the alkalies were combined with citric acid, as in the ordinary saline draught, they also had the effect of depriving the urine of its acid properties.

[It is now well known that alkalies, when combined with vegetable acids, as the citric or tartaric, reach the urine in the form of carbonates, and are therefore as efficacious for the purpose required as the carbonates themselves. There is no more pleasant or convenient way of administering them than in an effervescing draught of citrate or tartrate of potash or soda.]

But it may be inquired if no known internal medicine will dissolve a stone already formed, what is the good of merely altering the diathesis, and checking the increase of the calculus, as other measures must still be necessary? The reasons for persevering in the aim of correcting any particular state of the system, and the urinary secretion on which state the increase of calculus depends, are very important; for it is found that, though medicines may be quite incapable of dissolving a calculus, they relieve a great deal of the distress and suffering, apparently the effect of the diathesis itself, as will be presently noticed; and sometimes afford such ease, that the operation may be postponed until the health is improved, or in a very old subject even be dispensed with altogether. The aim is also of high importance, with the view of preventing relapses.

As the lithic acid diathesis seems to be concerned in the production of about two-thirds of the whole number of the urinary calculi, the correction of it has been a chief aim amongst modern practitioners

For this purpose, M. Magendie, whose experiments tend to prove that this diathesis may be lessened and removed by abstinence from animal food, and other nutriment abounding in azote, founds his practice very much upon this alleged fact. His indications, however, are four in number, viz.: 1. To lessen the quantity of uric acid produced by the kidneys. 2. To augment the secretion of urine, a maxim which leads him to consider cutaneous perspiration injurious; a statement which I think must be rejected, considering that much of the precipitating acid is thrown off by the skin in perspiration, and consequently ensuring a due performance of the cutaneous functions must in these cases be beneficial. (See *Medical Trans. of the College of Physicians*, vol. vi.) 3. To prevent the lithic acid from assuming a solid form, by saturating it. 4. When gravel and calculi are formed, to promote their discharge and attempt their dissolution. (*Récherches, &c. sur la Gravelle*, p. 42.)

For correcting the lithic acid diathesis, Dr. Prout particularly enjoins the avoidance of errors in diet, exercise, &c. The error of quantity of food he deems worse than the error of quality. Patients, he says, should abstain altogether from things which manifestly disagree with them, and which must be unwholesome to all, such as heavy unfermented bread, hard-boiled and fat puddings, salted and dried meats, acescent fruits, and (if the digestive organs be debilitated) soups of every kind. In general also wines, and particularly those of an acescent quality, should be avoided. The wearing of flannel, the preserving a regular state of the bowels, and the occasional use of alterative medicines, are likewise commended. (*Prout on Gravel, &c.* p. 135.)

According to the same author, the treatment of calculous affections is either of a local or general description. The local treatment is nearly the same in all the species; the general treatment will depend upon the nature of the calculous diathesis.

What Dr. Prout calls the local treatment consists chiefly in prescribing hyoscyamus and opium, either alone or combined with uva ursi. The hyoscyamus, he says, is generally preferable in the lithic acid diathesis, and opium in the phosphatic. He also recommends the use of opium in the form of injection and embrocation, and especially in that of a suppository. The warm bath, fomentations, and sitting over hot water, are spoken of as other means of relief.

According to the observations of the same well-informed writer, the distressing symptoms, produced by lithic acid calculi, have a very constant relation to the severity of the diathesis present; a circumstance which, he says, is also more or less true with respect to all the other kinds of calculi: that is to say, in proportion as the urine is unnatural, and loaded with gravel and amorphous sediments, in the same proportion are the patient's sufferings. Hence, our first object should be to restore the urine to its natural state. The first means to be recommended, in ordinary cases, is usually a dose of calomel and antimonial powder, the Plummer's pill, or some other alterative purgative, taken at night, to be followed up the next morning by an alkaline diuretic purgative, composed, for example, of Rochelle salts and magnesia, or carbonate of soda; during the day, a strong infusion of uva ursi, combined with hyoscyamus and the liquor potassæ, may be taken.

These means are to be persisted in for a greater or less time, according to the circumstances, and till the urine begins to be natural; they may then be gradually left off, or varied, as occasion may require; and, under this plan, it will be found that, in the majority of cases, *not only the urine will assume its natural state, but most or all the distressing symptoms of calculus in the bladder will be very much diminished, and, in many instances, disappear.* It is obvious, also, that while the urine is in its natural state, the calculus cannot increase in size.

"After the diathesis is once fairly broken by these means, it may in general be easily prevented from recurring, by attention to the diet and other circumstances, formerly mentioned as inducing this diathesis, and by the occasional use of medicines; and the patient will scarcely know that he has a calculus in the bladder; at least, from the pain that it gives him. I state this with confidence; but at the same time, I wish to be understood to mean, that the freedom from pain, &c. depend, in no inconsiderable degree, upon the size of the calculus, its smoothness, upon the exercise a patient is obliged to take, &c., all of which are presumed to be favourable; for it must be sufficiently obvious that a foreign substance in the bladder cannot be prevented from acting *mechanically*, and from occasionally producing bloody urine, or a temporary stoppage of the discharge of that secretion from the bladder, and similar symptoms, if the patient is obliged to take severe exercise." (*Prout on Gravel, &c.*, pp. 202—204.)

At the beginning of the eighteenth century, lime and the alkalis were known to be frequently productive of relief in cases of stone; and in particular, the nostrum of a Mrs. Steevens, the active ingredients of which were calcined egg-shells and soap, acquired such celebrity for the cures which it effected, that much anxiety was expressed that her formula should be made public. The consequence was, that in the year 1739 parliament appointed a committee of twenty-two respectable men to investigate the merits of the remedy in question; and, on their very favourable report, the secret was purchased for the sum of 5,000*l.* These proceedings naturally interested our neighbours, and in the years 1740 and 1741 Morand communicated to the Academy of Sciences two memoirs, in which are reported numerous cases, where the new remedy was tried, and mostly with success; the greater number of the patients being described as either benefited or actually cured.

In many instances, stones, which had been unquestionably felt, were no longer to be discovered; and, as the same persons were examined by surgeons of eminence, both before and after the exhibition of the medicines, it is no wonder that the conclusion was drawn that the stones had been really dissolved. From the cessation of this success, however, and from its now being known that stones occasionally become lodged in a kind of cyst, on the outside of the general cavity of the bladder, so as to cause no longer any material suffering, surgeons of the present day are inclined to suspect that this must have happened in some of Mrs. Steevens's cases. This was certainly what happened to one of the patients, as Dr. W. Hunter informs us. It is evident that a stone so situated would not in general produce a great deal of irritation, nor admit of being felt with a sound. (See LITHOTOMY.)

That, in the lithic acid diathesis, the carbonates of soda and potassa, taken in large doses, have the effect of passing into the urine, and saturating the redundant lithic acid, in the unhealthy state of that fluid, is a fact decidedly proved. If there were any doubt yet remaining upon this point, it would be immediately removed by the perusal of the case of the celebrated Mascagni, as detailed by himself. (*See Mém. della Soc. Ital.* 1804.) This eminent anatomist being much afflicted with gravel, derived benefit from drinking the *aqua alcalina nephitica*, or Seltzer water; but, conceiving that more good might result from a trial of carbonate of potash, he took at first half a drachm of this substance in the morning, and as much in the evening, dissolved in ten ounces of water. The second day the dose was augmented to two drachms, and on the third to three, which quantity, dissolved in twenty ounces of water, was continued for ten days. "Before taking the carbonate of potash (says Mascagni), my urine was very acid, and immediately reddened litmus paper: as soon as the medicine was begun, I made the same experiment with the urine then voided, and found the intensity of the colour of the paper less. *The second day, the paper was very little altered; and, on the third, the urine did not redden at all.* The acid in my urine, therefore, was saturated, and, at the same time, the pain in my loins diminished, and no more gravel was voided with my urine. Afterwards the pain ceased entirely, the urine became clearer, and I perceived that it contained an excess of potash." Being attacked again at a subsequent period with the gravel, Mascagni adopted the same treatment, and experienced equal benefit from it.

In the lithic acid diathesis, the liquor potassæ has sometimes been thought to have more efficacy than the carbonate; but it does not generally agree so well with the stomach.

Sir E. Home and Mr. Hatchet first suggested the utility of giving magnesia in cases of stone; and the proposal was communicated to the public by Professor Brande. (*Phil. Trans.* 1810.) As Dr. Marcet observes, magnesia is often found advantageous in long-protracted cases, in which the constant use of the carbonated or caustic alkalies would injure the stomach. But he properly remarks that if magnesia is sometimes beneficial, it has of late years often done harm. For, as this earth is the base of one of the most common species of calculi—viz. that containing the phosphate of ammonia and magnesia—there is nearly an even chance, when magnesia is prescribed, without any previous knowledge of the nature of the calculus, that it will prove injurious. Magnesia, also, when long and profusely administered, sometimes forms large masses in the intestinal canal, causing serious distress, and even fatal consequences.

Sir Benjamin Brodie has known several instances in which a great deal of distress was experienced from the lodgment of such a concretion in the rectum; and he refers to a case in which Mr. Wilson examined the body of a patient in whom many pounds of magnesia were found collected in the colon, above a contracted part of the rectum. (*On the Urinary Organs*, p. 173, ed. 2.) The same distinguished surgeon likewise enjoins great care in adjusting the doses of alkaline remedies to the peculiar circumstances



of each case. "If you give too little of the alkali, the result is not obtained, and the lithic acid is still deposited, although in smaller quantity: if you give too much, you not only prevent the formation of the red sand, but you render the urine alkaline, and a white sand (the triple phosphate of ammonia and magnesia) is deposited in its place." (P. 172.) Hence, in the exhibition of alkaline remedies, he recommends each case to be made the subject of a distinct experiment, and the patient to be made to enter into the surgeon's views, and assist him with observations. "You should be provided with paper, coloured blue by an infusion of litmus; and also with the same paper, slightly reddened by immersion in a very weak acid. Healthy urine ought to turn the blue litmus paper a little red; and you ought not to give alkaline remedies in such a dose as to destroy this property altogether; still less ought you to render the urine alkaline. If the urine turns the red paper blue, the patient is in danger of suffering from a deposition of the phosphates; and the alkalis must be given in smaller quantity." After all, however, Sir Benjamin Brodie concurs in the general observation, that more is to be effected by diet and mode of living than by medicine.

I have already noticed the effect of a free secretion from the skin in preventing calculous disorders, or, at all events, in rendering them less frequent. A copious perspiration, if it cannot be produced by exercise, may be so by the sulphur fumigating, or hot air bath. "The hot air bath (Sir Benjamin Brodie remarks) is certainly of great advantage to those persons who, having led an inactive life, are subject to dyspepsia, and those twinges in the limbs, especially in the feet, which, sooner or later, are followed by a regular attack of gout; and I believe that it may also be employed beneficially in cases, in which the patient suffers from a too large proportion of lithic acid in the urine. It is worthy of observation, that the perspiration, produced by the hot air bath, is highly acid, reddening the blue litmus paper nearly as much as it is reddened by acid urine."—(*Op. cit.* p. 176.)

#### OXALATE OF LIME DEPOSITS AND CALCULI.

[Oxalic acid has a strong affinity for lime, so that when present in the urine, either as a free acid, or a soluble oxalate, it immediately decomposes some of the salts of lime always contained in the urine, and crystals of oxalate of lime, which is an exceedingly insoluble salt, are formed. The oxalic acid may be derived directly from the food, being present in many vegetables; in rhubarb, for instance, it is especially abundant, and crystals of oxalate of lime may generally be detected in the urine after rhubarb has been eaten. Under such circumstances its presence is transient and unimportant. But it may also be produced in the system independently, as the result of some abnormal change in the blood or in the kidneys, but in what precise way has not yet been satisfactorily explained. The tendency to the production of oxalic acid from sugar, under the influence of oxidizing agents, has led to the idea that it may be derived from abnormal changes in the saccharine matters of the food. Dr. Prout especially believed it to depend upon the imperfect digestion of this class of substances. Liebig believed it to be produced by the imperfect oxidation of uric acid, which, he thought, should be converted by a due

supply of oxygen into urea and carbonic acid; but if the supply of oxygen were insufficient, it might result in the formation of urea and oxalic acid. Dr. Owen Rees considers it to be the result of decomposition of uric acid subsequent to the secretion of the urine by the kidneys.

From whatever cause proceeding, the *continuous* presence of oxalate of lime in the urine is usually associated with debility and nervous depression, to remedy which the treatment must mainly be directed. It is often found in persons suffering from unusual anxiety or overwork, and will disappear if proper rest and relaxation is obtained. Tonics are usually beneficial, especially in combination with the mineral acids, among which the nitro-muriatic acid was strongly recommended by Dr. Golding Bird. The condition of the digestive organs should be carefully attended to, and the diet should be regulated so as to exclude as far as possible any excess of saccharine material.

Oxalate of lime is met with in the form of crystals, often very minute, which are most readily discovered by the aid of the microscope, and after the urine has been allowed to stand for some hours to allow them to settle. The urine containing them is usually acid, but not necessarily so, and they are often found mixed with the amorphous deposit of urate of ammonia. They are transparent and perfectly colourless, their usual form being the quadratic octohedron. A rarer variety is the dumb-bell shaped crystals, first described by Dr. Golding Bird, respecting the real composition of which doubts have been entertained, in consequence of their action on polarised light having been found different from that of the octohedral crystals. It has been thought, therefore, that they might be composed of oxalurate of lime, or even be another form of uric acid. It is, however, now believed that they are really composed of oxalate of lime, as originally described by Dr. Bird. Crystals of oxalate of lime are soluble in nitric acid, without effervescence. For representations of these crystals, and for an account of the various theories entertained as to their formation, see *Golding Bird on Urinary Deposits*, 5th ed., by E. L. Birkett, M.D., 1857; *Pathology of the Urine*, by I. L. Thudichum, M.D., 1868; *Lionel Beale on Kidney Diseases and Urinary Deposits*.]

*Oxalate of Lime*, or *Mulberry Calculus*, is mostly of a dark brown colour, its interior being often grey. Its surface is usually uneven, presenting tubercles more or less prominent, frequently rounded, sometimes pointed, and either rough or polished. It is very hard, difficult to saw, and appears to consist of successive unequal layers: excepting the few stones, which contain a proportion of silica, it is the heaviest of the urinary concretions. Though this calculus has been named *mulberry*, from its resemblance to that fruit, yet, as Dr. Marcet has observed, there are many concretions of this class which, far from having the mulberry appearance, are remarkably smooth and pale-coloured, as may be seen in plate 8, fig. 6 of that gentleman's essay. [Oxalates of lime calculi, of a pure white colour, have been observed and described by Mr. Williams of the Norfolk and Norwich Hospital, and are supposed to be formed only in the kidney. (See *Syst. of Surg.*, Holmes, vol. iv. p. 437.)] According to Mr. Brande, persons who have voided this species of calculus are much less liable to a

return of the complaint than other patients who discharge lithic calculi. (*Phil. Trans.* 1808.)

With regard to chemical characters (says Professor Murray), it is less affected by the application of the usual re-agents than any other calculus. The pure alkaline solutions have no effect upon it, and the acids dissolve it with great difficulty. When it is reduced, however, to fine powder, both muriatic and nitric acid dissolve it. The solutions of the alkaline carbonates decompose it, as Fourcroy and Vauquelin have observed; and this affords us the easiest method of analysing it. The calculus in powder being digested in the solution, carbonate of lime is soon formed, which remains insoluble, and is easily distinguished by the effervescence produced by the addition of weak acetic acid, while there is obtained in solution the compound of oxalic acid with the alkali of the alkaline carbonate. From this the oxalic acid may be precipitated by the acetate of lead, or of barytes; and this oxalate, thus formed, may be afterwards decomposed by sulphuric acid. Another method of analysing this calculus is by exposure to heat: its acid is decomposed, and by raising the heat sufficiently, pure lime is obtained, amounting to about a third of the weight of the calculus. According to Fourcroy and Vauquelin, the oxalate of lime calculus contains more animal matter than any other.

#### PHOSPHATIC DEPOSITS AND CALCULI

The state of the system, which leads to the production of alkaline urine, and of white sand, is very different from that which is attended with a too acid condition of the urine, and the formation of red sand. The latter occurs in individuals who are over-fed, or over-stimulated, and take little exercise; but the alkaline urine indicates debility of the system. In a person who is exhausted by too severe mental or bodily exertions, or has long been worn by mental anxiety, the urine becomes alkaline. In many instances a course of mercury renders the urine alkaline: in some individuals, even a single dose of calomel will produce the same effect. In a person who is already weak, the further degree of exhaustion, resulting from the operation of an active purgative, will render the urine alkaline. Injuries of the spine will have the same effect. This fact Sir Benjamin Brodie observed as long ago as 1807; and always mentioned it in his Lectures ever since 1808. (*Op. cit.* p. 180.) It follows, from the foregoing facts, that when there is a deposit of the triple phosphate, purgatives, and especially mercurial ones, should be employed with great caution. Alkaline remedies are to be avoided, and acids exhibited, as first suggested by Dr. Wollaston. The patient may drink lemonade, or eat oranges, or lemons; but if the vegetable acids disagree, the mineral acids may be tried. The dose of the acid must depend on circumstances, and be regulated according to the results of frequent examinations of the urine with the reddened litmus and yellow turmeric paper. "From five to ten minims of muriatic acid, given three times daily, will generally be sufficient; but, in extreme cases, you may give as much as thirty or forty minims, or even more, of the strong nitric acid, in the course of the day, sufficiently diluted with syrup and water." (*Sir B. Brodie, Op. cit.* p. 187.) Tonics are also serviceable, as bark, sulphate of quinine, and prepa-

rations of iron. The diet should be rather a generous one, but easy of digestion. Fermented liquors and acidulous wines may be taken in moderation; and opium and henbane, if they do not interfere with digestion, are very useful. When the phosphate of lime is deposited, together with a ropy mucous secretion from the lining of the bladder, the indication is to remove the cause, namely, the chronic inflammation of that membrane. "Perfect rest, in the horizontal posture, opiate clysters or suppositories, opium, extract of henbane, or lettuce, given by the mouth, will be useful. The exhibition of the decoction of the root of the *pareira brava* is in many instances productive of excellent effects. It has a remarkable influence over the secretion of the ropy alkaline mucus. Injections into the bladder of warm water, and even of a weak solution of nitric acid, are sometimes useful." (*Sir B. Brodie, Op. cit.* 189.) When the secretion of the triple phosphate by the kidneys, and that of phosphate of lime by the bladder, are coexistent, this gentleman unites the two modes of treatment called for by this combination, and which seem to him quite compatible. (See BLADDER, INFLAMMATION OF.)

[Both alkaline and earthy phosphates exist naturally in the urine. The former, viz. phosphates of soda and potash, are very soluble, and never form deposits. The latter, or phosphates of magnesia and lime, are soluble when the urine is of normal acidity, but are deposited in the form of white sand when it becomes alkaline. The phosphate of magnesia combines with ammonia to form an ammonio-magnesian phosphate, which is thrown down in a crystalline form; the phosphate of lime forms a powdery amorphous deposit. Occasionally, however, the ammonio-magnesian phosphate is deposited in urine which gives a neutral or acid reaction with litmus paper; and Dr. Golding Bird explains the fact by supposing that, though the urine may redden litmus, it may contain no acid in an *uncombined* state. Dr. Thudichum believes that in these cases the acid reaction may depend on the presence of chloride of ammonium, in which the magnesian phosphate is very slightly soluble. Phosphate of lime, however, is so soluble in the latter salt, that it could not exist as a deposit as long as any of the chloride of ammonium is not neutralised. (See *Thudichum, Pathol. of the Urine*, 1868, p. 204.) It is worthy of notice that a white deposit of earthy phosphates, which might be mistaken for albumen, is sometimes thrown down when urine is heated. This probably occurs when the solvent acid is a volatile one, such as carbonic acid, the evaporation of which may cause the earthy deposit to appear. This, however, will be at once dissolved by the addition of a little nitric or hydrochloric acid, and is thus readily distinguished from albumen.]

The magnesian phosphate is always derived from the urine; the phosphate of lime, however, may also be derived from the mucous secretions of the urinary passages. It is present in small quantities in the secretions of all mucous membranes, but is produced in excess when these membranes are irritated and inflamed. It is present in considerable quantity in the ropy mucus of chronic inflammation of the bladder. This mucus is itself alkaline, but, in addition to this, its presence probably increases the alkalinity of the urine by favouring the decomposition of urea, and its conversion into



carbonate of ammonia. Any irritating cause, such as calculus, enlarged prostate, or urethral stricture, may therefore, in this way, produce alkaline urine and phosphatic deposits. Dr. Owen Rees has pointed out that undue *acidity* of the urine even may have the same effect, by exciting inflammation and increased mucous secretion, and that in such cases alkaline urine may be advantageously treated by alkaline remedies, to remove the acidity which was its original cause.]

*Triple Phosphate of Magnesia and Ammonia Deposits and Calculi.*—Dr. Wollaston describes the form of the crystals of this salt as being a short trilateral prism, having one angle a right angle, and the other two equal, terminated by a pyramid of three or six sides. These crystals, as Dr. Marcet has explained, are but very sparingly soluble in water, but very readily in most, if not all, the acids; and, on precipitation, they reassume the crystallised form. From the solutions of these crystals in muriatic acid, sal ammoniac may be obtained by sublimation. Solutions of caustic alkalis disengage ammonia from the triple salt, the alkali combining with a portion of the phosphoric acid. The existence of this calculus in the intestines of animals was first pointed out by Fourcroy; but, its being a constituent part of some urinary calculi of the human subject was originally discovered by Dr. Wollaston. (*Phil. Trans.* 1797.) According to Dr. Prout, this species of calculus is always nearly white; its surface is commonly uneven, and covered with minute shining crystals. Its texture is not laminated, and it is easily broken and reduced to powder. In some rare instances, however, it is hard and compact, and, when broken, exhibits a crystalline texture, and is more or less transparent. Calculi, composed entirely of the phosphate of magnesia and ammonia, are rare, but specimens, in which they constitute the predominant ingredient, are by no means uncommon. (*Prout*, p. 86.) When the blowpipe is applied, an ammoniacal smell is perceived, the fragment diminishes in size, and if the heat be strongly urged, it ultimately undergoes an imperfect fusion, being reduced to the state of phosphate of magnesia. (P. 69.) [Clusters of acicular crystals of this salt, adhering together by one extremity, so as to give the appearance of rosettes, are sometimes met with; also stellar or foliaceous crystals. (See *Golding Bird*, *Loc. cit.* p. 283.) The latter form may be produced artificially by the addition of ammonia to healthy urine.] One fact of great importance, respecting this species of calculus, is mentioned by Sir A. Cooper in his lectures; viz., that it is particularly liable to be re-produced after lithotomy, and therefore, until the patient's diathesis has been corrected by medical treatment, he cautions surgeons not to perform the operation. In cases of this description, he says, a substance like mortar is discharged from the bladder, and the urine is very fetid.

*Bone Earth, Phosphate of Lime Calculus.*—The presence of phosphate of lime in urinary calculi had been mentioned by Bergmann and others, when Dr. Wollaston first ascertained that some calculi are entirely composed of it. From the investigations of Dr. Wollaston, it appears that this substance sometimes, though rarely, composes the entire calculus, but that, in general, it is mixed with other ingredients, particularly with uric acid and phosphate of magnesia and ammonia. In the

first case, the calculus is described as being of a pale brown colour, and so smooth as to appear polished. When sawn through, it is found very regularly laminated, and the laminæ, in general, adhere so slightly to each other as to separate with ease into concentric crusts. It dissolves entirely, though slowly, in muriatic or nitric acid. Exposed to the flame of the blowpipe, it is at first slightly charred, but soon becomes perfectly white, retaining its form, until urged with the utmost heat from a common blowpipe, when it may be completely fused. It appears to be more fusible than the phosphate of lime, which forms the basis of bone; a circumstance which Dr. Wollaston ascribes to the latter containing a larger quantity of lime. (*Phil. Trans.* 1797.) It appears from the investigations of Dr. Prout that the inner membrane of the bladder, when affected with chronic inflammation, may secrete a quantity of adhesive mucus containing phosphate of lime. A portion of the phosphate of lime, thus produced, mixed probably with some of the triple phosphate from the urine, is deposited on the lymph, and thus the incrustation takes place. (See *Brodie on the Urinary Organs*, p. 224.)

*Fusible Calculus.*—Mr. Tennant first discovered that this substance was different from the lithic acid, and that, when urged by the blowpipe, instead of being nearly consumed, a large part of it melted into a white vitreous globule. The nature of the fusible calculus was afterwards more fully investigated and explained by Dr. Wollaston. (*Phil. Trans.* 1797.) According to the excellent description lately given of this calculus by Dr. Marcet, it is commonly whiter and more friable than any other species. It sometimes resembles a mass of chalk, leaving a white dust on the fingers, and separates easily into layers, or laminæ, the interstices of which are often studded with sparkling crystals of the triple phosphate. At other times, it appears in the form of a spongy and very friable whitish mass, in which the laminated structure is not obvious. Calculi of this kind often acquire a very large size, and they are apt to mould themselves in the contracted cavity of the bladder, assuming a peculiarity of form which Dr. Marcet has never observed in any of the other species of calculi, and which consists in the stone terminating, at its broader end, in a kind of peduncle, corresponding to the neck of the bladder. The chemical composition of the fusible calculus is a mixture of the triple phosphate of magnesia and ammonia, and of the phosphate of lime. These two salts, which, when separate, are infusible, or nearly so, when mixed together and urged by the blowpipe, easily run into a vitreous globule. The composition of this substance, says Dr. Marcet, may be shown in various ways. Thus, if it be pulverised, and acetic acid poured upon it, the triple crystals will be readily dissolved, while the phosphate of lime will scarcely be acted upon; after which the muriatic acid will readily dissolve the latter phosphate, leaving a small residue, consisting of lithic acid, a portion of which is always found mixed with the fusible calculus.

It is also remarked by Dr. Marcet, that many of the calculi which form round extraneous bodies in the bladder, are of the fusible kind.

#### CARBONATE OF LIME CALCULUS.

This substance is not enumerated by Dr. Marcet as entering in the composition of urinary calculi; but,

according to Mr. R. Smith, there can be no doubt of the fact. Dr. W. H. Gilby, of Clifton, he says, detected it decidedly in four instances. "A notice of it will be found in Mr. Tilloch's Journ. for 1817, vol. xlix. p. 188, in the account of a curious calculus, given to me by Mr. G. M. Burroughs, of Clifton; the nucleus of which is a common cinder, an inch and a half long and one broad. Since the publication of that paper (continues Mr. Smith) Mr. H. Sully, of Wiveliscombe, sent me three oddly-shaped calculi, which he removed from a lad, together with fifteen pea-sized ones previously voided by the urethra, which are entirely carbonate of lime, held together by animal mucus." (See *Med. Chir. Trans.* vol. xi. p. 14.) Dr. Prout has also seen small calculi composed almost entirely of carbonate of lime. (*On Gravel*, &c. p. 89.)

[Concretions of carbonate of lime are occasionally formed in the prostate; it is possible, therefore, that some of the calculi of this substance which have been found in the bladder may have been derived from this source.]

THE CYSTIC OXIDE CALCULUS is small and very rare. It was first described by Dr. Wollaston. (*Phil. Trans.* for 1810.) In external appearance, it bears a greater resemblance to the triple phosphate of magnesia than any other sort of calculus. However, it is more compact, and does not consist of distinct laminæ, but appears as one mass confusedly crystallised throughout its substance. It has a yellowish semi-transparency and a peculiar glistening lustre. Under the blow-pipe, it gives a singularly fetid smell, quite different from that of lithic acid or the smell of prussic acid. In consequence of the readiness with which this species of calculus unites both with acids and alkalis, in common with other oxides, and the fact of its also containing oxygen (as is proved by the formation of carbonic acid by distillation), Dr. Wollaston named it an oxide, and the term *cystic* was added from its having been originally found only in the bladder in two examples. Dr. Marcet, however, has subsequently met with no less than three instances of calculi formed of cystic oxide, all of which were unquestionably of renal origin.

[Cystic oxide or cystine contains a large proportion, 26 per cent., of sulphur, derived probably, according to Dr. Golding Bird, from the sulphur extractive matter of the urine, and the result of abnormal changes in the albuminous and other tissues containing sulphur. Cystic oxide calculi, usually pale yellow when removed, become of a brown or dirty green colour by keeping.]

A deposit of cystine is occasionally met with in the urine. It always occurs in a crystalline form, the crystals, as seen by the microscope, being flat hexagonal plates, generally superposed in clusters. This sediment is abundant, and might be mistaken for the pale urate, or for the phosphatic deposit. It is distinguishable from the former by not disappearing on warming the urine, and from the latter by being insoluble in very dilute hydrochloric or strong acetic acid. (*Golding Bird*, *Loc. cit.* p. 195.)

No very definite indications for the treatment of this deposit can be given. The nutritive and digestive functions must be regulated with care. Tonics will in most cases be required. The nitro-muriatic was recommended by Dr. Prout, and the

preparations of iron by Dr. Golding Bird, but the number of cases met with have not been sufficient to admit of definite conclusions, so that each case must be considered on its own merits, and in connection with such concomitant symptoms as may happen to be present. From the cases which have been recorded, the tendency to this deposit appears to be hereditary in a remarkable degree.]

#### THE FIBRINOUS AND OTHER PSEUDO-CALCULI.

The chemical properties of a new calculus, mentioned by Dr. Marcet, correspond to those of fibrine, and he therefore suggests the propriety of distinguishing it by the term *fibrinous*. For a particular description of these new substances, I must refer to this gentleman's essay.

[Substances of this nature are regarded by Dr. Golding Bird as consisting of dried inspissated albuminous matter exuded from an irritated kidney, and to be in no way analogous to calculi properly so called.]

A *Uro-Stealth Calculus* has been described by Heller, and specimens have been examined by Dr. W. D. Moore, who has given a detailed description of them in the *Dublin Quarterly Journal*, vol. i. 1854, p. 473. Uro-stealth is a fatty or resinous substance of waxy consistence.

*Blood Calculi.*—Concretions of a dark rusty or nearly black colour, and of considerable hardness, have been found in the bladder, and have been supposed to be formed from blood coagula. In some of these, examined by Dr. Rees, forms resembling the remains of blood corpuscles were met with.]

*Alternating Calculus.*—Lithic strata frequently alternate with layers of oxalate of lime, or with the phosphates. Sometimes also the mulberry alternates with the phosphates, and, in a few instances, three, or even four, species of calculi occur in the same stone, disposed in distinct concentric laminæ. On the comparative frequency of these and other varieties of calculi, Dr. Prout's work contains valuable information.

*Compound Calculi, with their Ingredients intimately mixed.*—Under this title, Dr. Marcet comprehends certain calculi which have no characteristic feature by which they can be considered as distinctly belonging to any of the other classes. He observes that they may sometimes be recognised by their more or less irregular figure, and their less determinate colour; by their being less distinctly, if at all, divisible into strata; and by their often possessing a considerable hardness. By chemical analysis confused results are obtained. (See *Essay on the Chem. and Med. Hist. of Calculous Disorders*, p. 90.)

*Calculi of the Prostate Gland.*—The composition of these calculi is said to have been first explained by Dr. Wollaston. (See *Phil. Trans.* for 1797.) They all consist of phosphate of lime, the earth not being redundant, as in bones. Their size varies from that of a pin's head to that of a hazel-nut. Their form is more or less spheroidal, and they are of a yellowish brown colour.

Consult *T. Lobb*, A Treatise on Dissolvents of the Stone, 8vo. Lond. 1739. *Stephen Hales*, Experiments and Observations on Mrs. Steevens's Medicines, 8vo. Lond. 1741. *Morand*, in Mém. de l'Acad. des Sciences, 1740 and 1741. *J. Rutty*, New Experiments on Joanna Steevens's Medicines, 8vo. Lond. 1742. *R. Whytt*, An Essay on the Virtues of Lime Water and Soap in the Cure of Stone, 8vo. Edin. 1761. *D. Hartley*, A View of the present Evidence for and



against Mrs. Steevens's Medicine, 8vo. Lond. 1739; and Supplement, 1740. *N. Hulme*, a safe and easy Remedy for the Stone, &c. 4to. Lond. 1778. *Wm. Butler*, Method of Cure for the Stone, chiefly by injections, 12mo. Edin. 1754. *B. Langrish*, Physical Experiments upon Brutes, in order to discover a safe Method of dissolving Stones in the Bladder by Injections, 8vo. Lond. 1746. *J. Jurin*, Effects of Soap-ley, taken internally for the Stone, 2d edit. with an Appendix, 12mo. Lond. 1745. *J. F. Schreiber*, De Medicamento à J. Steevens, contrà Calculum, divulgato inefficaci et noxio, Gùtt. 1744. *Murray Forbes*, A Treatise upon Gravel and Gout, with an Examination of Dr. Austin's Theory of Stone, an Inquiry into the Operation of Solvents, &c. 8vo. Lond. 1793. *W. Austin*, A Treatise on the Origin and component Parts of the Stone, &c. 8vo. Lond. 1791. *T. Beddoes*, On the Nature and Cure of Calculus, &c. 8vo. Lond. 1793. *J. S. Dorsey*, An Essay on the Lithontriptic Virtues of the Gastric Liquor. 8vo. Philadelphia, 1802. *M. Girardi*, de Uva Ursina, ejus que et Aquæ Calcis Vi lithontriptica, &c. Patav. 1764. *Scheele*, in Stockholm Trans. Fourcroy, in Système des Connoissances Chimiques, 1801. *Wollaston*, *Pearson*, and *Brande*, in Phil. Trans. and Journal of Science and Arts, vols. vi. and viii. &c. *A. Marcet*, On the Chemical History and Medical Treatment of Calculous Disorders, 8vo. Lond. 1817: a work full of valuable information. *Wilson Philip*, in Medical Trans. vol. vi. *Dr. Henry*, in Med. Chir. Trans. vol. x. *C. Scudamore*, On Gout, &c. edit. 3. *F. Magendie*, Recherches Physiologiques et Médicales sur les Causes, &c. de la Gravelle, 8vo. Paris, 1818. *Ph. v. Walther*, Ueber die Harnsteine, in Journ. für Chir. b. i. Berlin, 1820. *A. Copland Hutchison*, On the Comparative Infrequency of Urinary Calculi among Seafaring People, vid. Med. Chir. Trans. vol. ix. *R. Smith*, A Statistical Enquiry into the Frequency of Stone in the Bladder in Great Britain and Ireland, vid. Med. Chir. Trans. vol. xi. *W. Prout*, An Enquiry into the Nature and Treatment of Gravel, Calculus, &c. 8vo. Lond. 1821: a work abounding in original valuable observations. *J. Wilson*, On the Structure and Physiology of the Male Urinary and Genital Organs, and the Nature and Treatment of their Diseases, 8vo. Lond. 1821. *J. P. Frank*, On Urinary Calculi, see Journ. of Foreign Med. No. xix. *Sir Benjamin Brodie*, On Dis. of the Urinary Organs, p. 166, &c. ed. 2, 8vo. Lond. 1835. *John Green Crosse*, On the Formation, Constituents, and Extraction of Urinary Calculus, 4to. Lond. 1835. *Thomas King*, Lithotripsy and Lithotomy compared, &c. 8vo. Lond. 1832. *Dr. Yelloly's Analysis*, in Phil. Trans. And Remarks on the Tendency to Calculous Diseases, &c. 8vo. Lond. 1829. [*Golding Bird*, on Urinary Deposits, edit. 5. Edited by *Edmund Lloyd Birkett*, M.D., 1857. *A. H. Hassall*, M.D., The Urine in Health and Disease. *Lionel Beale*, F.R.S., On Kidney Disease and Urinary Deposits, 1868. *J. L. W. Thudichum*, M.D., Pathology of the Urine, 1868. *Holmes*, Syst. of Surgery, vol. iv. 1861.]

**URINE, INCONTINENCE OF.**—[Properly employed, this term is applicable to four different abnormal conditions affecting the urinary bladder. Incontinence signifies total or partial inability to retain a normal quantity of urine, no marked inflammatory condition of the mucous lining of the bladder being present. It is thus to be contrasted with the condition known as retention of urine on the one hand, and from undue irritability of the bladder on the other. In the latter case the organ is unable to retain its contents, not because there is any loss of power in the retaining apparatus, but because, owing almost invariably to the presence of some degree of inflammation in the inner coat, the presence of urine is felt to be irritating, and the bladder acts in consequence.]

The first form of incontinence to be noticed is that which results from central paralysis, the effect either of injury or of disease. Although this most commonly produces retention of urine, yet it sometimes occasions paralysis of the retaining muscular apparatus of the neck of the bladder and of the

urethra; and the urine leaves the viscus as fast as it enters by the ureters. When the paralysis is complete, as happens after injury to the spinal cord, retention is always produced. It appears to be only in a few exceptional cases of partial paralysis that true incontinence of urine is present. It is obvious, therefore, that this condition may affect individuals of all ages, although it is met with chiefly in those of middle and advanced life. As far as my own observation is concerned I believe it is more frequently met with in those functional disorders of the nervous system which arise from exhaustion, from sexual excesses, and the like, than in connection with the organic changes of the brain which appear late in life.

The second form is a very rare one, and affects the aged only. It is due to a peculiar enlargement of the prostate gland by which the internal meatus of the urethra is so expanded as to prevent the accumulation of urine, whence incontinence results. Almost invariably the result of enlarged prostate is retention of urine, and this may become so considerable that a quantity of surplus urine may be running off constantly; or this may occur during sleep only, or during muscular efforts of the body. This condition, however, is not incontinence, and is not included by the definition given above. It is a state of retention; the bladder is gorged with urine, and a portion overflows. It is of the utmost importance to guard against the common error of confounding these two states. Many a patient afflicted with retention, whose bladder was constantly overflowing, has been led by this circumstance to suppose that the organ was empty; and frequently the medical attendant has been similarly misled. It should be held as an axiom, the importance of which it is impossible to over-estimate, that an involuntary flow of urine indicates retention, not incontinence.

The third form is that which depends upon mechanical distension of the neck of the bladder: as by the presence of a calculus which is partly vesical and partly urethral, so that the urine dribbles by its side and is thus constantly voided. Over-distension of the neck of the bladder in the female for extraction of calculus has also been followed by incontinence. The abnormal flow of urine which is due to fistula, vesico-vaginal, vesico-rectal, &c. is not considered as incontinence in the common sense of the term.

The fourth form of incontinence of urine is that which affects children and young adults. It is not a total but a partial one, and occurs during sleep. The patient, without being aroused, passes water once, twice, or more, during the hours of rest, and this frequently in spite of all the precautions which are taken to avoid it. It is extremely common in early life, but sometimes unfortunately continues even after puberty, in which case it is generally an obstinate, and always a very distressing complaint.

*Treatment of Incontinence depending on paralysis.*—A successful treatment of this complaint must here depend mainly on the benefit which the disorder of the central organs is capable of receiving. As has been stated above, it is rather in connection with functional than with organic paralysis that we meet with this form; hence there is in such cases reason to hope that the patient may derive benefit from treatment. It is impossible therefore to describe it in this place,

since it resolves itself into that which the systemic condition requires.

When it continues notwithstanding that the paralysis of the extremities or voluntary muscles elsewhere has diminished, the effect of counter-irritation over the sacrum should be tried; the influence of a galvanic current passed daily from the spine to the perineum, groins, and pubes in succession, during a period of two or three weeks, is undoubtedly beneficial in some of these cases. Added to this the indication is usually present for tonic treatment, for the administration of iron, and for cold bathing. Sometimes strychnia, in small doses, carefully watched, and continued for a considerable length of time is a valuable agent in these cases.

*Treatment of the second form, depending on an abnormal and very unusual form of hypertrophy of the prostate.*—The mechanical condition which produces the disorder is not susceptible of alteration by any known mode of treatment. However, it is exceedingly rare, and few surgeons can cite more than a few examples of its occurrence. For this, as for the exceedingly common condition of unduly irritable bladder producing frequent micturition, a well-made urinal is often essential to the comfort of the patient. In the circumstance now under consideration it is absolutely necessary.

*Treatment of the third form, depending on mechanical distension of the neck of the bladder and its results.*—If it is due to the presence of urethro-vesical calculus the obvious course is to remove the cause, and after a successful operation the disappearance of the incontinence may be reckoned on. When it has persisted long after over-distension of the female urethra, it frequently defies all treatment. Generally, unless the distension has been very considerable, and has indeed probably amounted to serious rupture, the urethra will regain its tone within a few days after such operations, without any special treatment. In the worst cases it will often be found on careful examination that there has been some sloughing due to the violence used, and loss of some portion of the urethra essential to the proper performance of its function. The remedy for this condition is a plastic procedure of some kind, which will be considered in its place. The employment of well-adapted apparatus to receive and retain the urine is here also indispensable to the patient's comfort.

*Treatment of the fourth form; or that partial incontinence which affects children and young adults.*—In young children the disorder usually gets well of itself as they grow up and acquire strength. When they wet their beds really from idleness and carelessness (which I believe is rarely the case), moderate chastisement may be proper, inasmuch as the fear of correction will make them pay more attention to the earliest call of nature. It has always been my own conviction, that this doctrine is carried to an unjustifiable extent, particularly in schools, and been a pretext for the most absurd kind of severity. Nor is it doubted by any man who understands the subject, that, in almost all cases, the disorder is a true infirmity, arising from the causes already indicated, and not from indolence; the supposed crime taking place, in fact, when the child is asleep and unconscious of what is happening.

If excessive irritability and constitutional weak-

ness be the cause of incontinence of urine, and a very small quantity of urine forces the bladder to contract, the resistance of the urethra being involuntarily overcome, an endeavour should be made to lessen such irritability by the use of the warm or the cold bath, sea-bathing, tonics, chalybeates, good air, &c. And, in order to prevent the accident from taking place in the night-time, the child should not take any drink for some time before being put to bed; the bladder should be always emptied before sleep, and if necessary, the child ought to be taken up in the night for the same purpose.

But by far the best remedy which I am acquainted with for these cases, acting indeed for many like a specific, is belladonna. It should be given in small doses three times a day, say for a child of three to five years old the twelfth of a grain of the extract to commence with, increasing it if necessary by degrees to three or four times that quantity. With older children the dose is to be larger in proportion. It is essential that the quality of the drug should be unexceptionable, otherwise the treatment will appear to be defective.

Cauterising the prostatic urethra and neck of the bladder with a solution of fifteen to twenty grains of nitrate of silver to the ounce of distilled water has in my own hands effected cures after the failure of medicine. It is at first sometimes temporary only in its effects; but should be tried three or four times at least before relinquishing it as a remedy. I have had occasion only to use it at and after puberty.]

Henry Thompson.

URINE, RETENTION OF.—[*Retention of urine* is an inability, whether *total* or *partial*, of expelling by the natural efforts the urine contained in the bladder. The characteristic symptom, previous to the introduction of the catheter, is distension of the bladder, sometimes, but not always, to be perceived by an examination of the hypogastrium, after the patient has discharged all the urine which he is capable of expelling. As this complaint may exist when the flow of urine from the bladder is by no means totally stopped, great caution is required to avoid mistakes. Violent efforts to make water are often excited at intervals, and during these strainings small quantities of urine may be expelled. Such a case may be mistaken for strangury, as it exists in acute inflammation of the prostate gland, or of the bladder.

At other times a retention of urine may really exist, though the patient can make water in a stream, and discharge in the course of the twenty-four hours a quantity equal to that which is commonly discharged by a person in health. Under this circumstance the distension of the bladder will continue till the patient is relieved by the catheter. And lastly, it sometimes happens, when the bladder has suffered its utmost distension, that the urine runs off by the urethra as fast as it is brought into the bladder by the ureters. (See URINE, INCONTINENCE OF.)

In forming a correct judgment of all these cases it is very necessary to recollect the important division of retentions of urine into the *complete* and *incomplete* forms; a distinction which will at once put the surgeon on his guard against a variety of errors. He should also recollect the practical divi-



sion of all retentions of urine into two classes; one depending upon an impediment or obstruction at the neck of the bladder, or in the course of the urethra; the other upon causes which operate by weakening the bladder itself, and lessening the force of the detrusor urinæ, and other muscles concerned in expelling the urine. Thus the vesical orifice of the urethra may be blocked up with clotted blood, or be obstructed by a calculus, or by the pressure of a neighbouring abscess; or by a projection of a portion of enlarged prostate. The membranous or spongy parts of the canal may be the seat of strictures, or serve as a lodgment for a small calculus; and the bladder may be weakened by over-distension, or paralysed from the effects of certain injuries and diseases of the brain, spinal cord, pelvis, sacrum, &c. In the female it may be caused by the pressure of a gravid or misplaced uterus. There is only one particular case which cannot enter into this classification; it is the incomplete retention of urine, arising from a wound or rupture of the fundus of the bladder; but this is excessively rare, and almost invariably is associated with severe injury to the pelvis or abdomen. (See **BLADDER**)

Every case of retention of urine demands prompt assistance; but when the disorder presents itself in its complete form, the mischief of delay is of the most serious nature; for, if the bladder remain preternaturally distended, it not only loses its contractile power, but if it be not artificially relieved, the urethra behind the obstruction gives way and extravasation of urine takes place. (See **URINE, EXTRAVASATION OF**.) It is most commonly in urethral stricture that complete retention does take place; for when the cause is hypertrophied prostate obstructing the neck of the bladder, some urine generally issues, the retention is incomplete, and fatal consequences are not so imminent as in the former condition. In very exceptional cases, the bladder has been known to burst, or, speaking more accurately, its coats have given way through ulceration, and urine has been driven either into the abdominal cavity or into the cellular connection in the pelvis around the base of the viscus; in either case fatal peritonitis rapidly occurring.

*Treatment of Retention of Urine.*—When complete, and especially when the symptoms are at all urgent, the catheter is the first and generally the only means required to afford relief.

There are three principal conditions in which we meet with its occurrence. In organic stricture of the urethra,—in inflammation of the posterior part of the urethra and prostate gland, as a consequence of gonorrhœa, when probably acute inflammation and temporary enlargement of the prostate has some share in the difficulty,—and in the hypertrophied prostate of patients who are advanced in life.

The subjects of the first form are generally men in the middle term of life; those of the second are most commonly young; and those of the third are always elderly men.

1. *Retention in cases of Organic Stricture.*—Temporary and slight attacks of inability to pass water are usually overcome in subjects of organic stricture by hot fomentations or by the hip bath. But when the obstruction is obstinate, and the bath has been found insufficient to relieve, it is in most cases desirable to resort to the catheter.

And in nine cases out of ten it is the best and most desirable remedy to apply without delay of any kind. Nevertheless, it is quite true that the patient's sufferings may be greatly ameliorated by large and repeated doses of opium, and that if these be persevered in, he will probably obtain relief in the course of some hours, twenty-four, thirty-six, or more. This, however, is not effected without much exhaustion of the system, and over-distension of the bladder. Its relief is not to be compared to that which is afforded by a well-passed catheter. Only if the operator fails to pass one, if he cannot do it without seriously damaging the urethra, should opium be solely trusted in to relieve retention; and then doubtless it is much to be preferred in the two alternatives named. It is right to say that Mr. Skey believes "there is nothing at all comparable to it in the great majority of cases." For myself, I am bound to confess I prefer the following plan as the rule in these cases. If the patient is suffering from painful distension, and the bladder is evidently full, although not necessarily large or extending above the pubes, since in cases of stricture it is often preternaturally contracted, I should first take a bougie of medium size and pass it along the urethra until the situation of the stricture is revealed. This will probably be from  $4\frac{1}{2}$  to 6 inches from the external meatus, the most favourite situation for stricture; I then take a very fine gum-elastic catheter smaller than a No. 1, being careful to ascertain that it is pervious, and endeavour to insinuate it without a stilet. It is often successful, and it gives no pain. But if this fails I apply a silver catheter of about the same size, and passing it to the spot, commence by careful and very gentle exploration of each aspect of the urethral wall to find the orifice of the stricture and to pass it onwards through it into the bladder. If it does not pass after a short time those precautions and adjuncts should be adopted, if need be, which have been already detailed under the head of "Treatment of difficult cases of Stricture." (See **STRICTURES OF THE URETHRA**.) Very rarely does failure to traverse safely the passage occur in careful and fairly practised hands. If, however, we do not succeed; if under the influence of opium or of chloroform, the retention still remains, the question of opening the urethra or bladder by some operative procedure has next to be considered.

There are several methods by which this has been accomplished. 1. By "forcing the stricture" with a catheter. 2. By incision into the urethra behind the seat of stricture. 3. By puncturing the bladder; which may be done in three different ways.

The first mode, or that of forcing a stout and medium sized silver catheter through or by the side of the stricture, and onwards into the bladder, may be regarded as obsolete. It is an imperfect, uncertain, and hazardous proceeding.

The second mode is that by which the urethra is laid open from the perineum, just anterior to the anus. There are two ways of doing this. The first, in which a dissection is carried down to the stricture, and through it, if possible, thus making a way into the urethra behind; the other, in which an opening is made directly into the urethra behind the stricture, followed or not by division of the latter, according to the judgment of the operator. The former proceeding, or that of

perineal section, has been already described in its proper place.

The second method of opening the urethra from the perineum, viz., by an incision made altogether behind the stricture, has been long resorted to by surgeons for the purpose of relieving retention of urine. Of late years it has been recommended in this country by Mr. Guthrie and by Mr. Liston.

The latter writes: "When it is found impossible to penetrate the strictured part of the urethra with the catheter, and no abscess has formed, the proper practice is," as follows . . . "the forefinger of the left hand is introduced into the rectum; a straight bistoury having been pushed into the mesial line, with its back towards the bowel, is carried on-wards to the apex of the prostate, and in withdrawing the instrument the dilated passage is opened to the point of a catheter passed down to the obstructed point. This is preferable to puncture of the bladder in any situation; but the cases requiring either proceeding will be rare indeed, if the mode of using a catheter is properly understood." (*Pract. Surg.*, 4th ed., p. 484.)

The third mode is that of puncturing the bladder. This is performed in three ways:—by the rectum, above the pubes, and through the pubic symphysis.

1st. *The Puncture by the Rectum.*—The present usage is to open the bladder either by the rectum or above the pubes. Each operation has been a favourite one in its time. An effort has of late been made, mainly by Mr. Cock, of Guy's Hospital, to test the value of the former method, and during the last few years he has punctured the bladder per rectum, some forty times at least, and has studied the operation on a large scale. Mr. Cock believes it to be one fraught with less danger, and that it is more easy of performance, than any other which is adopted for the relief of retention.

The chief objections which have been raised against it are, the averred liability to the occurrence of abscess between the rectum and the bladder as an after result, the persistence of fistulous opening there; the infliction of injury upon the seminal vesicles, leading to inflammation of these and the neighbouring parts, including the testicle; and the danger of perforating the peritoneum with the trocar, and thus setting up inflammation of that membrane. All these results have undoubtedly been occasionally met with. That of wounding the peritoneum appears to be the least likely to happen if ordinary care only be employed. The bladder in rising carries its peritoneal coat along with it; and it has been observed in the examination of those cases where the parts have been preserved after death, that the puncture has almost invariably fallen short of the peritoneal fold, an inch, or an inch and a half. The vesiculæ seminales, or the vas deferens, appear to escape somewhat less frequently. Injury to either of them is a less serious matter than to the former. The operator, however, must carefully endeavour to maintain the middle line in order to avoid them. But modern practice has been very free from these complications, and there is now no doubt that the dangers of the rectal operation have been over-rated. In the forty cases reported by Mr. Cock, seven or eight deaths followed the operation; but there is no evidence that these were caused by it. In five cases, the patients had suffered from stricture for very many years, and in all, advanced

renal disease existed: in *none* does it appear to have arisen from any of the causes hitherto alleged to be sources of danger.

Further, it is unquestionable that the immediate result of the operation is so much improvement in the condition of the urethra, in consequence of the urine having ceased to pass by and irritate it, that the reduction of the stricture by dilatation may be much more readily accomplished than before.

The mode of performing this operation is as follows:—Having had the rectum emptied by means of an enema, place the patient on his back in the position for lithotomy, and let him be firmly held by two assistants, not tied. Oil, and introduce the left forefinger into the rectum, ascertaining the size and situation of the prostate, beyond which the tip of the finger should be fairly carried, so as to define its posterior boundary; not always an easy thing to do when the bladder is much distended, since its neck becomes then considerably elongated. Fluctuation should be felt by it there, communicated, through the contents of the bladder, from a tap made on the hypogastric region, unless the viscus be very contracted indeed, in which case the performance of the operation is of doubtful propriety, since the point of the trocar may enter the opposite coat of the bladder, from absence of the requisite amount of distension, or do some other mischief. Having found the spot beyond the prostate at which fluctuation is most distinctly perceived, and having directed an assistant to support firmly the lower part of the abdomen with both hands, so as to press down and steady the bladder towards the rectum, a well-curved trocar, seven or eight inches long, should be carried along the finger, directed strictly in the middle line to the part indicated, the handle well depressed, and the point carried through the coats of the rectum and bladder, until it is felt free in the cavity of the latter. The canula must be carefully kept *in situ*, while the stilet is withdrawn, and afterwards retained there by means of a bandage and tapes. The length of time it should be allowed to remain will depend on the amenability of the stricture to treatment. If this yields, the urine will readily pass through the natural channel, and the opening in the rectum will very quickly close. If there are any reasons for keeping the rectal opening patent for more than two or three days, it is necessary to substitute an elastic catheter for the silver canula. The catheter may be slipped through the latter, so as not to lose the route. I have had occasion to keep it open in one case for three, and in another for six weeks, in this way.

There are certain conditions which must be held to contra-indicate the performance of this operation. The absence of fluctuation when examining the bladder through the rectum, as already noticed. This may be occasioned not only by a contracted bladder, but by a considerably enlarged condition of the prostate or by tumor connected with it. The incompatibility of the employment of the trocar from the rectum in such cases will be sufficiently obvious.

2nd. *Puncture of the Bladder above the Pubes.*—The mode of performing it is as follows:—The patient being placed in a half-sitting, half-reclining position, and the pubes shaved, a vertical incision of the integument is made directly above the symphysis pubis, about an inch and a half or two inches in length at the surface; this is to be carried down-



wards through the linea alba, so as just to admit the tip of the finger to reach the distended bladder. Meantime, an assistant, standing behind the patient, should press one of his hands firmly on either side, against the abdominal walls in such a position as to steady the bladder. A straight, or a slightly-curved trocar (if the latter, the convexity of the curve should be upwards), is then to be carried with a very little inclination downwards into the bladder. It is better not to empty the viscus immediately, when very large, but to draw off its contents by degrees; as alarming syncope, and even death, have occurred on sudden removal of the pressure from the abdominal circulation. After the operation, the canula should be exchanged for a tube of gum or silver, adapted to slide through it, secured by tapes and a T-bandage, which may remain a considerable length of time, but must be removed and washed occasionally.

3rd. Lastly, *the Puncture through the Symphysis Pubis*.—This operation was first proposed by Dr. J. M. Brander, of Jersey, in Paris, in 1825, where he read a paper advocating the procedure on the presumed advantages of the situation, regarded anatomically; and he and others have several times performed it with success. Dr. Brander has employed a hydrocele trocar of medium size, although he alludes to one of flattened form. The first-named instrument offers an advantage by admitting of rotary movement in introduction. The patient should recline, and the trocar should be introduced—whether after a small preliminary division of the integuments or without it, appears to be immaterial—about the centre of the symphysis, reckoning from above downwards, and in a direction at about right angles to the vertical axis of the body. Dr. Brander says, “somewhat obliquely downwards and backwards towards the sacrum, varying the direction according to circumstances; a piece of flexible catheter is then to be introduced through the canula,” and retained by a tape.

In considering these methods of affording relief to the distended bladder in reference to a case of distension from stricture, the question to be first solved is the following:—

Are the patient's powers and condition such as to compel us to prefer the simplest method of affording immediate relief, without regard to ulterior results? It ought not often to happen that we are called upon to answer this question in the affirmative, if the early treatment have been under our own direction, for it would indicate that other appliances have been too long employed. But then this is not always the case. The surgeon's decision is often required when no time can be lost, and when the patient's powers are at a low ebb. In such circumstances, unless the urethra can be felt in the perineum distended with urine, which may sometimes be the case, the rectal puncture of the bladder, supposing the prostate not to interfere (putting aside the puncture by the symphysis as not yet sufficiently tested by experience), is a simple method, and will afford instantaneous relief at the smallest possible expense to the patient's powers. But if the distension spoken of is perceived, a lancet, or sharp-pointed bistoury, may be carried into it, and a female catheter introduced by its side before it is withdrawn: it is very rare indeed, however, that this condition exists. Still, if the bladder is felt distended above the pubes, no doubt this is the best situation in

which to retain an instrument afterwards. The supra-pubic operation in this condition is easily performed and without danger. It is otherwise, if the bladder is contracted, and at the same time hypertrophied; that is, when no trace of a distended viscus can be found above the supra-pubic symphysis. In all cases, however, the question of puncture depends much on the skill and experience of the surgeon; and very rarely indeed ought the operation to be necessary for retention of urine.

2. *Retention in cases of Inflammation of Prostate following Gonorrhœa*.—In this form of the retention the immediate resort to the catheter is less needful, and, indeed, less desirable than in the preceding. The urethra is excessively tender, often inflamed, discharging pus, and injury may be very readily inflicted on it. The subjects are young, and often vigorous, while the inflammatory condition which obstructs the urethra, unlike to the more mechanical narrowing which constitutes stricture, is often readily overcome by the powerful influence of a hot bath, which, at a temperature of 100° to 104°, fills the capillaries of the entire surface, and relieves the internal congestion, and enables the urine to pass in sufficient quantity. Should this, however, fail, the catheter may be resorted to; and the best instrument for the purpose is usually a *well-curved* gum-catheter, No. 6 or 7, without a stilet, which will usually slide into the bladder, if no force is used, more readily than any other. In some few instances a silver instrument may succeed; it should be one of medium size, which is much better than either large or small; the latter being the most objectionable of all instruments in these circumstances. For the general or medical treatment see TREATMENT OF ACUTE PROSTATIS under that head.

3. *Retention caused by Hypertrophied Prostate in elderly Subjects*.—A common result of this disease is a chronic and gradually increasing obstruction of the neck of the bladder, so that the course of the urine outwards is always more or less obstructed. This condition existing, it often happens that exposure to cold, an unaccustomed indulgence at the table, or in sexual excitement, or some other less obvious cause of congestion in the gland, occasions complete retention, and surgical aid is instantly required. As in the preceding class of cases, the hot bath is often of essential service; if much straining of a painful and involuntary character is present, opium is of great value; under the influence of these agents the water usually dribbles off in quantity sufficient to relieve the bladder, although by no means to empty it. If this relief is not ample the catheter is to be employed; a course which in any case must be adopted without much delay, since the bladder cannot be permitted to remain distended, even although the normal quantity of urine flows off day by day. I have found no kind of instrument so efficient for cases in these circumstances as a gum catheter of full size, say No. 9 or 10, provided that it has been treated in the following manner. At the same time a gum catheter not so treated is, I believe, one of the most inefficient instruments which can be employed, and a silver one is then preferable. To render it valuable for a case of hypertrophied prostate it should be kept for three or four months at least on a stout stilet, curved to an extreme degree, so that the lower half of the catheter describes about three-fourths of

a small circle; a curve, it is almost unnecessary to add, in which it is impossible to use it. But on proceeding to pass it the stilet is removed, the upper part or handle of the catheter is bent backwards, and the instrument possesses a form which enables it in most cases easily to ride over any obstacle at the neck of the bladder, without causing injury or drawing blood, as in these circumstances is sometimes the result of the silver instrument. But in some exceptional, and particularly in greatly advanced cases, the long prostatic silver catheter, with a large and prolonged curve, is the best and, indeed, a necessary instrument. It is not very frequently necessary to use the long prostatic catheter; most cases of prostatic retention are readily relieved by a No. 9 or 10 of ordinary form and length; it should be warmed and oiled before using, and its point kept along the upper aspect of the urethra during its passage towards the bladder, and its handle well depressed to avoid obstruction at the neck of the bladder; and if it is considerable the introduction of left index finger into the rectum sometimes aids the operator to carry the beak of the catheter over the tumor at this point. Generally speaking, it will be necessary in these cases to pass the instrument two, three, or more times daily afterwards for some time; and it is of great importance to discover the kind and form of catheter which causes least pain and disturbance to the patient. While in many cases the well-curved gum catheter answers the purpose best, it is equally certain that the straight but very flexible instrument of the French goes more easily than any other. Retention may occur from over-distension of the bladder, from atony, and from true paralysis, no change in the prostate gland existing. The catheter need not have any special form; an ordinary gum-elastic instrument, of small but sharp curve, is the preferable kind as a rule.

Retention may be occasioned by rupture of the urethra, as after a severe blow on the perineum, by fracture of the pelvis, &c. The one important point is, to be exceedingly careful on the first introduction of the instrument. If the true course is not hit at the first trial, it is rare indeed that the surgeon succeeds. Once let the catheter penetrate far through the breach, among the lacerated tissues outside the urethra and the right passage is more difficult to find. The best plan is to take a silver catheter, about No. 9 in size, and pass very lightly and gently in the known direction of the canal; it is the best chance of succeeding, and if it does so must be securely tied in. If any obstruction to the point is felt, force is sure to be prejudicial, for the certainty is obtained that a lacerated part is encountered; the point of the catheter must be withdrawn, and gently directed on the opposite side, in hope of finding a portion of unbroken urethral mucous membrane by which to slide on the instrument into the urethra. If there is no success, the treatment for extravasation of urine may be necessary; generally, there is much hæmorrhage in such a case among the tissues of the perineum, and urine may soon follow the track of the blood and do infinite mischief, if not evacuated by incisions there.]

Henry Thompson.

UTERUS, ANTEFLEXION AND ANTEVERSION OF. (See UTERUS, RETROFLEXION OF.)

UTERUS, ATROPHY OF. (See UTERUS, PROLAPSUS OF.)

UTERUS, CANCER OF. The disease generally first attacks the cervix, and especially the posterior lip or margin of the os tincæ. In the beginning the symptoms are attended with ambiguity, and cannot be discriminated with any degree of certainty from those arising from various other causes productive of irritation of the womb. Most frequently the disease is ushered in by irregularity of menstruation, a sanious bloody discharge, or a profuse leucorrhœa; together with an annoying sensation of tension, weight, and dragging pains in the lumbar and hypogastric regions, extending frequently to different points of the pelvis and hip; frequent desire to make water; tenesmus; and lancinating pain in the cervix uteri. On examination, the portion of it towards the vagina is perceived to be either hardened at every point, or indurated in some places and softened in others. The os tincæ is likewise indented, irregular, and half open. When pressure is made with the finger, a sanious bloody matter is discharged.

The disease may continue in this state for several months, or even years; but, at length, the symptoms become more aggravated; the darting pains, which now affect also the groins and thighs, occur with increased violence; and the discharge becomes exceedingly ichorous and fetid, blended with sloughy matter and clotted blood. Sometimes profuse hæmorrhages come on. The constitutional impairment becomes more and more serious, and is accompanied by the carcinomatous hectic, and the pallid sallow appearance of the countenance so characteristic of organic disease. Ultimately death takes place, either suddenly, from profuse bleeding, or, as more usually happens, the patient dies hectic, in a state of horrible suffering.

If, in this advanced form of the disease, a *post mortem* examination is instituted, the portion of the uterus connected with the vagina is found ulcerated, or more or less destroyed, and fungi, or indurated masses, extend from this point within the cervix. The uterus, or upper portion of the vagina is frequently much hardened; and the ulceration may even be continued into the rectum and bladder, so as to form new communications between one or even both these viscera and the vagina, and account for the involuntary discharge of urine and feces by the latter passage.

When the disease commences in the cavity of the uterus, the cervix remains for a long while unaffected, while the body of the womb enlarges in every direction, and may attain considerable magnitude. In such a case the swelling is sometimes distinctly perceptible through the parietes of the hypogastrium.

Cancer of the uterus may originate at any period after puberty (*Chelius, Handb. der Chir. b. ii. s. 630*); but the time of life between the ages of 40 and 50 is that in which its commencement is most common. [A specimen of cancer affecting the uterus and vagina in an infant nine months old was exhibited by Mr. Heckford, surgeon to the East London Children's Hospital, to the Obstetrical Society (see *Obstetrical Transactions*, 1868).] I have attended not less than three women, who died under the age of 30, from the effects of cancer of the womb. Cruveilhier observes, that from the age of 35 to that of 50 is the prin-



incipal season for this cruel disease, though he has known one woman of the town die of it, whose age was only 26; and has seen it in women as old as 60, 70, 80, and even 83. In University College Hospital, I lately had a case in a woman about 70, in whom it proved fatal about two years after its first attack. In this case the disease had implicated the whole of the vagina and even the labia. One young woman whom I attended in Great Ormond Yard for a cancerous womb, of which she died, had an aged mother who had suffered severely from carcinoma of each breast, but had latterly been freed from the disease by a sloughing process; an event which is uncommon, but does now and then happen. (See CANCER.) Next to cancer of the breast, cancer of the womb is the form in which the disease most frequently presents itself. Sometimes the disease takes place in the womb and breast together; and Cruveilhier records an instance in which cancer uteri was accompanied by a medullary tumor in the substance of the left hemisphere of the brain, so that, in the latter stages of the case, the patient was attacked with convulsions and hemiplegia. According to this distinguished pathologist, however, notwithstanding the tendency of cancerous diseases in general to affect the whole economy, by extending from the point first attacked, as from a centre, cancer of the womb is but rarely accompanied by this general implication of the system, and especially of the breast.

It appears also, from Cruveilhier's researches, that the vagina is as frequently the seat of cancer as the neck of the womb. "Its anterior paries is much more frequently attacked than its posterior; and hence it is rare to find instances in which the lower portion of the bladder does not participate in the disease." (*Anat. Path.* liv. xxiii. pl. 6.)

Cruveilhier finds, that what he terms the *areolar pultaceous cancer* is the most frequent of all the forms of cancer to which the uterus is liable. In this the uterus is transformed into a spongy texture, from which a cancerous substance, of greater or less consistence, may be compressed in the shape of small worms; so that, when this texture has been emptied by suitable preparation, a hollow cellular structure remains. Cruveilhier conceives that he has made out the fact that cancer of the uterus begins in the venous system. However this may be, he notices another fact, which is of greater importance to the practitioner, viz. that the *lymphatic glands in the pelvis are almost constantly affected in cancer of the womb*. He specifies in particular two, situated one to the right and the other to the left, at the sides of the pelvis, on a level with the highest part of the ischiatic foramen; these, he says, are often the only lymphatic glands implicated. The lumbar glands he finds less frequently diseased than the pelvic; and he states, that they may be enlarged and red without presenting any vestige of cancerous structure. The inguinal glands are only involved when the disease attacks the external pudenda, and the orifice of the vagina. In only one dissection he found the cancerous substance in the thoracic duct, though he examined it at every opportunity; and, in another instance, he traced the same substance in many of the lymphatics, which proceeded from the diseased parts. (*Op. cit.* liv. xxvii.) In one case, dissected by Cruveilhier, one ureter was enormously dilated, and the corresponding kidney

wasted. "The relations of the ureters with the lateral and superior part of the vagina, and with the lower part of the bladder which is often implicated in cancer of the uterus, account for the impediment to the flow of the urine through the ureters, the lower portions of which are often surrounded by cancerous masses, which compress them. This compression may take place in so great a degree, that the lower part of the ureter is completely obliterated; and, what is remarkable, such compression does not produce the fatal consequences which theoretically might be expected. The urine dilates the ureter (see liv. xxvii. pl. 2, fig. 2), which at the same time that it becomes dilated, is lengthened and rendered tortuous or spiral, like a varicose vein. The pelvis and calices in their turn are also expanded, so as to acquire a considerable capacity. The kidney, compressed by the urine accumulated in the dilated calices, gradually wastes away, and is converted into a mere shell or husk of a pale yellow, having some resemblance in colour to the changed state of the kidney known of late by the name of Bright's Disease; and such atrophy may proceed so far that no urine can be secreted, or so little that any redundancy may be easily prevented by absorption." The possibility of life continuing long, with an obstruction of both ureters, would be, however, a very different case from that described by Cruveilhier.

Gangrene, consequent on cancer of the womb, is found by Cruveilhier to be very common, sometimes destroying the cancerous structure, layer by layer, and, in other instances, attacking the whole mass of it. In both cases, the discharge becomes horribly fetid, and when the finger is withdrawn from the vagina, it brings away a sloughy putrid detritus, which Cruveilhier says can be compared to nothing more like it than the substance into which hospital gangrene transforms the textures invaded by it. The sloughing may advance slowly or rapidly; a difference which has vast influence on the intensity and acuteness of the symptoms. When gangrene attacks the whole of the cancerous mass, and nearly annihilates it, the case might be mistaken for one of primary mortification; and, in many examples, the cancerous state of the pelvic and lumbar absorbent glands is the only criterion of the gangrene having been preceded by a cancerous affection of the uterus. (*Cruveilhier, Anat. Pathol.* liv. xxiv.)

As I have never seen more than palliative relief derived from medicines or local applications, in the treatment of true cancer of the womb, I shall not dwell long upon this part of the subject. So far as my experience goes, temporary relief is to be sought principally in the judicious employment of narcotics and purgatives as occasion requires, the horizontal position, leeches on the hypogastric region in the early stage, fomentations, and frequent ablution with tepid water, or decoction of poppies. I have not generally found the chloride of soda lotion, nor any astringent injection, superior to tepid water in the temporary relief afforded; but when the discharge is copious and exceedingly fetid, they may be tried. The tincture of iodine, the hydriodate of potash, the iodide of mercury, the carbonate of iron, the liquor arsenicalis, the aqua laurocerasi, and almost all the medicines specified in the article CANCER, I have seen tried, but without any permanent benefit.

Modern experience proves, however, that when cancer, or rather scirrhus, is confined to the neck of the uterus, it will sometimes admit of being successfully removed by excision. The cervix uteri, in the healthy state, projects from three to six lines into the vagina; but M. Lisfranc has known it to make no projection at all. The vagina around it is thin, and in contact, on one side, with the bladder, and, on the other, with the rectum; while upwards it is continuous with the proper substance of the uterus. The vagina may be detached from the cervix uteri to the extent of more than half an inch, without any risk of opening the cul-de-sac of the peritoneum, which separates it from the bladder; but since the latter viscus adheres very intimately to its anterior surface, it might then be reached by the instrument. Behind, the peritoneum not only covers the corresponding surface of the uterus, but also descends over the vagina, to form what M. Velpeau terms the recto-genital excavation; so that, on this side, the knife, if carried only a few lines, would open the peritoneum. M. Velpeau considers it erroneous then to say that there is a space of eight lines in front, and ten behind, between the upper edge of the cervix uteri and the serous membrane of the abdomen. The distance is stated by M. Malgaigne to vary, according to the greater or lesser projection of the cervix. M. Malgaigne also states that the vagina may always be detached from the cervix to the extent of more than half an inch in front, without hazard of wounding the peritoneum; but, behind, the vagina ascends further, and there is less space between it and the peritoneum. (See *Velpeau, Nouv. Éléments de Méd. opér.* t. iii. p. 620; *Malgaigne, Man. de Méd. opér.* p. 747, ed. 2.) [Dr. Emmet (*Amer. Journ. of Obst.*, 1869) recommends, before amputating the cervix, to examine whilst the patient is placed on her knees and elbows; this, by favouring gravitation, enables us to note the exact length of the neck more accurately. In the ordinary posture the neck is always apparently longer from prolapse of the uterus.]

According to Baudelocque, the excision of the cervix uteri was first suggested in 1780, by Lauvariot. M. Tarral even ascribes it to Tulpius; but the tumors which the latter took away were, according to M. Velpeau, evidently polypi. Lazzari, who puts in a claim for Monteggia, is also believed to have made a similar mistake; nor has M. Velpeau been able to satisfy himself that the operation was ever performed by André de la Croix and Lapeyronie, as M. Tarral represents. Troisberg recommended it, however, in 1787; and, as a critical writer observes, sometimes the cervix uteri was removed accidentally with the knife by ignorant persons, who mistook it for a polypus. (See *Edinb. Med. and Surg. Journ.*, No. 103, p. 377.) Professor Osiander, of Göttingen, first executed the operation in 1801, on a widow, whose vagina was filled by a very vascular fetid fungus, as large as a child's head, growing from the orifice of the womb. By means of Smellie's forceps, the fungus was drawn down; but it broke off, and a tremendous hæmorrhage ensued. The operator, without loss of time, introduced several crooked needles, armed with strong ligatures, through the bottom of the vagina, and body of the uterus, until they emerged at the os tincæ. These ligatures served to draw down the uterus, and retain it near the mouth of

the vagina. Osiander then introduced a bistoury above the scirrhus portion, and divided the uterus exactly in the horizontal direction: for an instant the bleeding was profuse, but it was quickly stopped by means of a sponge saturated with styptics. In about a month the woman recovered. Osiander afterwards performed eight similar operations upon different patients, all of whom are reported to have experienced a cure. The observations of Osiander were no sooner promulgated in France, than M. Dupuytren adopted the new operation, and made numerous trials of it. M. Récamier followed Dupuytren; so that, by 1815, the excision of the cervix uteri had become in France a common operation. However, it remained for M. Lisfranc to extend the practice, and to convince the most incredulous of the little danger resulting from it. (*M. Velpeau, Nouv. Éléments de Méd. opér.* t. iii. p. 615.) Dupuytren also performed the operation eight times; but, instead of employing the ligatures and knife, as Osiander did, he drew down the uterus with hook forceps (*les pinces de Museux*) and divided it, above the scirrhus part, with curved knives and scissors. One of the patients, on whom Dupuytren operated, had a return of the disease, and submitted to a second operation with no better result; but was afterwards effectually cured by the application of caustic, with the aid of the speculum invented by M. Récamier.

In 1828, M. Lisfranc had performed this operation on thirty-six individuals, as is stated, for cancer uteri, the recognition of which last declaration as a positive fact, I beg to observe, is a matter of great importance in determining the merits of the operation. Of the thirty-six patients thus operated upon, "thirty were then well, three dead, and three in progress of recovery. One female, operated on some years before, had since become pregnant, and recently given birth to twins. Lately, at the Hôtel Dieu, the entire uterus has been removed by M. Récamier; and, in September last, this formidable operation was performed at La Charité, by M. Roux. The patient died in twenty-four hours after the operation." (See *Practical Formulary of the Parisian Hospitals*, by F. S. Katier, p. 17.) Langenbeck's extirpation of the whole uterus, by cutting through nearly the whole of the linea alba, I do not deem it necessary to detail, as it is a proceeding which I would never recommend to be imitated. The poor woman experienced the same fate as the patient of M. Récamier.

Dr. John Brown, surgeon to St. Mark's Hospital, has published one of the best descriptions of the operation of removing the cervix uteri, as witnessed by him at Paris, in 1826 and 1827. To perform this operation (he observes) the patient must be placed as for lithotomy, with the parts exposed to a clear light. The speculum (that of M. Récamier, or that of Madame Boivin) is then to be introduced. The condition of the cervix having been ascertained, and the speculum withdrawn, the left forefinger is passed up, and on it the double hooks, which are firmly fixed in the projecting lips of the cervix, one on each side, and given to an assistant for a moment. The operator, then taking both hooks in his right hand, gradually and gently draws down the cervix, till it has been brought nearly on a level with the external parts; he next passes a button-pointed bistoury behind the diseased portion of the uterus, and removes it. The



cut surface of the uterus quickly resumes its natural position on the removal of the hooks, no dressing being commonly applied to the part; and the patient being put to bed, is placed on a strict regimen for several days, venesection and leeching being freely employed, not only to remove, but even to prevent, attacks of inflammation. (M. Lisfranc usually bleeds his patients at La Pitié to 3x. or 3xij. soon after the operation, the effect of the excision being considered by him, particularly where there has been preceding menorrhagia, as analogous to a suppression of the menses; repeating the bleeding, leeching the sacral region, and using emollient fomentations and enemata on the least occurrence of abdominal tenderness. Such treatment is generally very successful, although it is not uncommon to bleed three or four times from the arm, besides applying leeches.)

After the simple introduction of the speculum, in certain cases where an inflammatory diathesis exists (more particularly in young persons, or where the cervix, in addition to other disease, appears gorged with blood), care is to be taken to throw emollient lotions, or those containing the chlorides of lime, or soda, into the vagina several times daily, by means of a syringe; and the wound, if tedious, may require to be touched with the nitrate of silver. Women, so treated, are usually able to go home in three or four weeks. It is not desirable that the patient should go to stool soon after the operation, as the effort might detach the coagulum from the wound. One woman is alleged to have become pregnant *fifteen days after the operation*, went the usual time, and was delivered in three quarters of an hour, as there was no cervix uteri to resist the passage of the infant.

Even with regard to the excision of the cervix uteri, it is perfectly manifest to me that many of the cases in which it was performed were not truly cancerous. Doubts may be entertained, I think, whether the enormous tumor removed in the very first instance of such operation by Oslander, was really a cancerous affection. Several of the cases operated upon in Paris were decidedly not of this character. On this point I fully agree with Dr. Brown, an eye-witness, who remarks: "While I admit the facility with which such a measure may be accomplished, I must be permitted to doubt its necessity in some of the cases related. The second and third were, in my opinion, such affections as would have yielded to common local and constitutional measures, and would, I have no doubt, have been so treated by British surgeons, and perhaps by a few of our French brethren."

Instead of the excision of the cervix uteri for cancerous diseases, M. Bayle advocated the application of caustic; and his advice was founded upon the fact shown by pathological anatomy, that, in the early stage of malignant ulceration of this part the texture of the uterus is healthy at the distance of two or three lines from the ulcerated surface. The patient having been placed in the right position, and the speculum introduced, the cancer is to be cleansed with dossils of charpie. If the surface is irregular, or the seat of fungous granulations, they are to be removed with curved scissors, or a sharp-edged kind of scoop (Dupuytren). In this manner, indeed, such growths may be removed, not only from the cervix, but from the interior of the uterus. After the ulcer has been cleaned, a roll of charpie is placed below the speculum, in

order to protect the vagina from the action of the caustic. Then the caustic is applied, either the arsenical paste (Bayle), or the pure potash, scraped to a point, and fixed in a porte-crayon; or the acid nitrate of mercury, with which lint is wetted and conveyed with forceps to the ulcer. The application is continued for one minute; then copious injections of tepid water are employed for the removal of the uncombined particles of caustic; the charpie and speculum are withdrawn; and the patient put into a warm bath. In about four or six days, the application is to be repeated; and, if no ill consequences follow, it is to be continued at short intervals, but more and more lightly each time, in proportion as the cure advances. (*Lisfranc*; also *Malgaigne, Man. de Méd.* p. 745, ed. 2.)

[It has not been thought desirable to alter the author's description of uterine cancer beyond slightly condensing it. The history down to Mr. Cooper's time, and the appreciation of the practice of amputating the cervix for malignant disease, must serve as the basis of all discussions of the subject. The subsequent sketch is not intended as a correction of Cooper's account, for in that respect he is seldom open to assault, but as an exposition of the subject, such as the actual state of knowledge requires.]

All the known forms of cancer may affect the uterus; and all by preference seem to affect the cervix, beginning at the vaginal portion or os externum, and mostly terminating at the os uteri internum.

1st. Fungoid or medullary carcinoma is by far the most common;

2nd, in frequency, come the epithelial kinds; and

3rd, the scirrhus or hard cancer. This last, West and Rokitsansky say, is extremely rare.

1. The *Medullary Cancer*, or *Encephaloid*.—It is found as a thick, bony, hard, nodular mass, of white, grey, or red colour, consisting of a fibrous framework, with a brain-like pulp in the interstices. As a rule, cancer is characterised by an infiltration of cells of a monstrous type, and great activity of multiplication, into the natural areolar tissue. Wherever areolar tissue is found, there cancer is prone to form. In uterine encephaloid, these cells commence in the cellular tissue between the mucous membrane and the proper tissue of the uterus. Lebert thinks cancer may begin in the follicles of the neck of the uterus. The disease gradually encroaches upon the deeper strata; but commonly there remains after death a thin layer of muscular substance beneath the peritoneal investment of the uterus. The extension is not so much inwards into the uterine tissue, as centrifugal. At first this, like the other forms of cancer of the uterus, appears to be strictly local, confined to the cervix. But after a time, difficult to determine, the disease invades the areolar tissue of the fundus of the vagina, the base of the bladder, the rectum, the broad ligaments, uniting all these parts into one mass. As the cell-growth proceeds, the normal elements of the parts invaded disappear. The diseased mass increases in size, reaching often a considerable bulk, so that the finger, scarcely introduced through the vulva, will in cases somewhat advanced at once strike upon it. The deformed os uteri is brought low down, as in prolapsus. It is often hardly recognisable from the

nodular, irregular projections which surround it. It is sometimes occluded by these, but more often held unnaturally patulous. In this stage, the cervix uteri being involved in a growth extending to all the surrounding structures, is set fast; it has lost all mobility; or, if any remain, it moves only with the whole diseased mass.

The next feature of importance in the history is the marked tendency to softening and suppuration. Softening is soon followed by death of the mucous membrane of the os uteri; "an ulcer (West) forms, with raised, irregular, hardened edges, and a dirty putrilage takes the place of the smooth but enlarged lips of the os. The disease may go still further; the lips of the womb and its cervix are altogether destroyed, and a soft, dirty-white, flocculent substance covers the uneven, granular, and hardened surface. The ulceration may begin in the substance from softening, or on the surface without previous softening in the deeper parts.

The stage before ulceration varies much in duration. In many cases it is certain that the extension of the disease has greatly advanced before the patient seeks advice. Probably a year or more may elapse before ulceration occurs. The duration of the stage of ulceration is also variable. Sometimes it runs through this stage rapidly; at others, the ulceration, without healing or spreading much, is kept up for months. The patient indeed grows worse, losing flesh and strength, assuming the characteristic worn, straw-coloured, cachectic look. The discharges continue, composed of pus from the ulcerated surface, fetid from the admixture of dead and decaying materials, tinged with blood from the giving way of some of the vessels distributed to the granulations, while every now and then abundant hæmorrhages break forth. If we examine, we find sprouting granulations or a positive fungous outgrowth from the surface, and then after a time the fungus disappears, the surface feels less uneven, the edges less unhealthy, and we can almost persuade ourselves that here and there a process of cicatrisation has begun. New formation and death of the newly-formed tissues go on in rapid succession—a series of abortive attempts at cure, such as prevent the rapid extension of the ulcer, and keep alive the delusive hope of recovery. And, indeed, under the spontaneous or assisted powers of Nature, it is not uncommon for the disease to exhibit stages of apparent arrest, during which the discharges are lessened, the local suffering is abated, and the general health improves. But, sooner or later, relapse is but too sure, and the patient at length sinks under the exhaustion consequent upon repeated discharges—watery, purulent, and hæmorrhagic—pain, obstruction to the rectum and bladder in the performance of their functions, and impairment of nutrition.

As the disease advances upwards into the cervix, eating away the tissues, a large gaping cavity with irregular edges is formed, sometimes extending by fistulous passages into the bladder and rectum. Now, although primary cancer of the body of the uterus is extremely rare, the disease will almost always spread to it from the cervix if the patient's life be sufficiently protracted. In advanced cases the body of the uterus is almost always enlarged, and this from two causes. The maintenance of an active parasitic growth, like

cancer, attracts blood to the organ: it grows under this morbid stimulus as it will under that of developing a fibroid tumor, or as under the normal stimulus of gestation. In addition there is the extension of the cancerous deposit. The mucous membrane of the body is more generally affected. Sometimes nothing more is apparent than a general and intense redness of the interior of the womb; but much more frequently the lining membrane is covered by a dark offensive secretion, and is beset here and there by small white deposits of cancer.

The irritation caused by the morbid condition of the body of the uterus will often set up a slow or chronic inflammation in the broad ligaments and pelvic peritoneum. The fibrinous effusions resulting bind the uterus to the bladder and rectum, adding to the mass formed by the cancerous deposit, and still further determine that firm fixing of the uterus in the pelvic cavity which is observable in almost every instance of carcinoma of the medullary kind, except in the very earliest stage. Cancerous deposits take place under the pelvic peritoneum; extending, the peritoneum is involved, and at length is indistinguishable in the midst of the large mass of cancerous disease which conceals the uterus and its appendages from view.

As varieties in the forms in which cancerous disease invades the uterus, it has been observed that it may—although this is extremely rare—begin and run its course in the body of the organ, the cervix remaining altogether or comparatively free; also the cancerous deposit may take the polypoid form. In this latter case the tumor generally springs from the cervix. West relates two cases. He believes this form is always associated primarily or secondarily with similar diseases in the uterus itself.

The *diagnosis* of cancer of the uterus in the early stages is beset with difficulties. The opportunities of studying the disease at this stage are so rare, that, even when seen, for want of knowledge of its characteristics, it may escape recognition. Thirty years ago there can be no doubt that cases of simple hypertrophy or inflammatory engorgement were not unfrequently assumed to be cancer; and credit was asked for having cured them. Duparcque, Lisfranc, Ashwell, and Montgomery certainly fell into this error. And, notwithstanding the more accurate knowledge since extended, mainly through the researches of Téallier and Henry Bennet, of the consequences of inflammation of the cervix uteri, enabling us in most cases to eliminate these conditions, the clinical observer is still liable to mistakes.

The characters assumed by the os and cervix uteri during the earlier stages of medullary cancer are less familiar and therefore less clearly defined than those which mark the later stages. At first, whilst strictly localised in the cervix, the cervix is larger than natural, and one or more bumps of the size of half a nut, hard, resisting the finger, quite insensible, may be found on the lips of the os uteri. There is often, also, some puckering of the os. At this stage the mobility of the uterus is not impaired. Through the speculum these bumps show a violet-red tint, quite distinct from the rosy tint of the rest of the cervix.

A characteristic form of malignant disease of the os uteri in the earliest stage is due to the extension or spreading of the superficies of the os, whilst the cervix above remains the same. This



gives the figure of a mushroom to the part. It is true that ordinary hypertrophic elongation of the cervix begins somewhat in a similar way; but the "cancer-mushroom" is distinguished by its more complete resemblance to the mushroom shape, the spreading proceeding all round the os; and by the everted os of hypertrophy presenting a smoother surface. Malgaigne describes the "Champignons cancéreux;" and the same feature is insisted upon by Dr. Braxton Hicks (*Guy's Reports*, 1866).

The *Cauliflower Excrescence* of Dr. John and Sir Charles Clarke is the best known form of the epithelial cancer of the uterus. It appears from Gooch's criticism to be the same disease as was described by Levret and Herbiniaux, under the name of "Tumeur vivace." It also affects by preference the cervix. Opinions differ as to its malignancy. Rokitansky believes it to be cancerous, calling it the villous cancer. He describes it as a conferva-like growth, consisting of corpuscles the size of linseed grains, pale red, transparent, tolerably firm, hanging from the os uteri into the vagina, bleeding profusely on the slightest touch, and developed out of an encephaloid. It often fills the vagina, and causes profuse watery secretion. During life it becomes turgescient, like the uterine surface of the placenta; but dead, it shrivels up, and then only resembles a flocculent mass.

Virchow, on the other hand, says it is not cancerous, ranking it under the papillary tumors, of which there are three forms—the simple, the cancröid, and the cancerous. The cauliflower excrescence, according to him, begins as a simple papillary tumor, and runs into cancröid, but not into cancerous papillary tumor. It is formed only of papillary or villous growths, which consist of thick layers of peripheral flat and cylindrical epithelial cells, and a fine inner cylinder of extremely small cellular tissues with large vessels, running in loops. This tumor is also called papillary hypertrophy of the cervix uteri. Mayer regarded it as an originally local affection. Hannover separates it from cancer, under the name of epithelioma. Lebert and Schutz call it epithelial cancröid.

The divergence of opinion as to the cancerous nature of this growth is difficult to reconcile. But if it be admitted—and clinical observation dictates the admission—that the cauliflower excrescence frequently springs from a base of medullary cancer, or at some stage is associated with cancer, there is strong ground for taking the more unfavourable view. Certainly, in some cases the cauliflower-form becomes lost in the ordinary characters of medullary cancer; appearing to be simply a phase in the development of the latter. At the same time it is eminently important in a therapeutical aspect, to bear in mind the apparently lesser degree of malignancy of the cauliflower excrescence, and its greater concentration in, or limitation to, the vaginal portion of the cervix, up to a certain period of its growth, than is at all common with regard to the medullary cancer. Ablation of the growth by amputation of the vaginal portion is not seldom successful, if performed during the stage of localisation.

It is not easy to get an opportunity of examining the disease in its initiative stages. The symptoms produced are not such as to lead the patient to seek advice. Dr. West says, when he

has first seen it, the cervix has been already somewhat increased in size, the os uteri not open, but its lips flattened and expanded, so that their edge, which felt a little ragged, projected a line or two beyond the circumference of the cervix, while their surface was rough and granular. This irregularity was seen to be produced by the aggregation of numerous small, somewhat flattened papillæ of a reddish colour, semi-transparent, and often bleeding very easily. Generally, these small sessile papillæ increase in size, and form a distinct outgrowth from the whole circumference of the os uteri of the size of an egg, an apple, or even larger. These growths are split up by deep fissures into lobules of various sizes, all of which seem to be connected together at their base. The dimensions of these growths are not in general the same throughout, but they spring from the surface of the os uteri by a short thick pedicle, which is the elongated and hypertrophied cervix, and then expand below into the peculiar cauliflower shape. At the base the substance is much firmer. Though the vagina does not by any means escape from participation in the disease, and a granular or papillary structure may be felt sometimes extending over its roof, and for some distance along one or other wall, yet this is by no means constant. The tendency to involve adjacent parts is far less than in ordinary cancer. Usually the outgrowth, in the course of time, disappears in part, under the processes of alternate partial death and reproduction which characterise the medullary cancer. The irregular, sharp-cut edge of the os, whence it grew, is at first felt granular and mucous within, but afterwards grows thicker and nodulated, assuming by degrees all the characters of a part which has from the first been the seat of medullary cancer.

The *Scirrhus* or *Fibrous Cancer* is so very rare that Dr. West has never recognised a clear case during life, and Mr. Paget has not met with it. Rokitansky thus describes it, deducing his description, as he admits, from a very few observations: "On a careful examination one may discover, in the midst of the tissue of the portio-vaginalis, another structure recognisable by the different shade of white of the fibres composing it, and which, though closely packed, intersect each other in every imaginable direction; while the small interstices between them are filled by a transparent matter, of a pale yellowish red or greyish colour. This new structure is infiltrated into the uterine substance without any distinct limits, extending further in one part than in another, and here and there heaped up in greater quantity, thus producing the enlargement of the portio-vaginalis, the uneven nodulated character, and the well-known induration of its substance."

There is a form of *intractable ulceration* of the os and cervix uteri, which most authorities refer to epithelial cancer, but which some regard as of tubercular nature. The tubercular ulcerations are thus described by Robert—"They may be recognised by their excavated base, their greyish appearance, and the presence of a caseous matter in the midst of the muco-purulent discharges which come from the interior of the cervix; also by the presence in the cervix of tumors of uncertain size, rounded form, at first firm and with no change of colour, afterwards soft, whitish, yielding to the pressure of the fingers, and giving an indistinct sense of fluctuation. These tumors are

formed by the tubercular matter still in a crude state, or in course of softening. These scrofulous ulcerations are almost always accompanied by considerable engorgement of the cervix uteri." On the other hand, under the microscope, the softened matter is found not to consist of the elements of tubercle, but of epithelial cells similar to those of the uterine mucous membrane, while the indurated callous structure which forms the base of the ulcer is formed of a mixture of fibro-plastic and epidermoid materials. Robin says this kind of ulcer is to the uterus what lupus or canceroid ulcers are to the face. Lebert, Hannover, and Dr. Charles West support the testimony of Robin.

The *Corroding Ulcer* of Dr. John Clarke, or *rodent ulcer*.—Opportunities for observing this form of ulcer on the cervix uteri are exceedingly rare. But the observations that have been made justify the conclusion that the disease, when affecting the uterus, is similar to the rodent ulcer of the face or other parts. Its aspect, rate and mode of progress are unlike those of cancer, while neither cancer-cells nor epithelium formations are present in the adjacent tissues. It begins at the mucous membrane covering the os uteri, involving the whole circumference of the os, and utterly destroying both it and the subjacent parts, but there is no thickening, hardness, or deposit of new matter in the vicinity. Unlike cancer, the rodent ulcer may continue for years, without causing any very formidable symptoms.

The lymphatic glands of the pelvis, and especially those which surround the uterus, are frequently the seat of cancerous extension. The invasion proceeds step by step, successively catching the glands situated by the lumbar vertebrae, and following the course of the large vessels, which may be compressed or ulcerated. Sometimes the inguinal glands become cancerous. This is especially the case when the disease has attacked the vagina and vulva. I have described two cases in which the glands in remote parts of the body were also affected. It may, however, have happened that, in these cases, the enlargement and induration were due to irritation from the absorption of the fluid element (the cancerous ichor) of cancer, and not to the actual spread of cancer-cells.

In forming the *diagnosis* of cancer, the speculum is commonly useless—except in the very earliest stage—and may be injurious. The tissues often bleed freely on the slightest touch of the finger; and if the speculum is introduced greater injury is caused, and the effused blood obscures what might otherwise be seen. The finger by the vagina and rectum tells all that is necessary to establish the melancholy diagnosis.

I believe the sign that most frequently arrests attention in the first place is *hæmorrhage*; and then, when we examine, we find the disease far advanced. In several cases the first thing to suggest the presence of disease has been hæmorrhage on sexual intercourse. *Pain* of a marked character, even the stabbing, lancinating pain described as almost pathognomic of cancer, is often absent for a long time. It is rather a concomitant of the later stages. The pains have a radiating character, starting as it were from the centre of the disease, and shooting to the sacrum, vertebral column, loins, groins, and thighs.

In the early stages, no particular *odour* is perceived, but when ulceration has begun, an odour,

penetrating and offensive, is almost certain to be emitted. It is so peculiar that frequently by its presence of a cancerous patient in the room it is made known.

In advanced cancer the aspect of the patient is often enough to excite a strong suspicion of the nature of the disease. Emaciation is general, but not constant. The skin acquires a dirty straw tint, indicative of a profound alteration in the properties of the blood, and of impaired nutrition. It is true that a very similar tint is often seen in women who have long been draining from polypus or inversion of the uterus. But internal examination at once clears up the diagnosis. The alteration referred to is due to three causes: the influence of the cancerous cachexia, which, as Becquerel has shown, first destroys the globules, and afterwards diminishes the quantity of albumen; the hæmorrhages, which very quickly diminish the globules; the serous discharges. Thus the water of the blood increases; the globules and the albumen diminish. The cancerous cachexia is sooner or later followed by hectic or irritative fever.

What is the *duration* of cancer of the uterus? As the early stages so often escape detection, it is not easy to determine the total duration. It is probable that the stage before ulceration, of limitation to the cervix, may last for some months, even two or three years. When ulceration has begun, the downhill course is often rapid. But it may be protracted for a year, or even two years, the disease being at times apparently suspended, feeding the eager sufferer with the hope that the treatment is working a cure.

Cancer is not, indeed, absolutely incurable. The morbid mass may destroy and eliminate itself. Dr. Habit relates a case which is not altogether unique. (*Monatsschr. für Geburtshunde*, 1862.) Cancerous matter united the uterus to the surrounding structures; the vagina was filled with large granulations and fungous growths. Gradually all was replaced by firm cicatrix, and the uterus could no longer be felt.

The *Treatment*.—The question of amputation has been amply discussed above by Cooper. It may still, after more recent experience in this country, be doubted whether a *permanent* cure has been effected by this method. But there can be no doubt that by it, in favourable cases, suffering has been mitigated, the disease suspended, and life prolonged. Probably the disease will reappear and run its course in a year or less. But I have known a respite of two years and more to have been gained. The prospect is best in the case of cauliflower excrescence. Gooch urged removal by ligature, as giving the patient a chance of life; and if failing, by the excrescence growing again, it does not render the case worse than it was before. Dr. Emmet, of New York (*Amer. Journ. of Obst.* 1869), says that where he has been able to amputate in healthy tissue above the disease, he has known several cases where no return has occurred several years afterwards, but that as a rule the disease returns in four or six months. Dr. C. West gives a table of recorded cases of total extirpation of the uterus on account of cancerous disease. In three cases only did the patient survive the operation; in twenty-two death was the consequence.

The amputation of cauliflower excrescence is best effected by the galvanic cautery. Cure is re-



quired after the operation to keep the os uteri from closing.

Various caustics have been employed: as the chloride of zinc, Vienna paste, and others. Their use, with the view of destroying the diseased mass, is now, I believe, generally abandoned. But quite recently attempts to effect a radical cure by acting upon the cancerous growth have been made on a somewhat different principle. Bromine in solution has been recommended by Dr. Wynn Williams and Dr. Routh to be applied on pledgets of lint to the diseased surface. In some cases it has appeared to check the disease by destroying the vitality of the cancer-cell. I have used it extensively, and have acquired the impression that disease is checked by it. And there is no doubt that it is most effective as a deodorant. Dr. Broadbent (1866) recommended acetic acid on the following reasoning: "Cancer owes its malignancy to its characteristic structure. . . . To alter its cells is to put an end to their power of dividing and multiplying, and consequently to arrest the growth of the tumor. In acetic acid we have an agent which on the microscopic slide rapidly effects important changes in cells of every kind, dissolving the cell-wall and affecting the nucleus. Not coagulating albumen, it may diffuse itself through a tumor, and, reaching every part equally, it may probably produce similar results when the cells are *in situ*." He injects equal parts of acetic acid and water. I do not know how far this proposal has borne the test of clinical experience. But it seems that a hope of controlling this hitherto intractable disease may be found in its further pursuit. In one case in which I repeated the application several times phlegmasia dolens supervened; the patient died. Dr. Skene (*Amer. Journ. of Obstetrics*, 1869) inserted arrows of chloride of zinc into presumed cancerous affection of the cervix uteri; recovery resulted.

The palliative treatment is very important. Constitutional remedies may help the patient to bear up against the incessant wear and tear of an exhausting disease. Iron will help to counteract the degradation of the blood; quinine or bark to maintain the appetite; but the most useful of all remedies I have found to be cod-liver oil. Narcotics become indispensable in the later stages. Conium, hyoscyamus, belladonna, chloral and, above all, opium, must be resorted to, either in the form of pill or draught, or as suppositories introduced into the rectum or vagina, or by subcutaneous injection. Local remedies tend usefully to counteract some of the bad effects of the disease. Deodorants may very effectually prevent decomposition and offensive odour. The best deodorants are chloride of zinc, carbolic acid, and bromine. These may be applied on pledgets of lint introduced into the vagina, and renewed once or twice a day. By bromine especially the offensive odour may be completely subdued. In some cases I have found the best results from acetate of lead.

Wherever cancer has made progress, so as to encroach a little by its mass upon the surrounding organs, some impediment to the functions of the rectum and bladder follows. In the case of the bowels, this impediment entails a retrograde disturbance of the function of the entire alimentary canal. Beginning with the rectum, there is difficulty in defecation; this, in its turn, causes retention of faecal matter in the large and small intestines,

where it ferments or decomposes, producing distressing flatulence and distension of the abdomen. Constipation alternates with diarrhoea. Then again digestion is disordered; and the products of imperfect digestion being absorbed, a condition that may be called *copraemia* results. This chain of events is, indeed, common to almost all tumors which press upon the pelvic organs. On the side of the bladder there ensue incontinence, perhaps retention, and, when a fistula is established, a constant escape, of urine. The ureters may become obstructed; then urinæmia will result. This is one mode by which cancer kills.

Death may be the result of the natural course of the disease; more often of putrid infection, in some cases of cancerous infection. But mostly it is due to some intercurrent complication: as peritonitis, phlegmasia dolens, hydronephrosis.

The dilatation of the ureters and pelvis of the kidneys becomes the cause of death by the production of cerebral phenomena, convulsive or comatose. Aran relates a case of this last. The atrophy of the kidney is described by Cruveilhier (*Anat. pathol.*)

Cancer of the uterus is sometimes unfortunately complicated with pregnancy. This condition renders the cancerous growth more active; and, since the child must traverse the diseased tissues, labour can only be effected at the expense of dangerous or even fatal violence. Dr. West has collected seventy-four cases of cancer complicating labour. In forty-one death soon followed labour; thirty-three recovered from the effects of labour. Forty-seven of the children were lost.]

Robert Barnes, M.D.

Whoever wishes to obtain further information respecting operations for the removal of the cancerous uterus, should consult *Sabatier*, Méd. opér. t. iii. p. 397. Paris, 1824. *Alf. Velpeau*, Nouv. Élém. de Méd. opér. t. iii. *M. Malgaigne*, Man. de Méd. opér. 12mo. Paris, ed. 2. 1837. *J. Hatin*, Mém. sur un Nouveau Procédé pour l'Amputation du Col de la Matrice, &c. Paris, 1827. *Canella*, Cenni dell' Estirpazione della Bocca e del Collo dell' Utero. Milan, 1821. *Ammon*, Parallele der Französischen und Deutschen Chir. p. 257, &c. *Joerg*, Aphorismen, etc. zur Würdigung zweier von Dr. Hofrath Osiander in Leipzig unternommenen Operationen, Leipz. 1820. *Struve*, in Hufeland's Journ. b. xvi. s. 3. 1803. *Gutberlat*, Siebold's Journ. b. i. s. 2. *C. Wenzel*, Ueber die Krankheiten der Uterus, Mainz, 1816. *Langenbeck*, Neue Bibliothek, &c. b. i. s. 3. p. 551. *Laud Wolf*, in Archives gén. de Méd. Janv. 1836, p. 105: case of amputation of scirrhus uterus in the state of prolapsus, the result fatal. *Récamier*, in Revue méd. Déc. 1825: removal by ligature, followed by cure. Also, in Archiv. gén. de Méd. 1829, t. xxi. p. 78. *M. Roux*, Deux Cas de l'Extirpation de l'Utérus suivis de Mort, Bulletins des Sciences méd. Oct. 1829. *Sauter*, Die gänzliche Extirpation der carcinomatösen Gebärmutter, &c. Constanz, 1822: result successful. *Siebold*, Beschreibung einer vollkommenen Extirpation der scirrhusen nicht prolapsirten Gebärmutter, Frankf. 1824. *Paletta*, Journ. von Graefe, &c. bd. 5, h. 3. *Holscher*, ib.; *Chelius*, Handb. der Chir. b. ii. Heidelb. 1827; and, more especially, the writings and published lectures of *M. Lisfranc*. Also, *James Blundell*, M.D., Case in which the Uterus, in a state of Malignant Ulceration, was successfully removed; and two other Cases, &c., Lond. Med. Gaz., Aug. and Nov. 1828. *John M. Banner*, Case of Extirpation of the Uterus, ib. Oct. 1828. And, above all, before a surgeon makes up his mind to attempt the excision of the Uterus, either in a state of prolapsus, or under any circumstances, I recommend him to read carefully the cases, facts, and reflections contained in art. 3, p. 376, of the *Edinb. Med. and Surgical Journal* for April, 1830, No. ciii.

[*Téatier*, Du Cancer de la Matrice, &c., Paris,

1836. *Récamier*, Recherches sur le traitement du Cancer, et sur l'histoire générale de cette maladie. Paris, 1829. *Panly*, Maladies de l'Utérus, d'après ses leçons cliniques de *M. Lisfranc*. Paris, 1836. *C. West*, Diseases of Women, 1856. *E. Wagner*, Der Gebärmutter-Krebs. Leipzig, 1858. *Sibley*, Statistics of Cancer at Middlesex Hospital, "Med. Chir. Trans." 1859. *Virchow*, Cellular-Pathologie, 1860. *Collis* on Cancer. Dublin, 1864.]

UTERUS, DISPLACEMENTS OF. (See UTERUS, INVERSION, PROLAPSUS, RETRO-FLEXION OF.)

UTERUS, HYPERTROPHY OF. (See UTERUS, PROLAPSUS OF.)

UTERUS, INVERSION OF. [May be defined as a dislocation by which the inner wall of the uterus is thrust outwards; its cavity disappearing; and another cavity forming above, the inner surface of which is the proper external covering of the uterus. This cavity contains a portion of the Fallopian tubes, sometimes the ovaries and portions of the round ligaments which are dragged in by the fundus uteri. Even convolutions of intestine may fall in.]

There are degrees of inversion. The most simple division is that proposed by Crosse: *First*, depression: the fundus or placental site falls inwards, projecting into the cavity of the uterus. *2nd*, *Introversio*, or *Intussusception*: so great a part of the fundus falls in that it comes within the grasp of the portion of the uterus into which it is received. In the extreme form of this degree the fundus reaches to the os uteri, through which it may be felt like an intra-uterine polypus. *3rd*, *Perversion*: the fundus passes through the os uteri. There are degrees of this. In the extreme form the inversion is so complete that even the cervix and os are inverted. The essential conditions for the production of inversion are on the one hand relaxation of some part, or the whole, of the walls of the uterus, and, on the other, considerable enlargement of its cavity. When the uterus has contracted, its walls are so thick, and the cavity is so reduced, the anterior wall being flattened close in contact with the posterior wall, that inversion cannot take place. Of this any one may convince himself by passing his fingers into the living uterus during active contraction; or by trying to invert a uterus out of the body which has been well contracted.

Adhesion of the placenta, growing from the fundus, is a frequent cause. This is often united with spastic narrowing of the lower segment of the uterus. This narrowing will generally prevent complete inversion. In this case, the os uteri may not relax until partial inversion has lasted some time, when, the os yielding, as it always will do under sustained pressure, it permits the tumor formed by the advancing body of the uterus to pass through. Thus the inversion is complete.

Anatomical conditions concur in this process. During gestation the ligaments become elongated and offer no great resistance to inversion; and the hollow or cup made by the inverting outer surface of the uterus receives the broad ligaments, and sometimes the ovaries. The connections of the cervix on the other hand to its ligaments and to the bladder and vagina, hinder the inversion of this part for a time. Inversion, then, begins at the fundus or placental site. This part is liable, in consequence of the placental attachment, to paralysis (Rokitansky); and being thicker than the other parts of the uterine walls, forms a projection into the cavity.

That is the first step. Then if the placenta adhere and be dragged upon by the cord from below, or if the diaphragm and abdominal walls act as in a bearing-down effort, the part, already disposed to fall inwards, is forced further down into the cavity. The external cup-like depression formed by paralysis of the placental site may be felt by examination through the abdominal walls; and, especially is this the case if you drag upon the cord, the placenta adhering. When things have gone thus far, further pressure or dragging brings the fundus down upon the cervix and os. If this part be contracted, it may prevent the fundus from coming through; or, the pressure continuing, the os may yield and allow it to slip through; or the advancing fundus may find the cervix relaxed and offering no opposition. Indeed, the cervix is very liable to temporary paralysis after labour; and more especially is this the case when, as is not uncommon, it is lacerated. Accordingly it has been observed that some cases have occurred gradually, others suddenly. This explanation represents the views that are most generally received. The histories of several cases by the late Dr. Samuel Merriam (*Medical Times*, 1851) strongly confirm its correctness. In one case, inversion was caused whilst dragging away adherent placenta. The patient was much exhausted. The re-inversion was very difficult from extreme tenuity of the substance of the uterus, and the size of the inverted bag. Dr. M. was obliged to mould the uterus with his fingers, the parietes not possessing the slightest degree of firmness or contractility. In a subsequent labour this patient had profuse hæmorrhage with adhering placenta; inversion again took place, and speedily proved fatal.

Smellie relates a case told him by Lucas of a woman whose uterus after inversion, having been replaced, was immediately re-inverted. "It was like a piece of tripe." The uterus has even been inverted after *post-mortem* delivery under circumstances which preclude the idea that active contraction of the organ was an efficient factor. Dr. A. Taylor relates (*Guy's Hosp. Rep.* 1864) the following case communicated by Dr. Bedford of Sydney: A pluripara died undelivered. The body was exhumed. The fœtus and placenta were found between the mother's thighs. The uterus was inverted and driven out of the pelvis, the placenta remaining attached. The uterus had ruptured; this was the cause of death. The uterus was not contracted. There was much gaseous distension of the abdomen. This, the usual cause of *post-mortem* delivery, had driven down and inverted the flaccid uterus. Hæmorrhage again is known to be a disposing cause. Whoever has had his hand in the cavity of a uterus powerless through loss of blood, who has felt its flaccid wall yielding to every pressure, internal or external, like "tripe," or wet brown paper, will understand how easy it would be for such a uterus to be inverted. Indeed, I have often felt partial inversion taking place whilst endeavouring to detach adherent placenta by the fingers.

Dr. Inglis contributes (*Edinb. Med. Journ.* 1867) an observation which will be very interesting, if confirmed by further facts. He says that in seven cases of inversion out of nine the child was born with the occiput directed posteriorly. "The rubbing round of the head in rotating the occiput forwards, he thinks, leads to the inversion.



It produces an extremely complete and extensive dilatation of the cervix, and in time also increased expulsive action. If this last occur before the cervix has regained its tone, either hour-glass contraction or inversion will occur."

Lazzati and others have distinctly observed that the uterus was inert at the time of inversion. Many histories show that inversion followed immediately upon very rapid labours; in which it is probable that the uterus is more or less a passive body, expulsion being effected by bearing-down efforts. Hæmorrhage, by inducing relaxation, or uterine paralysis, is a predisposing cause.

Sir James Simpson thinks there is often some laceration of the cervix. Monteggia (*Istituzioni Chirurgiche*) says he has known an inversion take place, in consequence of a laceration of the cervix caused by forced labour.

Mr. Windsor believes that, when the uterus and vagina are in a relaxed state, and the female has been subject to prolapsus uteri, there is a greater disposition to the occurrence of inversion at the time of labour, than when such condition of the parts does not exist. (*Med. Chir. Trans.* vol. x. p. 360.)

Delivery in the upright posture has been a not infrequent condition. Inversion has happened after delivery by ergot and the forceps. Dr. Woodson relates a case where inversion took place after abortion at four months.

Inversion has been said to have occurred several days after delivery. Ané, Baudelocque, and Dubois cite cases. Some, at least, are open to the doubt that the inversion had occurred soon after labour, but had escaped detection till later.

It is, however, certain that the uterus may be inverted by a process of *spontaneous active self-inversion*. The first distinct indication of the mode in which this is effected is given by John Hunter. In the museum of the College of Surgeons, No. 2654 (See *Pathological Catalogue*), is a specimen of an inverted uterus. The accident occurred independently of pregnancy. A polypus had been attached to the fundus. A ligature had been applied near the attachment. The tumor had sloughed off just before the patient died. Hunter described the case under the title of "Intussusception," to which he likens inversion. "The uterus," he says, "is liable to inversion from two causes: one is immediately after labour, when it is so large as to admit of its containing itself, and which is commonly from an imprudent mode in disengaging and bringing away the placenta, when that substance has been attached to the fundus of the uterus. The second is somewhat similar, namely, the expulsion of an adventitious body, although of another kind, and at a very different period in the state of this viscus. It begins to take place when this viscus is small, but becoming gradually large enough (by the very disease that produces it) to admit of an inversion; so that in the first cause the uterus is first large, so as to admit of an inversion, and by its contraction to its natural state, it, as it were, fixes it. This is done immediately, because its cause is immediate, for this enlarged state of the parts is of short duration; but the second is gradual, because it is to produce itself, by the very action of the uterus in expelling an unnatural body (such as a polypus). The polypus as it grows will gradually fill the cavity of the uterus, and the uterus will be constantly en-

deavouring to remove it. The action of the uterus will be downwards, and as the body of the uterus acts on this substance, it will be gradually squeezed down towards the os tincæ, and the fundus will, of course, be gradually drawn into its own cavity, and as the polypus is squeezed down, so will the fundus follow. When the whole of the polypus has got into the vagina, if it has no length of neck, then will the fundus uteri be as low down as the os tincæ, the upper half of the uterus just filling the lower half; but I conceive it does not stop here. I conceive the contained or inverted part becomes an adventitious or extraneous body to the containing, and it continues its action to get rid of the inverted part, similar to an intussusception of an intestine." It is remarkable that in this case an intussusception of the small intestine co-existed.

Dr. Radford recognised activity of the uterus as a factor. (*Dublin Journ. of Med. Sciences*, 1837.) The uterine pain, diminution of bulk, firm, resisting fat, sudden formation and rapid protrusion observed in some cases, suggested to him "the deduction that the *body* and *fundus* of the uterus are in a state of *unnatural excitement and action*," the os uteri being soft and yielding.

Moser (*Jahrbuch der Geschlechtskrankheiten des Weibes*, 1843) seems to agree with Radford. He says:—"There is a preponderating contraction of the fundus whilst the rest of the uterus is relaxed, in which case the fundus may descend into the body of the uterus."

Hohl (*Lehrbuch der Geburtshülfe*, 1862) advances a similar doctrine. The necessary condition, he says, is contraction of the fundus. He cites two observations of his own in which, after natural labour, pain suddenly occurring, inversion took place without dragging on the cord. The process is analogous to invagination of intestine, which occurs in consequence of greater contraction and activity of the upper portion of the intestine, so that it easily descends into the more relaxed portion below. But Hohl admits flaccidity as a cause. Thus he saw inversion take place after delivery by forceps of a woman dying of cholera. There was deep syncope; and the uterus was paralysed.

In a most admirable and complete monograph on the subject, Mr. Crosse (*An Essay, Literary and Practical, on Inversio Uteri*, J. G. Crosse, F.R.S., 1847) says the most powerfully predisposing condition to the commencement of inversion (*depressio*), and without which the greater degrees cannot transpire, is partial inertia. He also points out that one of the most constant conditions is attachment of the placenta to the fundus uteri. Then, again, the action of the uterus in increasing an inversion, when once this has commenced, has been admitted and indicated by very many authorities, but by none more pointedly than by Denman (*Practice of Midwifery*), who observes that "if a disposition to an inversion be first given by the force used in pulling the funis, it may be completed by the action of the uterus." Crosse then states the modern doctrine in distinct terms:—"I cannot conceive that the organ itself has any power to *commence the displacement*, and to cause simple *depressio*. But when a commencement has been made, and the case goes on to *introversio*, bringing the fundus within the grasp and influence of the uninverted body of the uterus, this organ will, by the natural powers called into action by its sensi-

bility, regard the inverted part as an extraneous mass, and proceed to act upon it instinctively by successive and suitable efforts of its muscular coat, to propel it downward; whilst the os and cervix will by consent, and as transpires in the regular process of delivery, become dilated, and thus a part of the uterus will act on the rest, and carry on the displacement even to *perversio extrema*. . . . The *nus depressorius* of the abdomen awakened will assist the expulsion."

Dr. Tyler Smith maintains the same theory (*Manual of Obstetrics*, 1858). He says:—"There is first cup-like depression of the fundus uteri; coincident with, or immediately following upon, this depression, there is hour-glass contraction of the body or lower portion of the uterus. The annular contraction of the body grasps the introcedent fundus as it would a foreign body, and carries it downward for expulsion through the os, the os being itself in a state of inertia. After the inverted uterus has passed through the dilated os, this part becomes contracted, and prevents re-inversion. The steps are—introcession, intussusception, inversion."

Dr. Matthews Duncan (*Edinb. Med. Journ.* 1867) admits the spontaneous and artificial passive forms, and spontaneous and artificial active forms. In the active form there is a paralysis of a part, commonly the seat of the placenta. This part falls into the part below, which is in a state of hour-glass contraction. By this the paralysed introcedent part is seized and carried down.

The accident appears to be far less frequent at the present day than formerly. Ruysch saw it frequently, and was called to two cases in one day. On the other hand, Dr. McClintock says that out of seventy-one thousand labours in the Dublin Lying-in Hospital not one case was known to have occurred. A very common history used to be that the uterus was inverted by the midwife pulling on the cord. The actual comparative rarity must be attributed to the improvement of obstetric practice. Many men of large experience have never seen a case. Crosse, however, who has collected four hundred cases, contends that the partial form is more frequent than is suspected. There are several specimens in Guy's museum illustrating this partial inversion.

B. Langenbeck (*Med. centr. Zeitung*, 1860) exhibited the inverted uterus of a woman who had never been pregnant. On the inverted fundus was seated a fragile, sarcomatous heterologous growth of broad basis, the size of a walnut. Abarbanell (*Monatsschr. für Geburtskunde*, 1861) relates the following: A woman had become very anæmic from frequent hæmorrhages. A smooth tumor the size of the fist was first felt protruding from the uterus; fourteen days later, under violent expulsive pains with profuse hæmorrhage, the tumor was driven through the external genitals, and the uterus was completely inverted. The tumor was amputated, whereupon the uterus quickly replaced itself. McClintock gives a case (*Dis. of Women, Dublin*, 1863). Dr. Emmet (*Amer. Journ. of Obstetrics*, 1869) relates a case. He amputated the tumor by the wire-ecraseur, and then reduced the inversion. Prof. E. Martin relates a case in which inversion was caused by a tumor. This removed, spontaneous reinversion took place. (*Mon. f. Geburtsk.*, 1869.)

Inversion is spoken of as *recent* or *chronic*. The

differentiation may be made as follows: It is recent so long as the uterus has not completed its involution, that is, has not returned to the ordinary state of non-pregnancy. The tissues during this stage are softer, the muscular fibre still possesses contractile power, and reduction by manipulation is still feasible. It is chronic when the process of involution is complete. The tissues are then condensed, more unyielding, and sustained elastic pressure is the proper form of applying force.

The *symptoms* of inversion are chiefly those of shock, indicating sudden severe injury. They vary with the degree and progress of the inversion. Thus the first degree, or simple *depression*, may be unattended by pain, and indicated solely by hæmorrhage and a corresponding depression of the vital powers. The hæmorrhage comes from the relaxed introcedent part. The depression at the fundus may be felt through the abdominal walls as a cup like hollow. As the descent proceeds, and becomes *introversion*, urgent symptoms arise, according to the degree of compression exercised by the uninverted portion upon the inverted portion. A sense of fullness, weight, as of something to be expelled, is felt. Expulsive efforts, both uterine and abdominal, sometimes very violent, follow. Hæmorrhage is not constant. It seems that, when the inverted portion is firmly compressed, the hæmorrhage is arrested, and that bleeding is a mark of inertia. When the inversion is complete, the uterus is felt in the vagina, or may be seen as well outside the vulva; then pain and collapse are aggravated; clammy sweats, cold extremities, vomiting, alarming distress, restlessness, extinction of the pulse occur. During the expulsion the woman has often exclaimed that her intestines were passing from her. A tumor appears in the vagina or externally, generally covered by the placenta. The cord is traced up to the insertion, and the placenta, of convex form, is spread over the tumor.

The shock, either with or without hæmorrhage, is sometimes so great as to quickly extinguish life. Cases are known where the shock attending simple depression has been fatal. Where the case is not fatal, and the uterus is not reduced, the symptoms of chronic inversion succeed. First, the tumor, by its bulk, causes distress of the bladder and rectum. Then it is probably forced externally. Chronic inflammation, thickening, and induration of the parts ensue. The surface may become dry from exposure, or ulcerated and bleeding from chafing. It may be difficult or impossible to reduce it within the vagina. If the tumor remain within the vagina, it may still be a source of chronic irritation to the vagina, and may itself be the seat of chronic inflammation. Congestion, abrasion of surface, ulcerations, give rise to profuse mucopurulent leucorrhœa, and frequently to hæmorrhage. Irritative fever, emaciation, pain, discharges, break down the constitution; and after some months, or even years, the patient may sink from exhaustion, or a degree of tolerance is established, the symptoms becoming less severe.

As Windsor remarked, an epoch of special danger is that of weaning and the resumption of menstruation. The discharges of blood then become more frequent and profuse. When the climacteric age has been reached, the uterus undergoing natural atrophy, severe symptoms may subside.



Cases have been known of the inverted uterus sloughing off: Saxtorph (in *Actis Soc. Med. Hav.*); Deboneir (*Richter's Chir. Bibl.*); Radford (*Dublin Journ. of Med.* 1835). In other cases the strangulation caused by the cervix has ended fatally before there was time for sloughing. (*Velpeau.*) More marvellous still, cases have occurred in which the recently inverted uterus has been torn away by the attendant, the patient recovering.—(*Dr. J. C. Cooke.*)

J. L. Casper says (*Handbook of Forensic Medicine, New Sydenham Soc. Translation*, vol. iii.) laceration of the pelvic ligaments may attend spontaneous inversion of the uterus.

The diagnosis is especially important; it is not always easy; and the most deplorable consequences have followed from error. M. A. Petit had a patient in the hospital at Lyons. Six surgeons decided that it was polypus, and a ligature was applied. A shriek caused suspicion of inversion; the ligature was removed. The woman died at the end of five days. On examination inversion was found. Dr. Wm. Hunter tied the inverted uterus for a polypus in a young woman who said she had never been pregnant. She died; the uterus was found inverted.

Wrisberg (*Commentatio de uteri post partum naturalem resectione non lethali*, 1788) relates a case of a young woman delivered by a midwife. The placenta was dragged out with the uterus inverted. The midwife cut off the whole mass with a knife and buried it. It was disinterred, and its nature verified, and Wrisberg examining the patient felt the opening at the fundus of the vagina into the peritoneum. The woman recovered. Strange and shocking as it seems, similar histories, excepting the recovery, are not uncommon. Several are related in Crosse's Essay. Dubois (*Dictionnaire de Méd.* 1846) says he knew of two cases of inversion mistaken for polypus by two of the most skilful surgeons in Paris. In one case a ligature was put on; the patient died in thirty-six hours.

In the presence of the recent accident, the most frequent mistakes have been to suppose the mass is a second placenta, or the head of a second foetus. The forceps has been applied to the inverted uterus to drag it away.

The diagnosis is especially difficult when inversion is complicated with polypus. The polypus may be detected, but not the inversion; and a ligature applied to the polypus may include a portion of the uterus. Gooch relates (*Diseases of Women*) the following case: Dr. Denman passed a ligature round a polypus of the fundus; as soon as he tightened it he produced pain and vomiting. As soon as the ligature was slackened these symptoms ceased; but whenever he attempted to tighten it the pain and vomiting returned; the ligature was left on, but loose. The patient died about six weeks afterwards, and on opening the body it was discovered that the uterus was inverted, and that the ligature had included the inverted portion.

The diagnosis has to be made under the two different circumstances of recent occurrence and chronicity. In the first case, the history furnishes useful indications. The sudden sense of injury and shock following labour suggests immediate exploration. Negative and positive signs concur in pointing to a conclusion. In the first place the

uterus is not felt, as it ought to be, a firm round ball behind the pubes. On passing the hand firmly into the pelvic cavity from above downwards behind the symphysis, a vacuum is felt. Keeping the hand in this situation, the fingers of the other hand are passed into the vagina, and there a mass rounded, soft or firm, is felt. The relations and position of this mass are clearly defined between the two hands. If the placenta is attached, the uterus is obscured by it. But bared, the diagnosis will be cleared up, if the finger is carried all round the mass up to its insertion. On pressing the mass upwards, as in attempt to replace it, the fingers exploring through the abdominal wall will sink into a pit formed by the disappearance of the uterus through its os. Then the finger in the vagina exploring the root or insertion of the tumor, comes to a circular furrow at the fundus of the vagina, and a prominent ring, which is the os uteri. If the inversion be not complete, the finger, or more easily the uterine sound, will pass a little way between the ring formed by the os and the pedicle of the tumor. If the inversion is complete, only the furrow will be felt. If the inversion has been followed by prolapse of the mass beyond the vulva, the exploration is easier, as the tumor may then be felt continuous by its origin with the inverted vagina; it may also be seen. Its aspect is that of a florid tumor with a very vascular, velvety surface, easily bleeding on the slightest touch; or if the presenting part be that to which the placenta had grown, it is uneven, of a dark hue, with placental shreds or coagula attached to it. The tumor is painful to the touch. Any attempt to drag upon it causes a sensation described by the patient as if her inside were being dragged out. Pain is also felt down the legs; vomiting is likely to occur. In size, the tumor may equal a child's head, or it may be no larger than a fist. A crucial test is the alternation of the mass from contraction to relaxation. This vital act inducing characteristic changes of size and consistence pertains to the uterus alone.

The diagnosis from polypus is not always easy. A polypus may complicate pregnancy. Pregnancy usually causes an intra-uterine polypus to grow at an accelerated ratio. After the birth of the child, the polypus will be extruded, perhaps dragging the fundus uteri a little with it, thus simulating, if not producing, a minor degree of inversion. To distinguish this from inversion, it must be remembered that polypus thus appearing after labour, is actually even more rare than inversion. The probability therefore of inversion ought to operate with at least equal force upon the mind of the surgeon. The chief points of distinction are that a polypus is not sensitive; it does not change its form or size, it does not contract or relax; its expulsion does not produce such severe shock. In form and size polypus may resemble inversion, but it differs in relation to other parts. It is quite possible that the placenta may have been partially attached to the surface of the polypus; it will then exhibit placental shreds and clots like the uterus. The finger and sound must be relied upon to make the case manifest. The hand outside will discover the uterus *in situ* behind the pubes. The finger in the vagina will travel round the polypus, between it and the ring of the os uteri which embraces it. If the attachment of the

tumor is to the cervix, the pedicle will be felt on one side of the circumference, whilst in the other parts the finger or sound will pass beyond, several inches into the cavity of the uterus. If the attachment is at the fundus then the sound will pass all round.

The difficulty of distinguishing inversion in the chronic state from polypus is greater. Velpeau having, in error, tied an inverted uterus, said, "I know too well that there are cases in which doubt is the only rational opinion." Soon after the accident, the uterus diminishes greatly in bulk, becomes harder, perhaps less sensitive, and in these features more nearly resembles polypus. But setting the history—always a fallacious diagnostic element—apart, the means of discrimination are satisfactory. The speculum may reveal the oozing of the menstrual fluid. In other respects its use is doubtful. The sound (Simpson, *Edinb. Med. Journ.* 1843) is of more value. "If it passes two inches and a half or more beyond the edge of the cervix, the disease is not inversion of the fundus; if it cannot pass at any point around the stem of the tumor to a greater extent than about one inch, the uterine cavity may be considered as shortened by inversion." The inverted uterus is flattened anteriorly and posteriorly; its largest part is lowest; it diminishes very gradually, presenting a comparatively large neck at its highest part where it is encircled by the inverted neck, if the inversion is not complete, and by a thickened ridge if complete. The size of the inverted uterus is scarcely larger, and is often smaller than in the natural state. Herbiniaux placed so much stress upon this as to affirm, "that if the tumor be so large as to distend the vagina and prevent your getting at the os uteri, it may be boldly pronounced polypus; and not a partial inversion, which is always of small size, and fills the vagina." The form of the tumor has been thought to offer distinctive characters. S. Cooper (*Previous Editions of Surg. Dict.*) described the inverted uterus as forming a mass wider or as wide above as its origin is at its most dependent part, whereas in polypus the neck is narrower. This is often true, but not constantly so; and it would not be safe to rely upon a variable sign. J. G. Forbes describes a case (*Med. Chir. Trans.* 1852) of incomplete inversion of eighteen months' standing, in which the tumor close to the os was four inches and a quarter in circumference; this was the widest part. This seems to be more especially the character of incomplete inversion. In many cases of complete inversion the upper part is narrowed so as not to be distinguished in this respect from many polypi. This was the condition in one case observed by myself.

A sign insisted upon by Crosse is the feeling the stretched round ligaments within the tumor (inverted uterus), and pain being produced in the groins on lowering the tumor a little so as to render the tension greater. Maligne (*Thèse des Polypes utérins*) advises the following method:—Introduce a male catheter into the bladder, direct its end downwards and backwards, so that, carrying the coats of the bladder before it, it may enter the peritoneal cul-de-sac formed by the inversion, and be felt by the finger in the vagina through the coats of the inverted organ. Another method is this:—The catheter in the bladder, direct the end backwards, so as to bring it to project in

the rectum, where a finger will feel it with only the coats of the rectum and bladder intervening; but if the firm resisting uterus be there, the end of the catheter will not be felt. Digital examination by the rectum will also enable the surgeon to explore the tumor in the vagina more fully. Often the end of the finger will get above the tumor, thus completely exploring it. If the uterus be in its place, it may thus be felt between the finger in the rectum and the fingers of the other hand passed down behind the pubes. If the uterus be inverted, then the vacuity above the tumor felt in the vagina will indicate that this tumor is the uterus. This mode of exploration should never be omitted. It would be impossible to conclude either that the case is not one of inversion, or that a sure diagnosis cannot be made until this method has been carefully employed. Dubois takes occasion to say that the mistakes he refers to in which death occurred from ligaturing an inverted uterus, would not have been made if exploration by catheter in bladder and finger in rectum had been resorted to. The diagnosis from prolapse of the uterus and vagina ought not to be doubtful. The presence of the os uteri at the lowest point of the tumor, admitting the sound for a distance of two and a half inches or more, at once decides the existence of prolapsus.

The difficulty of diagnosis has been felt even in the presence of the parts put up in spirit. Thus Crosse, by further dissection, proved that a specimen which for years had passed for one of inversion in the Glasgow Museum, was in reality one of polypus growing from, and perfectly occluding, the os uteri. He pleads with pardonable urgency that the mode of putting up these specimens is bad; and that the tumor ought to be slit open by a longitudinal cut so as to expose the cavity and its contents.

There is one final safeguard against ligaturing an inverted uterus in mistake for a polypus, upon which I would most strenuously insist, having myself been saved by it from a probably fatal error. Do not give chloroform when applying the ligature, wire, or écraseur to remove a polypus. The pain experienced on tightening a ligature round the uterus is an almost certain diagnostic sign, warning the operator to relax the ligature.

The prognosis must always be serious. Weber truly calls inversion "*malum ingens, periculique plenum*." Crosse, who has shown the greatest industry in the collation of cases, says that above one-third of all the cases, under whatever circumstances, or in whatever degree they occur, prove fatal either very soon or within one month. He analysed 109 fatal cases. 72 proved fatal within a few hours, most of them within half an hour. 8 cases proved fatal in from one to seven days, and 6 in from one to four weeks. If the patient survive a month, the case is chronic, and the immediate danger is small. But the danger recommences at eight or nine months, when the menstrual function is resumed. Many of these will die within two years. If the inversion takes place suddenly and completely, the uterus remaining flaccid, the danger is extreme; if it takes place slowly—that is, under spontaneous uterine action—the danger is less.

As to the prospect of reduction, a much more favourable expectation than was lately held is justified by the improved methods of treatment.



Denman thought that, if two hours had elapsed, reduction could hardly be effected. Crosse, even, a surgeon neither desponding nor unskilful, says: "You can only expect success by attempting the reduction within the first few hours;" and this refers only to partial inversion. In total inversion he was strongly impressed with the opinion that replacement could only succeed by attempts made almost immediately. When reduction is effected, the prospect of recovery rises greatly. But still many die of the shock or hæmorrhage.

If not reduced, the patient has to run the hazards of gangrene (this is rare); of hæmorrhage, and mucous and purulent discharges; of irritative fever. Cases are recorded of spontaneous reduction taking place months and even years after the accident. That the minor degrees, *depression* and *introversion*, may be spontaneously cured, it is not difficult to understand. Crosse says, "There is not a shadow of evidence of *total inversion*, in the strict sense, replacing itself spontaneously." A few cases, as those related by Boyer (*Maladies chirurgicales*) and Baudelocque (Daillez, *Thèse*), are examples of reduction following external force in the form of a blow or succussion. Dr. Meigs, nevertheless, relates several cases. Of such cases Dr. West remarks that "it is easier to conceive that an experienced man should commit an error of diagnosis than to understand how any efforts of nature could cure a chronic inversion of the womb." The error may be one of the two following. Either the tumor was a polypus, which has disappeared by being spontaneously cast off; or it was a true inverted uterus, which has been separated by sloughing, and cast off in like manner.

In some instances the subject of inversion has evinced more or less perfect toleration of her infirmity. This was the result in a case reported by Guyon (*Journ. de Chir. et de Méd. prat.* 1861), in which inversion had existed twenty years without alteration of health; in one by Dr. Comstock (*Boston Med. and Surg. Journ.* vol. viii.), the patient followed her occupation as a dairymaid; in one by Dewees (*Midwifery*), she was enjoying good health ten years after the accident; in one by Ramsbotham, the patient regained flesh, her health became good; in one by Lisfranc (*Clin. Chir.* 1843), he examined the body of an old woman at the Salpêtrière, the uterus was completely inverted, it had not been suspected during life; in one by Dr. C. H. Lee (*American Journ. of Med. Sc.* 1860), inversion remained undetected for twenty-five years, ablation was given up, the patient was so well; in other cases referred to by Gregory Forbes; and in one reported by Dr. Woodman (*Obstet. Trans.* vol. ix.), brought to the London Hospital whilst I was obstetric physician there.

When reduction has been effected, the uterus may recover its function, and pregnancy ensue. Many such examples are known. There is also a probability, not, indeed, high, but suggesting caution, that inversion will again take place during labour. For a long time after replacement, the cavity of the uterus probably remains shorter than normal. The thickened walls take time to resume their natural condition. I state this from the observation of a case reduced by myself. This depends, no doubt, in some instances upon the re-

duction being imperfect, the fundus remaining in the state of depression, or squatting.

What has been said will indicate some of the principles of *treatment*. Attempt to reduce should be made as early as possible; but success should never be despaired of. In the recent accident, we may or may not have the attached placenta complicating the case. Should we first detach the placenta? If we do, we lose a little time. If we do not, there is the greater bulk to pass back through the os uteri. I believe it is the better practice to get rid of this complication first. To effect it, look for the margin of the placenta, insinuate one or two fingers between it and the globe of the uterus; supporting this organ by the other hand, continue to peel off the placenta by sweeping the fingers along. When it is wholly detached, proceed to reduction. The mode of manipulation must vary according to circumstances. If the uterus is large, flabby, and the cervix dilated, it may be quickly replaced by depressing the fundus with the fingers gathered into a cone, and carrying the hand onwards through the os. Lazzati recommends to apply the closed fist to the fundus. This is better than the fingers, which, as he truly says, might perforate the uterine wall. In executing this, two things must on no account be omitted: one is to support the uterus by the other hand, pressing firmly down upon it from above the symphysis pubis externally, lest we lacerate the vagina; the other is to observe the course of the pelvic axes, and the form of the pelvic brim. Pressure will first be made a little backwards towards the hollow of the sacrum; then the direction must be forwards to the brim, and at the same time to one side, so as to avoid the sacral promontory. As in attempts to reduce a retroverted gravid uterus, failure has often ensued from not understanding this latter point. It was first, I believe, pointed out by Dr. Skinner of Liverpool.

I can testify to the value of the rule from personal experience. By attention to it mainly, I was enabled to reduce an uterus in fifteen minutes which had been inverted for ten days, defying repeated efforts of other practitioners. The patient made a good recovery.

When reduction has been completed, the hand, following the receding fundus, will occupy the cavity of the uterus, and the organ will be grasped between the hand inside and the hand supporting outside. The opportunity should be taken to induce contraction by pressure externally, and by excitation internally. But I would not withdraw the hand from the cavity, lest re-inversion take place, until I had taken the following further security. Pass up along the palm of the hand an uterine tube, connected with a Higginson's injecting-syringe; throw up by means of this six or eight ounces of the weaker solution of perchloride of iron (*Brit. Phar.* 1867), so as to bathe the whole inner surface of the uterus. The effects of this are, to instantly constrict the mouths of the vessels, to stop bleeding, to excite uterine contraction, and to corrugate the tissues. When this state is induced there is safety. Or the styptic may be applied by swabbing, by means of a pledget of cotton or lint carried on a probang. I have followed this practice in numerous cases of post-partum hæmorrhage. It has never failed to arrest hæmorrhage; and if the vital powers were not

hopelessly depressed, it has caused contraction as well.

If uterine action be present, especially if the cervix and os are constricting the inverted part, the difficulty is greater, and it is no longer judicious to commence by pushing in the fundus. As Dr. McClintock (*Diseases of Women*, 1863) has well shown, to do this is to double the inflexion of the uterine walls, and thus to double the thickness of the mass that has to pass through the os. He advocates the method practised by Montgomery, which consists in regarding the inversion as a hernia, and in replacing that part first which came down last. The tumor must be grasped in its circumference near the constricting os, firmly compressing it towards the centre, and at the same time pushing it upwards, forwards, and to one side. The pressure must be steadily kept up, as it is sustained pressure that wears out the resistance of the os. After a time the os is felt to relax; the part nearest is pushed through; and then, generally suddenly, the body and fundus spring through. Two things facilitate this operation: chloroform and a semi-prone position of the patient.

If the opportunity of reducing within a few hours or days be lost, the difficulty increases through advancing involution of the uterus and contraction of the os. Still the same manipulation may be attempted. We must act steadfastly on the faith that pressure sufficiently long kept up upon the os uteri will cause it to yield. It is really a question of time—too long a time, indeed, for the hand of the surgeon to work—but not for other mechanical appliances. Dr. Tyler Smith is entitled to the credit of proving this point by success. (*Med. Chir. Trans.* 1858.) In a case of inversion of twelve years' standing, he effected reduction by maintaining pressure upon the tumor, and then upon the os, by an air-pessary during several days. Pridgen Teale (*Med. Times & G.* 1859) reduced an inversion of six months by the air-pessary in three days. Dr. C. West (*Med. Times & G.* 1859) by similar means reduced an inversion of a year's standing. Dr. Bockenthal (*Monatsschr. f. Geburtsh.* 1860) succeeded in six days in reducing an inversion which had lasted six years. Mr. James Hakes (*Liverpool Med. and Surg. Reports*, 1868) by same means reduced a chronic inversion in fourteen days. Dr. Schröder, of Bonn (*Berliner klin. Wochenschr.* 1868), thus reduced an inversion of two years. And latterly (1869), Mr. Lawson Tait, on my suggestion, effected reduction in the same manner. The last woman died, but her case was already desperate. Borggreve, indeed, had applied the same principle. He used a stem eight inches long, with an egg-shaped knob, which he fitted to the inverted fundus, and held it in gentle pressure by a T-bandage. In three days the uterus was returned. Dr. Marion Sims relates an interesting instance of the influences of constant pressure. A stem-pessary, with an external support, after pressing for some days upon the inverted fundus, was found to be taken up into the inside of the re-inverted uterus, the os having yielded and allowed both to pass in together.

Courty (*Maladies de l'Utérus*, 1866) relates a case in which inversion had existed ten months, inducing repeated hæmorrhage and extreme debility. He reduced it in the following manner:—The uterus was dragged outside the vulva by Museux's vul-

sellum; then the index and middle fingers of the right hand were passed into the rectum, and hooked forward over the neck of the uterus; then the uterus was seized with the left hand and passed back into the vagina, still holding the neck hooked down; the fundus of the uterus was turned so as to look forwards to the pubis, the neck turned to the sacrum. The fingers in the rectum, separating, rest firmly in the angular sinuses formed by the utero-sacral ligaments; then the thumb and index of the left hand, pressing on the pedicle of the tumor, gradually increase the depth of the utero-cervical groove. The two hands acting thus in concert, the uterus was reduced without violence in a few minutes. He had failed with the air-pessary; the patient could not bear it. He cites Barrier (*Bull. de l'Acad.* 1862) as having reduced a case of fifteen months' standing, who found a *point d'appui* by pushing the neck of the uterus against the sacrum.

Dr. Emmet (*Amer. Journ. of Med. Sc.* 1866) succeeded in the following manner:—He passed his hand within the vagina, and whilst the fundus uteri rested in the palm, the five fingers were made to encircle the portion within the cervix, as near as possible to the seat of inversion. Whilst the portion was thus firmly grasped, it was pushed upwards, and the fingers were immediately afterwards expanded to their utmost. This manipulation, with the aid of the other hand over the abdomen, was persevered in until the fundus had passed within the os uteri. The advance gained was in proportion to the amount of dilatation accomplished by the spreading of the fingers, thus increasing the transverse diameter of the uterus, and shortening its long diameter. When the reduction had so far advanced that the fingers could not be passed fully up to the seat of inversion, steady pressure was applied to the fundus by the tips joined together, whilst an increased effort was made by the hand outside to roll out the parts by sliding the abdominal parietes over the edge of the funnel.

The evidence then of experience, as well as of physiological reasoning, is now so strong that we can rarely be justified in resorting to the ultimate remedy, one full of danger, of amputating the inverted uterus. One caution must however be present to the mind when attempting reduction. The resistance may be due to adhesions. To force these would be to endanger the patient by lacerations or peritonitis.

From time to time a method which may be described as the Forcible Taxis has been employed. Of late years a proposition has been made, supported by several distinguished American physicians, to admit this method to a recognised place in the treatment of chronic inversion. The fact that death after rupture of the uterus or vagina has several times been the consequence of forcible taxis should alone be sufficient to discredit the method. No number of successes ought to outweigh failure so deplorable. Forcible re-position has been attempted either by the hand alone or by aid of a *repoussoir*—that is, some kind of blunt instrument of wood or ivory. Depaul (*Gaz. des Hôp.* 1851) used a *repoussoir* in a case eleven days after labour. The patient died in a few days from rupture of the uterus. Laceration also occurred in several cases in America.

Another proceeding stands before amputation.



For twenty years I have taught in my lectures that the unyielding cervix may be divided by incisions carried into its substance from above downwards at different points of its circumference. Pressure then applied will cause it to yield more easily. Huguier, Professor Simpson, and Dr. Marion Sims have suggested the same plan.

I am not aware that it had ever been carried into execution before 1868, when I treated a case in this manner with complete success. The inversion was complete; it had lasted six months; the patient was so prostrate from continuous discharges that the prospect of her holding out many weeks was small. I first tried to re-invert by keeping up continuous elastic pressure during five days, with occasional attempts by taxis, as recommended by Tyler Smith. This failing, I drew down the tumor to the vulva by passing a sling noose of tape round it, thus putting the neck on the stretch; I then made three incisions in the neck about a third of an inch deep, one on each side, and one behind in a longitudinal direction—that is, across the fibres of the cervical sphincter. Then, compressing the uterus with my left hand, and supporting the os uteri by the fingers of the right hand through the abdominal wall, I found the cervix yield and the body went through into its place. The cervix yielded by laceration extending from the incisions; and I very much feared at the time that serious, if not fatal, mischief had been done. No material inconvenience, however, followed; and examination three weeks afterwards showed the cervix and uterus to be in their proper places. The woman has since become pregnant. Notwithstanding this successful issue, I believe that the method should only be resorted to after a full trial of Tyler Smith's plan, and then with great caution. I should recommend that only two incisions be made, one on each side of the os, and these of moderate depth. The re-inversion should be trusted to sustained elastic pressure.

It has happened in several cases that only partial reduction could be effected; that is, the body would return through the cervix in a doubled form, the fundus still being depressed, and presenting just above the cervix. In such cases, continuous steady support by a cup-shaped pessary, as the end of a stethoscope, may in time complete the reduction.

When well adapted and steadily pursued attempts to reduce have failed, and the patient's life is threatened, then only shall we be justified in resorting to the "*anceps remedium*" of amputating the offending organ. The annals of medicine, it is true, contain many examples of successful amputation; but such a result can in no case be predicated with confidence.

The conditions of safety depending upon Nature may be absent; and the surgical means at present known are imperfect. When the uterus is cut across at the neck, of course a hole is made opening from the fundus of the vagina into the peritoneal cavity. The danger of fatal peritonitis is great. The shock of the operation also is serious. Hæmorrhage is likely to ensue; and some blood will escape into the abdomen. There are various methods of performing the operation. The uterus has been seized by a vulsellum, drawn down, and the cervix cut through with a knife. In one case, Velpeau, before excising, passed two strong threads

through the neck of the tumor for the purpose of restraining any hæmorrhage that might occur, but they were not tied. The patient died on the second day of peritonitis. Then it was thought that the ligature applied to strangle, and to slough through, as in the case of a polypus, would be less dangerous. Treated in this way, the result has been varied. In several instances, where a whipcord ligature has been applied by Levret's or Gooch's double canula, agony so intense has been produced as to render it necessary to remove the ligature, and the patient has died notwithstanding. The cause of the excruciating pain is, I believe, the compression of the included Fallopian tubes. I have observed the same pain in cases where the tube has been tied in the pedicle of an ovarian tumor. And it has been observed in several cases that the surface and substance of the uterus proper was nearly insensible; pain being developed only on tightening the ligature. In some cases, the patient has died with the ligature attached. There is a preparation illustrating this in the Museum of Bartholomew's Hospital; death ensuing from peritonitis eight days after tying. On the other hand, it seems not unreasonable to hope that a ligature gradually tightened may set up adhesive inflammation in the neighbouring peritoneum, and thus shut off the abdomen from communication with the vagina when the uterus falls away. Certain it is that this hope is not always realised. Thus Dr. McClintock (*Opus cit.*) relates a case in which a ligature was applied during eighteen days, occasionally relaxing it on account of the severity of the pain, before the uterus was separated. No peritoneal adhesion had taken place. The woman, however, made a good recovery. In eighteen cases where the time that elapsed before the uterus fell is stated, the ligature took from nine to twenty-eight days to sever the parts. The average time was seventeen days. It has been remarked that the ligature has arrested the hæmorrhage. Dr. Ramsbotham has a case in which the ligature had to be removed at the end of twenty-four hours, owing to symptoms of violent peritonitis; but the profuse sanguineous and mucous discharges ceased.

Mr. J. G. Forbes (*Op. cit.*) suggests that the simple application of a ligature around the neck of the tumor to destroy its vitality appears to possess more advantages than the other modes of operating.

Dr. McClintock relates two cases in which strangulation was first effected by a ligature for some days, and then the uterus was removed below the ligature by the chain-écraseur. The patient recovered. This combined method seems likely to unite most conditions of success.

Dr. Marion Sims relates (*Op. cit.*) a case in which, after vain attempts at reduction, and being compelled by the consequent pain and prostration to abandon the ligature, he resorted to the chain-écraseur. When the parts were all divided, except the right broad ligament, "all at once the most fearful hæmorrhage he ever encountered took place." It was happily stopped by passing the finger into the abdominal opening and compressing the source of the hæmorrhage. The blood which had escaped into the peritoneal cavity was sponged out by probang; and the divided edges of the cervix were united by five or six silver sutures. The patient recovered.

Dr. Noeggerath recommends, in attempting

reduction by taxis, to push in one horn of the uterus. Dr. T. Gaillard Thomas reduced one case in a very remarkable manner. The uterus was lifted up so that the operator could feel the cervical ring against the abdominal wall. He then cut down in the median line as for an exploratory incision in ovariectomy; then he inserted his finger into the uterine sac, and found there was no adhesion. He then inserted a steel dilator made on the principle of a glove-stretcher into the cervix, and expanded the blades. "The dilatation was easy and rapid;" but contraction returned as soon as the dilator was withdrawn. The uterus was drawn down, and one horn pushed in, then the other, and the organ was reduced. The abdominal wound was closed by sutures. The patient quite recovered.

In cases where neither reduction nor ablation can be attempted, hæmorrhage and other discharges may be restrained by lotions of tannin, alum, perchloride or persulphate of iron, or of carbolic acid; and probably some advantage may be derived, by compressing the uterus, by wearing an air-pessary in the vagina.

Six different modes of dealing with chronic inversion have been tried with the following results in the cases I have been able to examine:—

1. By ligature alone: Of these twenty-six were successful, ten unsuccessful. Of the unsuccessful eight died, and two recovered without extirpation.

2. By ligature and excision: nine were successful, three unsuccessful. These three all died.

3. By excision simple: Three were successful, two died.

4. By sustained solid pressure there have been several successful cases.

5. By sustained elastic pressure, in eight cases the uterus was restored, in seven of them recovery was perfect, one died, being already beyond hope. In three or four cases reported the pressure was given up.

6. By forcible taxis: Six successful cases are reported, four failed, all of them dying.

In appreciating the relative merits of these different operations, it must be remembered that the highest success attained by ligature or excision is achieved at the cost of mutilation; the woman is unsexed; and failure commonly means death.

The history of forcible taxis is disastrous. It is true, that success restores the woman to her former integrity, but the penalty of failure to return the uterus is not unfrequently death. The parts will not sustain more than a certain amount of violence without laceration; much force is necessary; and it is impossible to restrict with nicety the force employed within safe limits. Sustained solid or elastic pressure is free from the objections that surround the preceding methods. Success means restoration to integrity; and failure does not mean death or injury; it simply leaves the patient in *status quo*, and in a condition to be treated with every prospect of success by the adjuvant method of cervical incisions.]

Robert Barnes, M.D.

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#### UTERUS, POLYPI OF. (See POLYPUS.)

UTERUS, PROLAPSUS OF (*Hypertrophy and Atrophy of*). The womb, situated in the upper and middle part of the pelvis, is but imperfectly secured in its natural place by means of its broad and round ligaments; hence it sometimes descends into the lesser cavity of the pelvis, so as to pass more or less down the vagina, or even protrude beyond the labia. The first case is the *incomplete*; the second, the *complete*, prolapsus uteri.

In the first form of the disease, where the uterus has not passed down so low as to protrude externally, some of the complaints which the patient experiences depend upon pressure of the displaced viscus upon parts unaccustomed to it, particularly the bladder and rectum; while other inconveniences arise from the tension of the ligaments destined to retain the organ in its natural position. These last grievances are chiefly a sense of heaviness in the pelvis, and a dragging pain in the loins; symptoms which are aggravated when the patient sits up or walks about, but diminish when she remains in bed, though, as the disease, when neglected, scarcely ever fails to grow worse, they rarely subside altogether. However, such amendment actually sometimes happens, in consequence of the parts becoming gradually habituated to their change of situation. When the disease comes on with great suddenness, the symptoms are remarked to be much more severe than when it takes place slowly; in the first case, long-continued syncope, pain over the whole abdomen, tenesmus, uterine hæmorrhage, inflammation of the peritoneum, and severe febrile symptoms, may be excited.

With regard to the effects caused by the pressure of the tumor on the bladder and rectum, they consist of more or less difficulty in voiding the



urine and fæces. The dysury and constipation increase in proportion as the patient continues in an upright posture, and the uterus descends nearer to the inferior orifice of the vagina. The irritation brings on a considerable mucous discharge, which, when the patient suffers little other inconvenience from the prolapsus, is apt to be mistaken for fluor albus or gonorrhœa.

A woman may become pregnant, notwithstanding an incomplete prolapsus of the womb. The displacement may even take place at a more or less advanced period of gestation (*Portal, des Accouchemens*); while, in other still more uncommon instances, the prolapsus has been remarked to disappear when the period of labour drew near. Cases exemplifying both these facts are related by Loder (*Journ. für die Chir. b. ii. p. 13*), by Saviard, Portal (*Mém. de l'Acad. de Chir. t. iii.*), in the *Journ. de Médecine*, t. xlv., and by Chopart (*Traité des Maladies des Voies urinaires*). A prolapsus uteri may also happen during parturition. (*Garin, Journ. de Méd. continué, t. iv. p. 265*; *Ducroix, Mém. de l'Acad. de Chir. t. viii. p. 393.*)

When in the course of time the prolapsus uteri changes from the incomplete to the complete state, all the inconveniences depending upon the pressure of the part upon the rectum and bladder subside; that is to say, the fæces and urine are now freely voided. But, on the other hand, the symptoms, arising from the stretching of the peritoneum, become considerably worse. The uterus drags down with it the vagina, which becomes doubled on itself; and a part of the bladder connected with the upper part of the latter tube is also drawn down. Some of the abdominal viscera may even fall into the cul-de-sac formed by the vagina, and considerably increase the size of the tumor. The swelling, protruding between the thighs, is of an oblong, nearly cylindrical form, and terminates below in a narrow extremity, in which a transverse opening, the os tincae, may be discerned, from which the menses are discharged at the periods prescribed by nature. However, the cylindrical shape of the tumor may lead to mistakes; for the vagina, being doubled on itself, and exposed to the effects of the air, sometimes looks like skin. Hence women thus afflicted have occasionally been supposed to be hermaphrodites, the tumor being mistaken for a penis. Such a case is recorded by Saviard.

The patient is generally troubled with tenesmus, and sometimes feels acute pain in the tumor itself, which is subject to inflame and ulcerate in consequence of its depending posture, the friction to which it is exposed, and the irritation of the urine.

The direction both of the bladder and urethra becomes horizontal, so that the urine is thrown forwards, or even upwards; in which latter case it wets the abdomen. Frequently the bladder cannot be emptied without the assistance of the catheter; and sometimes the displaced uterus becomes affected with inflammation and swelling. In many cases there are profuse hæmorrhages. However, some women become so habituated to the disease, that they hardly seem to experience any annoyance from it; whenever they are in an erect posture, and walk about, the womb falls down, bringing with it the vagina; and as soon as they lie down on their backs, the parts as readily return into their natural position again.

The displacement of the fundus of the bladder is the inevitable consequence of the connection of the bladder to the vagina and uterus. The quick or gradual way, however, in which the prolapsus has occurred, will make great difference in the degree of such displacement. A slowly formed prolapsus allows the cellular tissue connecting the vagina and bladder to yield, while a sudden prolapsus leaves no time for it. In one case, where the whole of the fundus of the bladder had been dragged down, M. Cruveilhier found in the displaced portion a large calculus; and in another instance, recorded by M. J. Cloquet, there were two calculi. Calculi, when met with, are usually in the displaced portion of the bladder; but M. Cruveilhier lately met with a case, in which the whole cavity of the undisplaced part of it was filled by a calculus, and the other part of it was free from them.

According to the researches of Cruveilhier, the deviation of the meatus urinarius from its proper course, in cases of prolapsus uteri, is less the effect of the displacement of the bladder than of the anterior paries of the vagina. This change may occasion retention of urine; and the very considerable size of the bladder, which Cruveilhier has constantly noticed in these cases, he regards as a proof of the difficulty experienced in passing the urine. The alteration in the course of the urethra sometimes makes the introduction of a catheter very difficult; and when this instrument or a probe is introduced into that canal, it is found to pass downwards into the substance of the tumor to a greater or less extent, according to the degree of prolapsus. This is accurately represented in the 10th plate of the work of Madame Boivin and Professor Dugès.

One of the most remarkable circumstances attending a prolapsus uteri, is the elongation which this organ undergoes. Cruveilhier has invariably observed it, and it is correctly represented in a plate published by M. J. Cloquet. (See *Cruveilhier, Anat. pathol. t. i. livr. 16, pp. 1-5*; and *J. Cloquet, Pathol. chir. pl. 8, fig. 3, 4 to Paris, 1831.*) This elongation chiefly occurs in the point of junction between the body and the neck of the womb, and is accompanied by a striking contraction or increased narrowness of the part.

Cruveilhier, in the second volume of his great work on pathological anatomy (livr. xxvi.), gives another plate, and additional observations, explanatory of the changes in the relation of parts occasioned by the inversion of the vagina or prolapsus of the uterus. It appears from his researches that sometimes the elongation, and sometimes the depression, of the uterus exists in the greater degree. He has met with cases in which the lengthening of the uterus was so considerable, that when the part was viewed within the pelvis, it seemed as if it occupied its right situation. The co-existence of an inversion or doubling of the vagina, without any displacement of the womb, which has only undergone an elongation, seems to him to prove that, in certain cases at least, the displacement of the uterus has its beginning in the foregoing change of the vagina. This latter becomes inverted on itself, just like the finger of a glove, by a mechanism precisely like that which takes place in intestinal invaginations. "If (observes Professor Cruveilhier) we look upon the cavity of the uterus as a continuation of the parietes of the vagina,

there will be, in the commencement of the prolapsus uteri, three duplicatures: 1. A central portion invaginated, which is the uterus; 2. Two folds, or reflections of the vagina. In a later stage, when the invagination is complete, there are only two duplicatures, as in a prolapsus of the rectum; viz. the central part of which is the uterus that has passed into the inverted vagina. However, in the most complete prolapsus, some vestige of the second duplicature, formed by the vagina, is constantly met with in the furrow of greater or lesser depth, situated behind the swelling; for though the inversion of the anterior paries of the vagina may be complete, that of the posterior paries is scarcely ever so. Hence, the tumor, caused by prolapsus uteri, is always longer in the vertical direction in front than it is behind."

Another point explained by Cruveilhier is, that in consequence of the relations of the peritoneum with the posterior surface of the uterus and the back part of the vagina, the peritoneum descends much lower in this situation than between the uterus and vagina in front. Hence, the anterior *cul-de-sac* of the peritoneum is generally too inconsiderable to admit the small intestines into it, while the posterior one may receive an enormous mass of them. It is under such circumstances that the prolapsus may form a swelling as large as a man's head.

One thing well deserving of attention is the greater or less deformity of the os tincæ; one of its lips, usually the posterior one, according to Cruveilhier, being very prominent, while the anterior one is effaced. In one case observed by this distinguished pathologist, the orifice, instead of the greater diameter of it being transverse, extended from before backwards. In some instances, the os tincæ was reduced to a very diminutive aperture, scarcely large enough for the discharge of the menstrual fluid. (See Cruveilhier, *Anat. Pathol.* t. ii. livr. 26.)

The continual irritation of the inverted vagina occasions, 1. A transformation (incomplete) of the mucous into a cutaneous texture. 2. Sloughs more or less deep in the lowest portion of the tumor, consisting of the neck of the uterus. If such sloughing were to implicate all the thickness of the parietes of the vagina and the peritoneal covering of them, air might insinuate itself into the cavity of the peritoneum and the uterus, and even the bowels protrude, if the latter were contained in the tumor; peritonitis might also ensue. Sometimes the os tincæ is obliterated from the effects of the irritation. Cruveilhier expresses his surprise that cancer of the cervix is not more frequent than it is, as a consequence of prolapsus; he has seen but one instance of it from this cause. (See Cruveilhier *Anat. Pathol.* livr. xvi. t. i. pl. 5.)

The rectum, which is less adherent to the vagina, and more fixed in its natural situation than the lower part of the bladder, is seldom displaced; and, when it is so, it is only for a small extent; in fact, it could not be displaced in the same degree as the bladder, unless the inversion of the posterior paries of the vagina were as considerable as that of the anterior. In one case referred to by M. Cruveilhier, where there was an incontinence of feces, the rectum, which was dilated and full of fecal matter, had been drawn forwards rather above its lower termination, and it formed a kind of funnel-shaped prolongation. In the example, of which

M. Cloquet has given a representation, the rectum was much dilated, and sent forwards a considerable digital prolongation, which extended into the posterior and inferior portion of the sac, formed by the inverted vagina. Here, then, as Cruveilhier observes, we see that there are incontinences of feces *par regorgement*, as well as of urine. The sphincter being kept for a long time distended, at length ceases to resist the discharge of portions of excrement separated from the mass of it.

M. Cruveilhier, in noticing the frequent entrance of the bowels into the pouch formed by the inverted vagina, informs us that he has not had an opportunity of seeing this in the dead subject, but he met with an instance of it in the living body.

Although Mauriceau, Saviard, Monro, and Cruveilhier record instances of prolapsus uteri in maidens, such cases are not common. At the Bloomsbury Dispensary, I have seen two examples in the course of seven or eight years. The disease is seldom met with except in women who have had children, and generally in those who have borne a great many. This particularity is ascribed by some writers to the elongation of the ligaments of the uterus in women, in whom this organ has been repeatedly gravid. The same consideration may also account for the frequency of prolapsus uteri during the first months subsequent to parturition, especially as the womb remains for some time after labour more enlarged and heavy than natural. The disease is more common in thin than fat women, and often takes place in females when they suddenly change from a fat to a very emaciated state. The displacement is facilitated by a capacious vagina, by a great width of the lesser cavity of the pelvis, and the effects of tedious and profuse attacks of fluor albus. Prolapsus uteri has also been brought on by violent concussions of the body; the protracted efforts of vomiting, coughing, or crying, hard labour, and lifting or carrying heavy burdens. In what has been stated, one may discern the reason why the affliction is so frequent amongst the lower classes of society, and why women, for a certain time after parturition, should avoid an erect posture and every kind of exertion.

The incomplete prolapsus alone is subject to obscurity, which, however, may be dispelled by manual examination. In this case, however, some precautions are necessary. For instance, as the womb generally returns into its natural situation when the patient lies down, the examination should always be made as she is standing up. For the same reason, if she is in the habit of lying long in bed, the morning is not the best period of the day for the examination. The practitioner may also be deceived if he examine the parts when the rectum and bladder are distended with their contents, in which state the uterus may be hindered from descending so far as at other periods.

If attention be paid to these circumstances, an incomplete prolapsus may always be distinguished without risk of error. However, the records of surgery prove that the case has sometimes been mistaken by the inexperienced or ignorant for a polypus, and the part extirpated under this supposition. So serious a blunder will be avoided, if care be taken to remember that polypi are generally softer and less sensible than the uterus; that in a case of prolapsus the os tincæ is situated at the lower part of the swelling; and that if by



chance any resembling aperture should be met with upon the corresponding portion of a polypus, the prolapsus may still be known by the greater depth to which a probe will enter such opening. The partial obliteration or deformed appearance of the os tincæ, in some cases, as explained by Cruveilhier, must be remembered. A polypus of the uterus is generally broadest at that extremity which is nearest the vulva; but the womb, in a state of incomplete prolapsus, forms a tumor, which is narrower below than above. With very few exceptions, the womb is likewise reducible, and the patient directly afterwards feels great relief; whereas a polypus cannot be pushed back, and the attempt, instead of giving relief, only increases the patient's sufferings.

In a complete prolapsus no doubt can ever prevail about the real nature of the case; for whatever uncertainty the feel of the parts may create, none can ever remain when the swelling is distinctly visible.

In the *treatment* of prolapsus uteri, there are two indications: the first is to reduce the part, and the second is to keep it from falling down again.

In the incomplete prolapsus, the first indication is very easy of accomplishment; and, indeed, when the patient is placed on her back, with her pelvis raised somewhat higher than her chest, the uterus often returns of itself into its natural situation again. At all events, the reduction may be immediately effected by pushing the uterus up into the pelvis with the fingers.

More difficulty generally attends the reduction of a complete prolapsus. Here the same posture is to be chosen as in the former case; but the legs and thighs should be bent. The rectum should also be first emptied with clysters. Sometimes, indeed, every attempt at reduction fails, notwithstanding the adoption of the most vigorous measures, the use of the warm bath, purgatives, venesection, low diet, fomentations, &c. Occasionally, the part is returned after a great deal of trouble; but, owing to the long altered state of parts, the reduction brings on worse symptoms than resulted from the continuance of the prolapsus. Such a case is recorded by Richter. (*Bibl. der Chir.* b. iii. p. 141.) The patient's sufferings were so much increased by the reduction, and so obstinate a constipation came on, that it became absolutely necessary to let the uterus descend again. In any irreducible case, all that can be done is to support the swelling, and prevent its increase with a suspensory bandage, and draw off the urine with a catheter whenever requisite. In these cases, the altered course of the meatus urinarius is to be remembered, and the catheter directed horizontally towards the rectum; or rather, as Ingleby and Cruveilhier state, the catheter should be directed downwards and backwards, with its concavity turned downwards. "It follows also from the kind of displacement which the bladder undergoes, that the catheter first enters the displaced portion of that organ, and is then conveyed by a lever-like movement into the portion of it that continues in its right place." (*Cruveilhier, Anat. Pathol. Ingleby, Edinb. Surg. Journ.* No. 122.) Sometimes the displacement of the bladder, resulting from prolapsus uteri, causes an incontinence of urine, as exemplified in several instances in the *Salpêtrière* alluded to by M. Cruveilhier. (*Livr.* 26.)

When the displaced uterus is inflamed and considerably swelled, the attempt at reduction should be preceded by antiphlogistic remedies; the patient should be kept in bed, be put on a low regimen, be bled, take purgative medicines, use the warm bath, and drink diluent beverages, while emollient applications are made to the part itself. This plan of treatment has often been attended with complete success, in cases of prolapsus uteri, of long standing and considerable size. Ruysch disapproved of making any attempt to reduce the uterus while it was inflamed and swelled. He also thought that the operation should be postponed when the uterus was in an ulcerated state. However, Sabatier rightly observes that, as this complication is only accidental and merely arises from the friction to which the tumor is exposed, and the irritation of the urine, the plan of immediately replacing the part cannot be attended with any danger. On the contrary, since the cause which produces and keeps up the ulceration will cease as soon as the reduction is accomplished, the sores will heal after the uterus is put into its natural situation again.

When a prolapsus uteri occurs in the early stage of pregnancy, this state should not let the practitioner neglect to reduce the part. Several instances are recorded in which the reduction was successfully accomplished in pregnant women; and one case of this kind is reported by Giraud. (*Journ. de Médecine*, t. xlv.) When pregnancy is far advanced, or the disease is of long standing, the reduction is difficult. Perhaps, says Sabatier, it may be more prudent, in these circumstances, to let the uterus continue protruded, than to disturb the mother and foetus with reiterated attempts to reduce the part. The uterus, however, should not be left to itself; but be well supported with a suitable bandage, and the patient kept in bed. When the prolapsus uteri occurs at the period of delivery, every attempt at reduction is both useless and dangerous. In this case, the delivery of the foetus should be expedited, by gradually dilating the os tincæ, which, at the same time, should be carefully supported. The extraction of the placenta also requires a great deal of caution, and it should be accomplished by introducing one hand into the uterus, with the palm turned away from the cavity of this viscus, towards the outside of the placenta, which is to be gradually separated from its edges towards its centre.

In cases of complete prolapsus uteri, Ruysch was an advocate for leaving the expulsion of the foetus, if alive, to be effected by nature: and the same writer advises us to be content with supporting the os tincæ. But, when the child is dead, he recommends extracting it with one hand, while the uterus is supported with the other. Sabatier, however, entertains different sentiments. The expulsion of the child, he says, is not less the effect of the contraction of the diaphragm and abdominal muscles than of the womb itself. Hence, when either of these agents fails to co-operate, the delivery becomes either very difficult or impossible. This is exactly what happens in the present case; for the uterus having fallen down, cannot be compressed by the diaphragm and abdominal muscles. Nor can Sabatier discern the reason why Ruysch should recommend the line of conduct to differ, according to the different state of the child. This is quite passive in parturition,

and contributes not in the least to its own expulsion.

The second indication, or that of keeping the uterus reduced, demands the employment of astringent injections and pessaries.

The uterus, in a state of prolapsus, is sometimes affected with scirrhus and cancer. A case of this description was met with by Ruysch; such a complication was seen in one instance by Cruveilhier. (*Anat. Pathol.* livr. xvi.) Its extirpation was completed by MM. Récamier and Marjolin, by means of a ligature, though the patient is stated to have died afterwards from some cause which had nothing to do with the operation. Instead of this method, which must inevitably be attended with great risk of tying a portion of the bladder, M. Cruveilhier recommends making an incision into the posterior paries of the vagina, and thus getting into the great peritoneal *cul-de-sac* between the bladder and rectum, drawing the uterus outward, and separating its cellular connexions to the bladder. A woman, whose uterus was cancerous, and in a state of complete prolapsus, without any inversion, was attended by Langenbeck, who succeeded in removing the diseased organ with a knife, and the patient recovered. According to this author's description, after the vagina had been separated from the uterus, the latter organ was detached from the peritoneum, without the latter membrane being opened, a small portion of the fundus uteri being left, however, apparently quite sound. The bleeding was very profuse, and required the use of the needle and ligatures. The ovaries, and divided ligamenta rotunda, were found connected with the removed portion of the uterus. (*Bibl. für die Chir.* b.i. p. 551. 12L., Hanover, 1818.)

Prolapsus uteri is so great an affliction, when it does not admit of relief by ordinary means, that any new suggestion, calculated to render the treatment effectual under such circumstances, ought to be rendered as public as possible. The horizontal position, astringent injections, and pessaries have long been in use, and, as every practitioner must have had opportunities of witnessing, they are frequently inefficient, or cannot be persevered in. Dr. Hamilton, of Edinburgh, advised another mechanical contrivance for preventing the prolapsus: it consists of either a strong T bandage, or, in more serious degrees of the disease, of a circular metallic belt, like that of a common truss, provided with a cross, or perpendicular strop, to which is attached a cushion stuffed with horse-hair, about six inches in length, by three in breadth; and of a thickness proportionate to the degree of relaxation, and, consequently, the degree of support required. By this simple means, in conjunction with cold bathing, and suitable constitutional treatment, Dr. Hamilton has found no occasion for pessaries. The cushion, I think, should be covered with oil silk, for the sake of cleanliness. Dr. Hamilton formerly suggested the propriety of endeavouring to relieve very bad and confirmed cases of prolapsus uteri, by exciting adhesive inflammation in the vagina, so as to bring about an agglutination of its surfaces. However, notwithstanding the more or less partial closure of the vagina, occasionally met with in the practice of surgery and midwifery, every pathologist is aware of the difficulty of making a mucous tissue undergo the adhesive inflammation; and this consider-

ation led Dr. Hamilton not to attempt it. A more valuable and practicable operation is that of treating such cases by approximating the pared surfaces of the labia, and uniting them by suture. Dr. Ireland tried this method in Dublin, and has published an account of the success which attended it. (See *Dubl. Journ. of Med. Science*, vol. vi. p. 484.) Cruveilhier prefers to this proposal the plan of bringing about a contraction of the upper part of the vagina, by touching it with the nitrate of silver, or an acid. An anonymous writer remarks, that a similar operation has been several times since performed by Velpeau, Boivin, Langier, and others. Some produce adhesions between the opposite surfaces by means of wounds made with the knife; others by means of sloughs and granulating surfaces, resulting from the application of escharotics. "Dr. Ireland seems to attribute the merit of devising this operation to Dr. Marshall Hall; but it is probable that Girardin, who proposed it in the year 1828, has the claim of priority. For an historical account of this operation, I must refer to the *Annali Universali di Medicina*, edited at Milan by Omodei, for December, 1835." (See *Dubl. Journ. of Med. Science*, vol. x. p. 126.) In 1831, the operation was performed by Dr. Fricke, of Hamburg, with a completely successful result; and he is a strong advocate for it.

The following quotation from Dr. Heming's translation of Madame Boivin's work, p. 53, affords some particulars of Dr. Marshall Hall's operation, which appears to have consisted in the excision of a strip of the mucous membrane of the vagina:—"Dr. Marshall Hall has lately cured a case of complete prolapsus uteri by artificial contraction of the vagina: a strip of the mucous membrane, an inch and a half wide, was removed along the whole of the canal, and the wound was sewed up. We hear nothing of hæmorrhage, and are assured that the patient suffered neither pain nor fever after the operation." In a note, the translator mentions that there was scarcely any hæmorrhage; and that in November, 1833, two years after the operation, the uterus and bladder were found by Mr. Vincent to be perfectly supported in their situation.

Professor Dieffenbach has long abandoned the employment of pessaries (see Cruveilhier, *Anat. Pathol.* t. i. liv. 16), and adopted the plan of curing bad cases of prolapsus uteri by removing an oval piece of the membrane of the vagina; a plan suggested to him by the observation of a case in which some parts of the vagina sloughed away, while the uterus was in the state of prolapsus. The uterus and the remains of the vagina were reduced during the granulating process, and the result was a complete cure of the disease. As this operation seems to me less safe and eligible than the foregoing one, I omit the details of it, which may be read in the 12th volume of the *Dubl. Journ. of Med. Science*, p. 488, or in *Medicinische Zeitung*, No. 3, 1836. Cruveilhier would prefer the excision of a few pieces of the mucous membrane, near the cervix uteri, to the method adopted by Dr. M. Hall, or Dieffenbach. Both these operations are analogous to Dupuytren's operation for the cure of inveterate cases of prolapsus ani, being founded on the benefit derivable from the contraction of the cicatrix. About two months ago, I practised Dupuytren's operation in University College Hospital, whereby a pro-



lapsus of the rectum, of more than four years' standing, and which had resisted all the ordinary means, was entirely cured.

Mr. Crosse refers to a case (*Revue Méd. Decembre, 1835*), where the uterus, shortly after impregnation, descended as low as the knees, and remained so until the full term of utero-gestation, when delivery was completed by embryo-ulcio with safety to the mother. "Might not the life of the child (he asks) also have been spared by free incision of the os uteri to effect delivery?" (See *Prov. Med. Surg. Trans.* vol. v. p. 92.)

Amongst the various practical deductions from the new relations of the parts in cases of prolapsus uteri, is the possibility of extracting calculi from the bladder, through an incision made in the anterior side of the tumour, with the aid of a director passed into the meatus urinarius, in the manner executed by Ruysch.

[Thus far Samuel Cooper. The article is so excellent that I have feared to mar it by interpolations. I simply add such information as subsequent progress demands. It is convenient, at the same time, to introduce a brief description of *Hypertrophy* and *Atrophy* of the Uterus.

I have seen prolapsus uteri in virgins caused—  
1. By attacks of epilepsy. 2. By violent coughing. 3. By the dragging of a polypus. 4. By succession, as from a fall upon the nates, and from railway collisions. In the first, second, and fourth cases the prolapsus may be called acute. It is produced by sudden violence, tending to drive the uterus and other pelvic contents out through the vulva. It is liable to be attended by acute inflammation, and is commonly marked by excessive local pain. 5. By the pressure of an ovarian tumor upon the uterus.

During the exercise of the child-bearing function prolapsus is more common. To the accidental causes which produce it in virgins are now added causes springing from several relations attended or not by pregnancy. The dominant feature of these causes is increase of bulk, arising from physiological or morbid congestion, from inflammation, from imperfect involution after labour: this is primarily or secondarily attended by relaxation of the structures which support the uterus, including the ligaments, and above all the vagina. The vagina alone, if in a state of healthy contractility, will maintain the uterus *in situ*; but when its contractility is impaired by over-distension, and by inflammation, the uterus squats down, or sinks in it, producing a minor degree of vaginal depression or inversion. The close attachment of the anterior wall of the cervix uteri to the base of the bladder, making the point of union the most fixed point or centre of movement of the uterus, makes it impossible for the cervix to fall without dragging the base of the bladder down with it. And it is remarkable that it is the anterior wall of the vagina, that which is connected with the base of the bladder, which first tends to descend. This is clearly seen when a patient having a disposition to prolapsus strains in an expulsive effort: the anterior vaginal wall first bulges out of the vulva under the symphysis, and is followed by the anterior edge of the os uteri, then by the posterior edge. Three indications in therapeutics flow from this fact: first, contracting the posterior wall of the vagina by perinæorhaphy is not calcu-

lated to cure prolapsus; secondly, mechanical contrivances for supporting the uterus must be adapted to elevate the cervico-vesical junction; or thirdly, to keep the body of the uterus from falling backwards.

Prolapsus during the reproductive period, then, is commonly dependent upon inflammation or its consequences. This condition is constantly liable to aggravation by continuance and recurrence of the causes, as sexual relations, labours, and abortions.

The connection between prolapsus and hypertrophic elongation of the cervical portion of the uterus, demonstrated by Cruveilhier (see above) with characteristic sagacity and accuracy, has been since (1859) described with great minuteness by Huguier. He distinguishes four varieties. The *first* affects the body of the uterus only, and may cause prolapsus; the *second* invades the os tincæ only or the sub-vaginal portion; the *third* invades nearly the whole of the neck, but especially the supra-vaginal portion. When the first and third co-exist, they make the *fourth* variety. To this I may add that hypertrophy of the body is very apt to cause retroversion, or retroflexion, or anteversion.

The mode in which hypertrophic elongation of the cervix uteri occurs is, I believe, as follows:—The first factor is endo-cervicitis, most commonly caused by labour. This leads to active hyperæmia and interstitial fibrin effusions. Then a process of gradual continuous eversion and growth of the cervix takes place thus:—The external tissues of the cervical portion are fixed to the bladder and the fundus vaginæ, and being comparatively free from liability to congestion and inflammation, maintain their original condition as to length and *relative* position. The mucous membrane, on the other hand, which lines the cavity of the cervix, is extremely vascular, is the primary seat of injury during labour, and of congestion and inflammation; it becomes swollen with gorged vessels, and serum and fibrin poured out into its sub-mucous layers; hence there is increased villous growth, which can only find room by bulging out through the os tincæ. This process continually going on, the external part of the cervix remaining short, the internal thickening, bulging out, and everting, more and more fibrinous matter is deposited in the submucous tissues, which, becoming consolidated by absorption of its fluid part, elongation and hypertrophic thickening of the cervix result. A fact which marks the extreme activity of the growth of mucous elements is the very frequent association of villous polypi at the os uteri with this disease. There appears to be a natural limit to this process of elongation. I have observed that the total length of the organ, in chronic cases, from fundus to projecting os externum, is almost invariably exactly double the natural length, i.e. it is five inches. The excess of length is all due to growth of the cervical portion; the body of the uterus remains normal in size, and frequently maintains very nearly its normal position, taking no part in the process.

Hypertrophy of the body of the uterus, leading by increased weight to prolapsus, is not uncommonly the result of imperfect involution after labour. It may arise from getting up too soon after labour; also by repeated abortions, the uterus not getting rest enough to recover its natural

condition; by metritis after labour, disturbing the normal process of nutrition and absorption, and by the omission to suckle. This last is I believe, a frequent cause. Lactation acts as a stimulus to uterine contraction, and the establishment of activity of function in the breast is essential to the proper rest of the ovaries and uterus. Another cause is retroflexion. In this state perfect involution cannot take place. This condition is best treated by maintaining the uterus in its normal position; by local application of iodine, sulphate of zinc, or nitrate of silver; by galvanic pessaries; by internal administration of ergot (Kiwisch), iodine, and cinchona.

Three conditions may exist in apparent procidentia uteri: 1. Hypertrophic elongation of the cervical portion of the uterus. This, of course, is attended by eversion of the vagina, the fundal portion of which is drawn down by the advancing os uteri. This is diagnosed by the introduction of the uterine sound. This will generally penetrate five inches before its point is arrested at the fundus uteri; and continuing to carry the sound gently on, a partial re-inversion or reduction is observed. 2. The case may be one of inversion of the vagina, the pouch formed by which, projecting somewhat in the form of a sausage, contains the uterus at the bottom, perhaps, of normal size, or, as in aged women, atrophied. 3. There is equally inversion of the vagina, the pouch outside the vulva containing the uterus retroflexed or doubled up. In the two latter cases the diagnosis can be established by the fingers, which, compressing the tumor, can determine the exact size, position, and form of the uterus; and further by the introduction of the sound.

S. Cooper has cited cases of complete procidentia of the gravid uterus. I have seen a case of the kind in the practice of the Royal Maternity Charity. In this condition it is obvious that, to expel the child, the uterus can derive no help from the diaphragm or abdominal muscles. If the whole mass can be easily returned within the pelvis, this will be the better course; if not, it will be wise to dilate the cervix uteri artificially by means of my water-dilators, and to deliver by forceps or turning, taking care that the uterus be well supported by the hands of an assistant during the delivery. When this is effected, the uterus must be returned, and a firm perineal bandage be applied to prevent it from falling through again. Occasionally, procidentia of the gravid uterus is simulated by pregnancy with hypertrophic elongation of the cervix. When labour comes on, the child passes along the lengthened canal of the cervix, and is arrested at the os externum uteri, which is outside the vulva. The os externum, being thus enormously distended, has been taken for the uterus itself, the body of which is really in its normal position.

In aged women, when the functions of ovulation and pregnancy are at an end, the uterus undergoes *atrophy*, losing bulk, increasing in hardness. At the same time, the cellular tissue of the pelvis loses much of its fat, the vessels, having less call upon them for supplies, bring less blood. The vagina too partakes in the atrophic process. The general result is, a small uterus imbedded in shrunken tissues. The padding is gone; the uterus falls. Especially is this the case if the woman leads a laborious life. Under great exertion in

the standing or kneeling postures, the ill-supported uterus easily falls through the pelvis. Hence the prolapsus and procidentia of senility being mainly the consequence of atrophy, nothing short of mechanical support by suitable pessaries is likely to be of much service.

The uterus occasionally undergoes a kind of rapid atrophy after child-birth. (Simpson, Chiari.) Of this I have seen several marked examples. Premature climacteric sets in. In some cases, atrophy is only apparent; the real condition being defective development. This is often associated with, perhaps consequent upon, atrophy of the ovaries.

The changes induced in the organs concerned in prolapsus are well described by Scanzoni:—The vagina, uterus and broad ligaments, bladder and rectum, being removed from the pelvis, we are struck with the size of the uterus, and with the expansion, relaxation, and want of elasticity of the vagina. The vagina has lost its rugæ; its surface is usually smooth, often livid, and if the prolapsus has lasted long in an extreme degree, it is very dry, covered with a thick layer of pavement epithelium, which gives to the mucous membrane the aspect of epidermis. The vaginal portion, commonly hypertrophied, often indurated, but sometimes very swollen and softened, is of bluish-red or slate-grey colour; around the orifice it is deprived of epithelium, and covered with erosions and ulcerations. Often, after a long persistence of the disease, a true inversion of the cervix is produced; the orifice begins by being sensibly dilated; its borders form a circle an inch or more in diameter, through which the cervix is inverted, so that the mucous membrane peculiar to the neck, covered by its vitreous secretion, is seen. A section of the uterus displays considerable hypertrophy with engorgement. The cavity is always much dilated, especially lengthwise; and the mucous membrane shows chronic catarrh.

The *treatment* will of course be governed by the particular characters of the case in question. Wherever hypertrophy, engorgement, inflammation co-exist, these conditions must be dealt with. In many cases the prolapsus disappears when the cervix uteri is restored to health. When this is insufficient, mechanical support will often be useful. It is even important to bear in mind that keeping the uterus at its proper level is a very effectual factor in curing inflammation and hypertrophy of the cervix. This is due, I believe, to the relief which the vessels supplying the organ obtain when maintained in their natural relations. When the cervix is sunk low in the pelvis, the vessels are dragged down, become elongated, varicose; they form large loops, with a depending curve liable to angulation by compression; the circulation through them is necessarily sluggish, and seeks relief by serous effusions into the tissues, thus increasing hypertrophy and impeding curative processes. A considerable degree of œdema is a frequent complication of the advanced degrees of prolapsus with inversion of the vagina. To such an extent is this the case, that occasionally the bulk of the protruding mass becomes so great that there is great difficulty in returning it into the pelvis. To facilitate this step it is necessary first to get rid of the œdema. This is done by applying straps of plaster around the mass so as to compress and support the tissues. After two or three days, th



patient keeping her bed, the mass will commonly be so far reduced as to enable it to return. If swelling be attended by inflammation of the surface of the mass, it will be proper first to subdue this by cooling astringent lotions; lead or tannin answers well. A properly applied pessary acts partly by re-inverting the vagina and cervix, by restoring the vessels to their natural relations, and thus by opposing two of the most prominent factors in the formation of prolapsus. Before applying pessaries, it is of primary importance to ascertain the absence of adhesions binding down the uterus. This is done by careful manipulation and by the use of the sound. On carrying the uterus gently upwards, obstruction, if existing, will be felt. Further information as to treatment by pessaries may be gathered on referring to the article "Pessary." Prolapsus may be likened to hernia, and the pessary is a kind of truss.

Chiari, Braun, and Spaeth (*Klinik der Geburtskunde*, 1855) rightly insist upon the importance of keeping the bladder empty. This tends to prevent the formation of the diverticulum or sacculum of the bladder. This sacculum was described by Golding Bird, who pointed out how it led to formation of phosphates and ammoniacal urine. Mr. G. Roper related to me a case of prolapsus uteri et vesicæ, in which the bladder contained several calculi which could be rattled about by the hand.

A similar case of complete procidentia with eversion of the vagina, and calculi in the pouch of the bladder, was under my care at the London Hospital.

The idea of supporting the uterus by contracting the vagina has been followed out in late years in various ways. The method of paring the surfaces of the labia and uniting them by sutures, referred to above by S. Cooper as having been practised by Dr. Ireland, has been extensively followed out by Mr. Baker Brown and others. I have fairly tried it myself. It cannot be called a radical cure, nor is the relief often permanent, unless the vulva is almost completely occluded. It has been seen that the small vulva and perfect hymen of the virgin do not prevent prolapsus, and the narrowing of the vulva simply forms a shelf to receive the falling uterus, which may gradually dilate the vulva and make its way out again. An operation that seems based on a more rational view of the pathology of prolapsus is that proposed by Dr. Marion Sims, and extolled by himself and Dr. Emmet of New York as most effectual. It consists in removing a portion of mucous membrane from the anterior wall of the vagina in the form of a V, the open part of the V embracing the cervix uteri, and uniting the sides by sutures. The result of this proceeding is to strengthen the vagina itself, which is one of the main supports of the uterus, and especially in that part, the anterior wall, which is always observed to come down first. (*Sims' Clinical Notes on Uterine Surgery*, 1866.) The plan advocated by Huguier of amputating the hypertrophic elongated cervix is useful in certain cases. The amputation may be effected by the knife, the écraseur, or the galvanic cautery. The latter modes are not free from objection. The chain or wire encircling the uterine neck is liable during tightening to drag in a fold of vagina and to open the peritoneum in Douglas' sac. No such accident need attend the use of the knife. Dr. Gustav

Simon (*Monats. für Geburtsh.*, 1859) transfixes the cervix with a strong needle, and applies the chain écraseur below this needle. The dragging in of peritoneal pouch or bladder is thus prevented. The best mode is, perhaps, to dissect up the vagina from off the cervix a little way, then to split the cervix by dividing it at the os on either side; then to cut off the anterior and posterior lips successively with the knife or scissors. If the mucous membrane be then drawn over the stump, and closed by sutures, as recommended by Sims, the wound will commonly close by first intention. I am disposed to think that the principle of this operation does not differ very materially from Dr. Sims' operation above described, of contracting the anterior vaginal wall. It seems difficult to amputate the vaginal portions of the cervix without removing a portion of the vaginal mucous membrane in front; and, when healing, a process of cicatricial contraction anteriorly necessarily results. I have seen this follow in cases of cervical amputation. The judicious course to adopt would seem to be this:—When there is prolapsus without marked elongation of the cervix, remove a portion of the mucous membrane of the anterior vaginal wall on Sims' plan; if there is considerable elongation, amputate a portion of the redundant neck; at the same time, remove a triangular piece of the mucous membrane just in front of the cervix, the base of the triangle merging in the stump of the cervix; and bring the sides of the triangle together by sutures. Care must be taken to secure the opening of the cervical canal during healing. It is very apt to close during cicatrization; and the troubles of retained menstrual secretion would follow. It must, however, be observed that, where protrusion of the uterus and vagina through the vulva has existed for some time, the vulva and perineum, from constant stretching, have lost natural resiliency. The mucous membrane of the posterior wall of the vagina will be in a similar state. Hence it may be useful to remove a strip of membrane posteriorly as in the operation for perineorraphy, so as to strengthen the floor of the pelvis.

The diagnosis is discussed under "Polypus" and "Inversion." The distinctive feature of prolapsus is the os uteri at the lowest part, which admits the sound.]

Robert Barnes.

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UTERUS, RETROVERSION AND RETROFLEXION OF, is said to happen, when its fundus falls downwards and backwards, between the rectum and the posterior part of the vagina, while its cervix inclines upwards towards the symphysis pubis. The ancients are suspected to have had some imperfect notions of this case, and, in proof of this opinion, certain passages are referred to in *Cælius* (Tetrab. iv. Serm. 4. C. 77), *Mercurialis*, *Mercatus*, and others (See *Dict. des Sciences Méd.* t. xxiii. p. 273). Be this as it may, it is generally confessed, that the subject had fallen into oblivion, when Dr. William Hunter called the attention of his pupils to the subject, in 1754, and afterwards drew up an interesting paper concerning it (*Med. Obs. and Inquiries*, vol. iv. 8vo. Lond. 1771). Subsequently, the knowledge of the subject was extended by the observations of *Wlzezeck* (*De Utero Retroflexo*, Prag. 1777), the remarks of *Richter* (*Chir. Bibl.* b. v. p. 521, and b. ix. p. 182), those of *Wall* (*Diss. de Uteri Retroversione*, Hal. 1782), and by the memoir of *Desgranges*, to which the prize of the Royal Academy of Surgery at Paris was adjudged in the year 1785. According to *Sabatier*, retroversion of the womb was mentioned by *Grégoire* in his private lectures on midwifery, at Paris.

*Walter Wall*, an English surgeon, who had attended *Grégoire*, suspected that he had met with a retroversio uteri in a woman some months advanced in pregnancy, and he called in Dr. Hunter, in order that he might have the benefit of his advice. However, she was attacked with an obstinate constipation, and retention of urine, and died in about a week. A large tumor was found occupying the whole of the pelvis, and pushing the vagina against the os pubis. It had been found impracticable to push the swelling back into the abdomen, although the patient had been put on her knees and elbows, while one hand had been introduced into the vagina, and two fingers of the other hand into the rectum. Great curiosity existed about what information would be afforded by dissection. On opening the body, the bladder, which was exceedingly full of urine, filled almost the whole anterior part of the abdomen, in the same manner as the uterus does in the last month of pregnancy. When it had been emptied, that part of it in which the ureters terminate, and which is connected with the vagina and cervix uteri, was found raised up, as high as the upper aperture of the pelvis, by a large tumor, which filled the whole cavity of the pelvis, and was found to be the uterus. A catheter, when passed into the vagina, could be made to lift up the latter viscus and the upper part of the tumor. This portion of the swelling, on which the bladder lay, consisted of the cervix uteri, while the fundus of

this organ was situated downwards towards the os coccygis and anus. The uterus was so large, that it could not be taken out of the pelvis, until the symphysis pubis had been divided, and the two ossa innominata pulled asunder. The same thing was exemplified in another instance (See *Perfect's Cases*, vol. i. p. 349). It was found impossible to assign any cause for the displacement of the uterus, as the patient had been making no exertion, and had met with no fall, though she is said to have been frightened at something just before the complaint commenced (See *Med. Surg. and Obs.* vol. i.).

Dr. Hunter, struck with the singular nature of the case, thought it deserving of the attention of medical men, and he made it the subject of a lecture, which he delivered in 1754. He was afterwards consulted by several persons, who were afflicted with retroversio uteri; but not in so acute a way as in the above instance. All the patients were in the third month of pregnancy, and first suffered a difficulty of making water, succeeded by retention of urine, and afterwards by tenesmus and constipation. Dr. Hunter always emptied the bladder and rectum by means of a catheter and clysters, which measures sometimes effected a cure, the uterus spontaneously resuming its natural position. In every instance, the accident disappeared when pregnancy was more advanced, and the uterus had acquired larger dimensions. In some cases, in which Dr. Hunter was consulted too late, the trials to empty the bladder and replace the uterus proved fruitless, and the women died. Dr. Hunter was so firmly convinced of the impossibility of saving patients, circumstanced in the above manner, unless extraordinary means were resorted to, that he thought that an endeavour should be made to diminish the size of the uterus, by introducing a trocar into the body of this viscus, through the posterior parietes of the vagina, so as to let out the water of the amnios, the relative quantity of which is known to be greater in the early than in the advanced stage of pregnancy (See *Jouvel*, in *Bulletin de la Faculté de Méd.* p. 173. an. 1832).

Such a puncture might certainly be the means of bringing the uterus back into its natural position; but not without considerable danger of abortion being produced. No risk of this kind would be encountered by puncturing the bladder above the pubes. In this manner, a free passage would be afforded for the escape of the urine, and the reduction of the uterus might then be effected. The suggestion of puncturing the uterus, I believe, has only been put in practice in one example in this country; and, I believe with Mr. Weir, that it is not likely to be often adopted, because a safer mode of discharging the fluid must generally be that of opening the membranes through the os tincæ, if such evacuation were deemed prudent (*Glasgow Med. Journ.* vol. i. p. 268). At all events, we must let the expedient of puncturing the uterus only be deemed applicable, as Mr. Baynham observes, "to cases in which the replacement shall be found impracticable, after the bladder has been emptied" (*Edinb. Med. Journ.* No. 103. p. 261).

Mr. Ingleby, in his valuable paper on Malposition of the uterus, lays it down as a maxim, that if, in retroversion, the continued pressure should occasion inflammation of the bladder, or render



the introduction of the catheter impracticable; or should a formidable obstruction arise to the passage of the feces, the evacuation of the liquor amnii through the os uteri; or, if this is not advisable, the puncture of the inferior part of the body of the uterus through the vagina (not the rectum), and the immediate restoration of the uterus, will be essential to the preservation of life. "This operation has once been adopted in England, in the dispensary practice of my colleague, Mr. Baynham, and I had the gratification of being associated with him in consultation upon it. The situation of his patient, who was six months advanced in pregnancy, was in every respect desperate; and since it was impossible to pass any instrument through the os uteri, as a last resource, the uterus was punctured *per rectum*, the liquor amnii drawn off, and rectification then speedily effected. Recovery most fortunately took place; and a more creditable and instructive case is not on record (See *Edin. Med. Journ.* for April, 1830). Boyer cites an instance very similar, both in its nature and result (*Mal. Chir.* t. x. p. 531), (See *Ingleby*, in *Edin. Med. Journ.* for January, 1835, No. 122).

Mr. Lynn, a surgeon in Suffolk, knew an instance of the bladder bursting, and the urine becoming fatally extravasated in the abdomen, in a case of retroversion of the uterus, in consequence of the patient's refusal to submit to paracentesis of the bladder.

Retroversio uteri does not often happen, except in the third or fourth month of pregnancy. If the uterus be pushed back by a distended bladder, and pressed against the sacrum, while the soft parts yield, it becomes, as it were, wedged, and is incapable of changing its position. In this immovable state, it presses upon the surrounding parts, and these upon it, so that a very serious train of bad symptoms is the consequence.

It must not be supposed, however, that retroversion of the womb occurs only in pregnant women. Schweighäuser and Schmidt had even seen it more frequently in unimpregnated females.

Although, in the case related by Mr. Baynham, the puncture of the uterus was performed from the rectum, he states, that he does not consider this an eligible situation. "It was selected, because the uterine tumor may be said to have pointed most distinctly to the rectum. Perforation of the uterus, through the vagina, is preferable, since, without an equivalent advantage, even this small wound of the intestine ought to be avoided. Moreover, there will be less probability of injuring the placenta, which is usually attached to the fundus; and trifling as the chance is of preserving the fœtus, it is entitled to consideration.

"The uterus, which in the case detailed by Mr. B., had become displaced about the end of the fourth month of pregnancy, continued in a state of retroversion at least six weeks, during which time the development of the ovum advanced, until it occupied the whole cavity of the pelvis, the child being fixed beneath the pubes and the angle of the sacrum. This unnatural position of the uterus does not materially, if in any degree, impede the growth of the child, so long as the capacity of the pelvis exceeds the bulk of the uterus; and, before these proportions are likely to be reversed, a remedy must be applied, or the patient will be lost from mischief done to the bladder. The dis-

tension of the bladder (two gallons of urine having by the use of the catheter been obtained in six hours) may seem incredible. A still larger quantity was drawn off by Dr. Hunter, who, after retention had existed five days, procured at one time seven quarts, and nearly half that quantity in the afternoon of the same day. The further use of the instrument was impracticable; and, after death, the bladder was found amazingly distended, being as large as the womb in the ninth month of gestation, and filling the whole cavity of the abdomen" (See *M. Baynham, Edinb. Med. Journ.* for April, 1830, p. 261. *Richter's Chir. Bibl.* b. v. p. 132; b. ix. p. 310). As Mr. Weir has remarked, pregnancy is not always necessary for the production of this affection, although he conceives that the womb must be in a certain degree enlarged, either by pregnancy or disease, before it can become retroverted. "Desault," he observes, "relates an instance produced by a polypus, and I have seen a case, where there was chronic enlargement of the uterus, but no impregnation. Sir Charles Bell mentions a fatal case of obstruction of urine, as having occurred in the practice of Mr. Cheyne, where, on examination of the body after death, the womb was found enlarged by disease, which had produced the same effect as if enlarged from pregnancy; for its fundus had fallen into the hollow of the sacrum, and had formed adhesions to the rectum, while the os uteri, pressing upon the urethra, caused the obstruction. Mr. Pearson (*Obs. on Cancerous Complaints*, p. 113) mentions a case of retroversion, where the womb was enlarged from cancer. The patient, with the view of curing the cancerous affection, adhered most rigidly to a diet composed of liquids only; and, in the course of four weeks, the severe pains were completely removed, the uterus reduced in size, and restored to its natural position. Dr. Burns mentions, that retroversion may take place, "whenever the womb is enlarged to a certain degree by disease." Dr. Ashwell refers to a case, which occurred in a woman, 30 years of age, the mother of several children, who had been pushed down by two drunken men, one of whom fell across her (*Guy's Hospital Reports*, vol. i. p. 134).

"Retroversion may also occur a short time after delivery, when the uterus is of that size which predisposes it for being thrown out of its true situation." Mr. Weir adverts to a case, reported to him, in which a retroversion happened two days after delivery. The same occurrence is noticed by Callisen, and most of the cases recorded by Dr. Merriman are of this description (See *Glasgow Med. Journ.* vol. i. p. 262). It is questionable whether the uterus in a perfectly healthy state can ever become retroverted. Dr. Denman was of opinion, that the case is possible; but this is contrary to what is usually believed, and requires the confirmation of facts. One of Mr. Weir's cases happened in a female 48 years of age, just after the catamenia had permanently ceased; and Dr. Merriman has known of similar examples. At this crisis, the circumstance of the uterus being apt to enlarge and grow heavy may explain the reason of its displacement (See *Glasgow Med. Journ.* vol. i. p. 265).

The first aim of a practitioner, consulted in a case of retroversio uteri, should be to empty the bladder and large intestines, and to relax the parts

by every possible means. Then he should immediately proceed to reduce the uterus, by placing the patient in a suitable posture, and making methodical pressure in the rectum and vagina. Should he be so fortunate as to succeed, the patient is to be confined in bed, her bowels are to be kept open, and she is to be advised always to obey the calls of nature the first moment she is conscious of them. She is also to be enjoined to avoid all kinds of exertion, and wait till the gradual enlargement of the uterus removes the possibility of its descending into the pelvis (*Sabatier, Med. Opér. t. ii.*).

The most important part of the treatment consists in the frequent employment of the catheter. "When the retroversion is complete, and the patient has nearly reached the fourth month, the mere evacuation of the bladder, at distant intervals, may fail to answer our expectations. The introduction of the catheter every fourth hour is preferable to the plan of retaining the instrument within the bladder. We guard against an accumulation of urine, and thus secure the great object in view. The amount of urine which will collect in the bladder within this period will be insufficient to maintain the cervix uteri in its unnatural situation" (*J. T. Ingleby, in Edinb. Med. Journ. No. 122. p. 139.*).

Some practitioners rather discourage the manual interference to reduce the uterus, believing that drawing off the urine will generally render such interference unnecessary (*Croft, in Lond. Med. Journ. vol. ix. p. 53. Denman's Midwifery, 4to. Lond. 1801. Burns's Midwifery, S. Merriman, on Retroversion of the Womb, 8vo. Lond. 1810.*).

This difference of practice arose from the different views taken of the cause of the displacement. Dr. Hunter believed that the retroversion was the cause of the retention of urine, and of all the other symptoms. On the contrary, Dr. Denman argued that the retention of urine was the first symptom, and that the consequent enlargement of the bladder raised the neck and mouth of the womb, and caused the fundus to fall backwards; in which position, its pressure on the urethra and rectum kept up the retention of urine, tenesmus, difficulty of emptying the bowels, &c.

In one case under Mr. Weir, although the urine was repeatedly drawn off by means of a catheter, with some difficulty, the uterus could not be reduced until an assistant pushed its fundus upwards with his hands passed into the rectum, while Mr. Weir himself cautiously drew down the mouth of the womb. Abortion followed, but the patient recovered.

I have adverted to the case where Dr. Hunter could not succeed in the reduction; and where, after death, the uterus was so fixed in the hollow of the sacrum, that it could not be replaced until the symphysis of the pubes had been divided. But, as Mr. Weir remarks, the reduction may in general be easily accomplished when attempted early; and, although it has been asserted that forcible attempts will be very apt to produce abortion, or even worse consequences, he is not aware of any case on record where bad effects were fairly attributable to the manual efforts. Abortion has no doubt occurred; but this, he argues, was the consequence of the disease, or deemed absolutely necessary to effect the reduction. He admits that violent and unnecessary attempts are not justifi-

able; but he contends that, if the retroversion be complete, and dangerous symptoms be present, the uterus must be replaced at every risk. Our efforts, he thinks, should be in proportion to the difficulty to be overcome. He is aware that cases have occurred in which the uterus could not be moved. Besides the cases quoted above from Dr. Hunter and Perfect (*Perfect's Cases in Midwifery, vol. i. p. 394*), there is a singular case related by Mr. White, of Paisley (*Med. Communications, vol. xx.*), in which many attempts to replace the womb were made in vain. Here, however, the uterus was enlarged from disease as well as one of the ovaries. The patient recovered after much danger, and the bursting of an abscess of the ovary into the rectum. "The advocates for non-interference have asserted (says Mr. Weir) that the catheter can in general be easily introduced; and that the distension of the bladder, which is the cause of the retroversion, being thus removed, all chance of danger is obviated; and one author mentions that no case will ever occur where the urine cannot be drawn off. Now, the cases already referred to clearly show that, in general, there will be more or less difficulty in introducing the catheter; and there are some on record where it was found impossible." In Dr. Cheston's (*Med. Commun. vol. 2. p. 96*), Mr. Lynn's (*Med. Obs. and Inq. vol. iv.*), Dr. Squire's (*Med. Review, 1801*), M. Bandelocque's (*L'Art des Accouchemens, sect. 253*), Doeverius's Case (*Merriman, on Retroversion, p. 12*), Mr. Combe's (*Med. Comment. vol. v.*), and Perfect (*Cases, vol. i. p. 394*), the urine could not be drawn off. In the first the bladder was punctured above the pubes, and in four the bladder burst.

I will conclude this article with the following instructive observations made by Mr. Baynham. "There are (says he) but few derangements of the human body yielding so large a proportion of fatal cases as retroversion of the womb; an event almost uniformly produced by injury of the urinary bladder, which, upon dissection, exhibits the marks of inflammation, effusion of lymph, ulceration, mortification, and rupture; and yet by some the complaint has been ranked under the most innoxious class of female disorders. It has been stated as a guide to practice, that the uterus will sustain no injury by this displacement; that there is no danger of its being locked in the pelvis; that it will frequently be restored by its own efforts to its natural position; and that neither difficulty nor danger will occur if the catheter be used once or twice daily." (*Dr. James Bell, Med. Pract., &c. vol. viii.; Denman's Introduction; Merriman's Treatise on Retroversion; Burns's Midwifery, &c.*) "I have witnessed" (continues Mr. Baynham, "the death of two patients from this cause, and the dangerous situation in which others have been placed. It is very true that an early and frequent use of the catheter affords relief, and sometimes proves a source of recovery; but, though some writers upon this subject place much dependence upon the curative efficacy of simply keeping the bladder empty, it will in general be found expedient, immediately after the employment of the catheter, to effect the reduction of the tumor by manual assistance, since it is only when partial displacement has happened that spontaneous restoration is likely to occur. The location of the tumor fairly beneath the brim of the pelvis, resting, as it must do, in



complete retroversion, within the hollow of the sacrum, seems to obviate the possibility of natural recovery" (*M. Baynham, Op. cit.* p. 262).

In all cases, after the bladder has been relieved, attention should be immediately directed to the state of the rectum; for the degree of pressure made upon it has been known in some cases to resist the passage even of an injection (See *Ingleby, in Edinb. Med. Journ.* No. 122, p. 139).

[The history of retroversion of the gravid womb is well given by Cooper. But of late years our knowledge of this displacement in the pregnant and non-pregnant conditions, and of the diseases with which it may be confounded, has become much more extensive and precise. Schmidt's observations, quoted by Cooper, as to the frequency of retroversion and retroflexion in non-pregnant women have been confirmed; and proofs have accumulated showing that these positions of the non-pregnant uterus commonly account for the like displacements in the pregnant. Schmidt contended for this. Tyler Smith (*Manual of Obstetrics*, 1856, and *Obstetrical Transactions*, 1861) relates cases in proof. Scanzoni adopts this view, and there can now scarcely remain a doubt that the opinion of Denman ascribing retroversion to the distension of the bladder is erroneous, an instance of placing τὸ ὕστερον πρότερον.

For this reason it is desirable in the first place to describe the backward displacements of the non-gravid uterus. Pure *retroversion*, whether in the gravid or non-gravid, is perhaps rare; there is almost invariably some degree of flexion at the seat of the os internum uteri, the os externum pointing downwards. Retroflexion is sometimes congenital; certainly I have frequently observed it in virgins of all ages. During infancy nothing arises to call attention to it; but after menstruation is established, distress begins. Dysmenorrhœa, sense of forcing or bearing down, lumbo-sacral pains, interruption of the functions of the lower bowel, as constipation, and hence retrograde disturbance of the whole alimentary canal, sooner or later follow. Hæmorrhoids frequently attend, and are apt to attract exclusive attention. Later on, the difficulty of defecation leads to a degree of paralysis of the muscular coat of the intestines, so that it is only by copious and frequent enemata or powerful purgatives that relief is obtained. The retention of excrementitious matter in the alimentary canal leads to gradual slow empoisonment of the blood by absorption, and a condition that may be called chronic copræmia is established. Healthy nutrition of the nervous centres is at an end. The general health suffers; depression of mind, and other nervous symptoms set in; and the patient becomes a confirmed invalid, the true cause not being suspected. Once existing, the displacement almost certainly undergoes aggravation. Under the menstrual issues there is periodical congestion of the organ; the flexion at the neck impedes the natural subsidence of this congestion; and the intestines loaded with fæces or distended with air pressing upon the fundus, press the enlarged body further back; and thus some enlargement of the body becomes permanent, adding to the local distress. If piles be present and lead to examination of the rectum by the finger, the enlarged retroflexed body of the uterus may be felt as a rounded firm mass bulging out

the recto-vaginal septum, and lying low down in the hollow of the sacrum. The real nature of this tumor will be determined by examining by vagina. The finger detects the os uteri directed downwards, perhaps a little forwards, towards the middle of the pelvis; behind it, the rounded tumour already felt by the rectum is now felt by vagina; if the abdominal walls are flaccid enough, or if the examination is made under chloroform, the other hand, applied above the pubes to meet the examining finger, will determine the absence of the body of the uterus from its normal position; and lastly the uterus sound, properly curved, and the point directed backwards, after fairly entering the cervical canal, by penetrating to the fundus uteri, and restoring it to its place by bringing the point forwards, proves to demonstration that the case is retroflexion of the uterus. This restoration of the uterus must be conducted carefully, tentatively, because adhesion from previous peritonitis may exist, fixing the uterus. E. Rigby and others have pointed out that part of the pain attending retroflexion is due to the ovaries being compressed behind and below the fundus. In the majority of cases, however, the ovaries supported on either side in the broad ligaments are kept clear from this compression; and the ovarian pain is due to the permanent congestion they suffer from the obstruction to the fulfilment of their function depending upon the abnormal condition of the uterus.

This form of retroflexion, which may be called *primitive*, in contrast with the secondary or acquired form, although frequently entailing sterility, does not do so in all cases. Now it is very easy to understand, that when a retroflexed uterus becomes gravid, the body of the organ, which is the exclusive habitat of the ovum, will continue to grow in the situation in which impregnation found it. The fundus is in the pelvis; it lies back in the hollow of the sacrum; as it enlarges, it will, about the end of the third month, or a little later, fill the hollow of the sacrum and become engaged under the promontory. If the promontory overhang the brim more than usual, the fundus may be detained under it; and continuing to grow, the organ gradually rotates more upon its transverse axis, so that the cervix and os rise and approach the symphysis pubis, the broad ligaments being the hypomochlion upon which the rolling backwards takes place. In such cases, and in all cases in which retroflexion existed before pregnancy, the os points downwards, although it changes its position by being lifted up behind the symphysis as the pregnancy advances. When this stage is reached, the cervix rising, drags the base of the bladder upwards, and compresses the neck of the bladder against the pubic bones; and retention of urine arises. Dr. G. S. Bedford relates a case in which a degree of paraplegia was produced by pressure upon the sacral plexus; and œdema of the lower extremities is not uncommon. The pressure upon the womb sometimes distends and forces open the anus.

Retroflexion or retroversion of the gravid womb may occur in several ways. There is *first* the condition just referred to of primitive retroflexion persisting during pregnancy. Secondly, it may be a continuation of retroflexion existing before pregnancy, or the result of a previous labour. Thirdly, the retroflexion may have been caused

by a tumor in the posterior wall, or by adhesions dragging the fundus backwards. Fourthly, as I have several times observed, retroversion of the gravid womb succeeds to prolapsus of the non-gravid womb. In the last case, the heavy fundus is gradually forced back by the intestines. In all these four cases, the gestation during the early months may be called *pelvic gestation*. The uterus grows within the cavity of the true pelvis, and becomes locked there when it ought to find room by emerging into the abdominal cavity. It must not however be concluded that retroversion of the gravid womb is always of gradual formation. It may arise—fifthly—suddenly. If, for example, a woman between the third and fourth months of gestation, subject herself to great and sudden exertion, as by lifting heavy weights, whilst the bladder is perhaps somewhat distended, and thus directing the fundus uteri backwards, the superincumbent pressure of the intestines will bear upon the anterior surface of the fundus, and the uterus, acting like a lever under the force applied to one extremity, will roll back, and may get locked under the promontory. Being there, tenesmus, uncontrollable efforts at defecation are produced, and the pressure of the intestines then acts still more directly upon the anterior wall of the uterus, tending to maintain and increase the retroversion. In this fifth case, there may have been originally no flexion; and the accidental displacement will be the typical *retroversion* of Hunter and Denman, the only form at one time recognised. The os uteri does not point downwards, or at least only slightly so; it is carried up high behind the symphysis, pointing forwards, and very difficult to reach.

There is still a distinction to be made—one of extreme importance. Retroversion or retroflexion may be *complete* or *incomplete*. This distinction is hardly yet understood. It has often been observed that retroversion of the gravid womb tends to spontaneous cure. This is generally supposed to arise from the uterus liberating itself suddenly or gradually, as it enlarges, from the pelvic cavity. Now, this is true only in a certain proportion of cases, possibly not even in the majority. What really takes place in many cases is as follows:—Down to the end of three or four months of pregnancy there is pelvic gestation with retroflexion or retroversion; at this stage the effects of eccentric pressure upon the organs surrounding the growing uterus are often felt. They may gradually subside, but examination reveals the persistence of the retroflexion. How then has relief been obtained? The ovum continuing to grow, pushes out that portion of the uterine wall which looks upwards and forwards to the abdominal cavity. This part is free; and it gradually enlarges to form a secondary sac or pouch, accommodating the main bulk of the fœtus down to the normal term of gestation. This secondary pouch or diverticulum of the uterus expands in the abdominal cavity just as the whole uterus does in normal gestation, whilst the posterior portion and fundus are retained in the pelvis throughout.

Towards the end of pregnancy, the predominance in rate of growth and of bulk of the abdominal diverticulum is so great as to draw the pelvic portion partly out of its lodgment there, producing a partial rectification of the form and relations of the uterus, the os comes nearer to the

centre of the pelvis, and there is no obvious obstruction to labour. The phenomena just described I have distinctly traced, and recorded in several instances; and I regard the process as an ordinary method by which Nature releases herself from the danger of a locked retroflexed uterus. But sometimes the course of events is not so favourable. The development goes on as described in two pouches, one pelvic, one abdominal, but the pelvic part of the gestation remains so considerable, that the os is kept fixed behind and above the symphysis, so that when labour comes on, it is found that the pelvic cavity is filled with the uterine pouch, containing, perhaps, the child's head, whilst it is almost impossible to bring the cervix and os down into relation with the axis of the pelvis, so as to afford a channel for the passage of the child. Meriman relates two cases which appear to have been of this kind. One of these he attended with Denman. They found the os came down gradually during the pain of labour, as if the uterus were rolling round to its natural position. Hecker describes (*Monatsschr. f. Geburtsh.*, 1858) a remarkable case observed in the sixth month. A pluripara had suffered repeated attacks of dysuria, at times threatening retention; at last she took to bed with crampy pains; the fundus was felt about the level of the navel, the uterus contracting; the os uteri was felt with much difficulty above the symphysis; the cavity of the sacrum was filled by a smooth elastic swelling, which compressed the vagina forwards. This was violently pressed down with every pain, so that rupture was feared. After failing to push the tumor out of the pelvis, it at length rose, and at the same time another round elastic swelling—the membranes—came down from behind the symphysis. The child was then delivered.

Dr. Oldham relates (*Obstetr. Trans.*, 1860) a still more striking case. The patient, a primipara, was at term. The head was contained in the pelvis, whilst the trunk and breech of the child were contained in the abdominal portion of the uterus; the os pointed downwards, but was high behind the symphysis. The vagina, of course, was flattened against the symphysis. Dr. Oldham contrived to deliver by pulling down the cervix, by pressing the breech down by a hand outside, and pushing up the pelvic mass. A sort of rotation took place, the child being delivered by seizing a foot. Dr. Oldham had seen this woman three years before. She was then suffering from dysuria and retroflexion of the womb.

In extreme flexions it is common to find some degree of atrophy and narrowing at the seat of the os uteri internum, the point at which the flexion is most marked—Rokitansky and Virchow both describe this, but interpret it differently. Rokitansky says the mucous membrane of the cervix is thick and strong, becoming gradually thinner towards the body of the uterus. The seat of inflexion, he says, is always the neighbourhood of the internal os. He finds the connective tissues at this spot thinner and looser, and says this is the result of catarrh of the uterus after labour. Virchow points out that the whole cervix, excepting the portio vaginalis, is connected by connective tissue to surrounding parts, especially to the hinder and under surface of the bladder. The cervix thus fixed, inflexions are produced by inflammatory adhesions dragging upon the body of the uterus.



Thus Rokitansky thinks the atrophy of the internal orifice is primary, Virchow thinks it secondary. Clinical observation proves that in the majority of instances, at any rate, there are no adhesions. The fundus can generally be lifted up to its normal position by reversing the sound. Again, the frequency of cure under Hodge's pessary proves the same thing. Nor can it be admitted that Rokitansky's theory is more than occasionally true. Retroflexion is undoubtedly frequently first observed to follow labour immediately, that is, before uterine catarrh can have set in. The mechanism in these cases is simply this:—The heavy fundus, being in a flaccid state, falls back partly by its gravity, partly by being forced down under the pressure of the intestines. In such cases, involution becoming impeded, catarrh will almost always ensue; and from long-continued angulation, the tissues at the seat of flexion will undergo some amount of atrophy. It is this altered state of the tissues of the cervix, combined with the increased weight and bulk of the fundus, that makes restoration to the normal position so difficult and tedious.

The terminations of this displacement in the gravid womb are:—1. Death by rupture of the bladder. This is very rare. 2. Death by gangrene of the uterus or other parts compressed. This is also extremely rare. 3. Dr. Arthur Farre says (Article, Uterus, *Todd's Cyclopaedia of Anatomy*):—"The sequelæ of this displacement when re-position cannot be effected are usually premature expulsion of the ovum, or sloughing of the uterine parietes, and slow discharge of the contents by fistulous openings into the vagina, rectum, or bladder." Abortion undoubtedly is not uncommon, and this, whether re-position be effected or not. But there is reason to believe that some of the few cases in which parts of the embryo have been discharged by fistulous openings were in reality not cases of retroversion, but of extra-uterine gestation (See a case by Guichard, *Rev. Thérap. du Midi*, 1857). 4. Death by blood-poisoning, the matter which should be excreted by the kidney being retained in the system. This condition is usually called uræmia; but since it is not clear that the noxious element is urea alone, a better term, because more comprehensive and less absolute, is urinæmia. This I believe to be the most frequent cause of a fatal termination. It was the chief cause in four fatal cases observed by myself. C. Braun relates (*Clin. der Geburtsh.*) a case which ended fatally under eclamptic attacks in consequence of Bright's degeneration of kidneys, and secondary uræmia. In many cases, conjoined with urinæmia, there is disease of the bladder, such as intense congestion, inflammation, even sloughing of the mucous coat (Haussmann, *Monatssch. f. Geburtsh.*, 1868). 5. Peritonitis, which may be fatal, or which may end in adhesions. In none of the four fatal cases seen by myself was there peritonitis. I am disposed to conclude that death by urinæmia and the shock of pain usually anticipates the outbreak of peritonitis. Peritonitis is a later event. Mr. Misley relates (*Medical Times and Gazette*, 1855) a case in which, after re-position, the patient died twenty days later of peritonitis. Adhesions of intestines were formed, and the ureters were distended fourfold. In some cases, no doubt, where post-mortem examination has not been made, peritonitis has been

inferred from the intense pain suffered during life. But this sign is fallacious, since in cases where peritonitis had been so diagnosed, post-mortem examination refuted the diagnosis. 6. Recovery by re-position, spontaneous or surgical, is perhaps the most frequent termination. 7. Recovery is occasionally effected by the safety-valve process, of partial outgrowth of the uterus upwards into the abdominal cavity.

If abortion do not occur during the acute stage of the symptoms, it may still follow re-position, by some days or weeks. But in a large proportion of cases, after re-position, gestation goes on to term. After labour the uterus is very liable to fall back, either immediately or in a few days, disposing to hæmorrhage, primary or secondary. Remaining retroflexed, the symptoms of retroflexion of the non-pregnant womb of course ensue. Amongst the remote effects, vesico-vaginal fistulæ, chronic catarrh of the bladder, disease of the kidneys, chronic catarrh of the uterus, may be observed.

*The Diagnosis.*—The conditions most frequently leading to error or doubt are: retro-uterine hæmatocele; pelvic cellulitis or peritonitis; fibroid tumors in the posterior wall of the uterus; a small ovarian tumor engaged in Douglas' sac; and some forms of extra-uterine gestation. I have known the first condition several times to be mistaken for retroversion. The history and the physical signs concur in leading astray. In both cases there may be a clear history or suspicion of gestation to three or four months, distress in the pelvis, with retention of urine come on more or less suddenly, the os uteri is felt high and close behind the symphysis, and there is a spherical smooth tumor filling the hollow of the sacrum, projecting the posterior wall of the vagina forwards. The differentiation is made out first by passing the catheter, then, whilst the forefinger of the left hand is in the vagina, on or just behind the os uteri, depressing the right hand deeply into the pelvic cavity about the symphysis to feel for the uterus. At three months' gestation, the fundus should be easily felt above the pelvic brim, between the two hands. Absence from its proper place makes it highly probable that the tumor felt by vagina and rectum is the displaced uterus. The part felt by vagina is very painful. The partial retroversion, in which a part of the gravid uterus grows out of the pelvic cavity is more difficult. But here the pregnancy will be more advanced, and parts of the child or foetal heart sounds may be made out in the abdomen. If the case be retro-uterine hæmatocele, a solid body—the uterus—may be felt between the two examining hands, and the uterus sound will pass upwards and forwards close behind the abdominal walls towards the umbilicus. In these cases whether there have been pregnancy or not, the uterus is generally somewhat enlarged, so that the sound will go three inches or more. This completely demonstrates that the uterus is pushed bodily forwards by something behind it. We have then to determine what this something is. A hæmatocele is rarely strictly limited to the pelvic cavity; still more rarely does it fill the sacral hollow so completely as the retroverted uterus; portion rises into the abdominal cavity; and if it have existed for some days, it will be solid, and may thus simulate a fibroid of the uterus or a pelvic phlegmon. The os uteri points downwards; it is low and easily reached. The whole uterus

pushed downwards as well as forwards. The tumefactions of peri-uterine inflammation are generally distinguished by their being felt more in the sides, by fixing the uterus centrally in the roof of the pelvis, and by their not projecting the posterior wall of the vagina. Fibroid or other tumors are generally distinguished by their history: they have grown slowly, and they rarely fill the sacral cavity so smoothly and completely as the retroverted womb. The diagnosis of extra-uterine gestation—the case being very rare, and therefore unexpected—is difficult. In a case which came under my observation, which led to error, the gestation had exceeded the normal term; peritonitis, with abdominal distension, set in, obscuring examination by the abdomen; the sacral cavity was filled by a semi-fluctuating tumor, which projected the posterior wall, and pushed the os uteri close to the symphysis pubis. The uterine sound passed four inches, close behind the abdominal wall. The tumor behind was then punctured, and fluid escaped. The patient died of the peritonitis.

The value of the uterine sound, as an instrument of precision in these cases, is very great. To pass into the cavity of a retroflexed uterus, it is obvious that the sound must be curved, and that the point must be directed strongly backwards towards the sacrum. If the point goes forwards towards the abdominal wall, for the normal distance, two and a half inches, or beyond, we are then certain as to the position of the uterus, and can exclude retroversion and retroflexion. The possibility of pregnancy compels caution in using the sound. But since, in the cases where the extreme urgency of the symptoms renders accurate diagnosis, with a view to relief, imperative, the life of the fœtus, if there be one, is already compromised, abortion is a condition of recovery, and the safety of the woman must be first considered, objection to the use of the sound disappears. If, on the other hand, the symptoms are not urgent, the use of the sound may be postponed, and there will be time to make out a diagnosis by other means.

The *Treatment* will first of all be directed to the relief of the imperatively urgent symptoms, retention of urine, and pain. The first object, and, to some extent, the second, will have been accomplished by passing the catheter for the purpose of diagnosis. The next point is to determine the possibility of restoring the uterus to its normal position. Two kinds of difficulty may oppose restoration. First, there may be adhesions binding down the fundus. These are extremely rare, but if they should be present, attempts to push up the uterus might be fatal. Blundell relates a remarkable case (*Obstetric Surgery*) of a young lady who had an ovarian cyst, which burst from a full. Peritonitis followed. On recovery she married, and becoming pregnant, died with an irreducible retroversion of the uterus. Inflammatory adhesions had fixed the uterus in the pelvis. Dr. Meigs relates a case in which the retroverted uterus was bound down by adhesions, associated with a Fallopian gestation. Secondly, reduction may be impeded by the congestion, tumefaction of the parts; the uterus is locked in the pelvis by its bulk. In such cases, and indeed in all cases where it is very difficult to reduce the uterus, the proper course, it appears to me, is to induce abortion. By merely lessening the bulk of the uterus, certain relief is obtained, the pressure is taken off, and

the stimulus of developmental attraction being arrested, contraction and involution of the uterus set in. Reduction will then generally be easy, and if it should be not effected, the diminished uterus ceases to be a source of danger. The induction of abortion, however, is not always an easy matter. The os uteri may be not only high up above the symphysis, but it may also be directed forwards and upwards, so that it is hard to reach, and it becomes difficult, if not impossible, to pass an instrument through it into the uterus. This is especially the case in pure retroversion. In the case of retroflexion the os uteri points downwards, and is more easy to reach. In either case an attempt may be made to pass a curved sound, or an elastic bougie, into the uterine cavity, to rupture the membranes, or, at least, to disturb the connexions of the ovum. This done, the patient should be allowed to rest in the prone position, the bladder being emptied every six hours by catheter. If it be found impracticable to pass an instrument through the os uteri, if reduction be also impossible, or the symptoms be urgent, it is justifiable to puncture the uterus by the vagina or by the rectum. There is risk of piercing the placenta, which is likely to be attached to the posterior wall of the uterus. But this risk must be encountered as the lesser evil. The best instrument to use is a trocar about the size of a crow-quill. The forefinger of the left hand applied inside the vagina or rectum determines the most bulging part of the uterus, and the trocar, guided by it, is pushed into the uterus. The rectum is to be preferred, because a puncture there is more certain to tap the body of the uterus, and to clear the cervix. On removing the trocar, liquor amnii should run out of the canula. Some diminution of bulk is immediately gained, and abortion will follow in a few hours. It has been found impossible to pass a catheter, and reduction being also impossible, the question has arisen between supra-pubic puncture of the bladder, and puncture of the uterus by rectum. A case of this kind occurred to Dr. Head, at the London Hospital (see *Lond. Hosp. Reports*, 1867). He punctured the uterus; it then became possible to empty the bladder; a shrivelled fœtus of five months' growth was passed, and, after a very severe illness, the woman recovered. The decision to puncture the uterus first was judicious, since it might still have been necessary to do it after having punctured the bladder. On the other hand, Dr. Münchmeyer relates (*Monatsschr. f. Geburtsk.*, 1860) a case in which he punctured the bladder; the uterus was then reduced, and recovery followed.

Reduction may be attempted, either leaving the ovum intact, or after abortion. In a fair proportion of cases, if seen early, simply keeping the bladder and rectum empty, and rest in prone or semi-prone posture, is enough to obtain restoration of the uterus; and unless very urgent distress continue, time should be afforded for this spontaneous cure. When it has been decided to try reduction, the plan to be pursued is as follows: Empty the bladder and rectum; give chloroform to the surgical degree; place the patient in the prone position, with the nates elevated; pass two or three fingers, or even the whole hand, into the rectum; apply the tips of them to one side of and under the uterine globe; push the globe upwards and to one side of the promontory of the sacrum, so as to clear



this projection. This oblique direction of the reducing force is a point of great importance. It was insisted upon by Dr. Skinner (*Brit. Med. Journ.*, 1860), who prefers the position on the left side, and recommends first, by finger in the vagina, to push the cervix uteri backwards towards the left acetabulum, so as to bring the uterus into the right oblique diameter of the pelvis; then the fingers in the rectum push the fundus towards the right sacro-iliac synchondrosis. If the patient is not under chloroform, pressure should be exerted during expiration only. I have reduced an impacted retroverted gravid uterus with comparative facility, by attention to this rule, which had resisted many previous efforts.

Various means have been suggested and tried to facilitate reduction. Halpin applied a sheep's bladder in the rectum, then distended it with air or water, with the view of so lifting up the uterus. Desgranges took up the same idea. I tried it in one case without success. Dr. Playfair relates (*Lancet*) a case in which fluid pressure, sustained for twenty-four hours in the vagina, replaced the uterus. In fact, a point d'appui is wanted below, which the perinæum is ill-adapted to give; and in most cases, it would be difficult to get a bladder into the vagina. The distensibility of the floor of the pelvis allows the bladder to expand downwards. And as it is impossible to govern with accuracy the direction of the force, the bladder expanding presses the fundus uteri directly upwards under the promontory: thus in reality calling for more force than would be necessary if the hand—a sentient and intelligent instrument—were used in the manner already described. Again, position has been much insisted upon. Blundell recommended the knee-and-elbow position. Godefroy (*Gaz. des Hôpitaux*, 1859) placed the patient on the edge of the bed, so that her head and chest were hanging down on the floor, the legs and pelvis only being on the bed. In this position there is no resistance from the abdominal walls. Then two or more fingers in the rectum easily replaced the uterus. Négrier, of Angers, introduced the whole hand into the vagina, turned it in supination, and pressed forcibly by the flat surface made by the backs of the first phalanges and by the thumb brought level with them. This he calls "*réduction à poing fermé*." He succeeded by it in four cases. An objection to pushing the uterus with the tips of the fingers is that the indentation thus made in its wall is likely to detach the placenta, and even to injure the tissue of the uterus. E. Rigby agrees with Dewees in recommending bleeding to facilitate reduction. In some cases where there is great congestion in the pelvic vessels, no doubt, this proceeding would be useful. It is scarcely necessary to do more than advert to the plan practised by Amussat, who supplemented his own strength by getting two or three assistants to push his arm behind him. If the uterus does not rise under moderate, well-directed force, it is better to abandon the attempt, and to fall back upon puncture. It is useful, whilst pushing the uterus from below, to exert counter-pressure by the other hand applied above the symphysis pubis. Professor Halbertsma relates a case in which the woman died; the uterus was found retroflexed and retroverted. There was no peritonitis. On pressing up the fundus, the uterus immediately rose like a feather into its place. This post-

mortem demonstration of reduction is especially valuable.

The management of the case after reduction is important. Richter, Baudelocque, and Simpson recommend to apply a pessary to prevent the uterus from falling back again. The best pessary for this is a large-sized Hodges' lever. I have on many occasions used this pessary to support the uterus when retroverted, during the first three or four months of gestation, as a security against impaction. This precaution should never be omitted in the case of pregnancy occurring in a woman who has once suffered from retroversion or retroflexion. Other points are, absolute rest, encouraged by opium; keeping the bladder empty—retention may persist from paralysis even after pressure is removed—and medicines, such as mineral acids, to correct the systemic disturbance from urinaemia. The bladder requires the most careful attention. The liability of the mucous coat to undergo necrosis must be borne in mind. Shreds detached may occlude the urethra.]

Robert Barnes.

See Lynn, W. Hunter, Garthshore, Bird, and Hooper, in *Med. Obs. and Inq.* vols. iv. v. and vi. Cheston and Cleghorn, in *Med. Communications*, vol. ii. Saxtorph, in *Collect. Soc. Med. Hafniens.*, vol. ii. 1775. Desgranges, in *Journ. de Méd.* t. lx. A. Wall, *Diss. de Uteri grande Reflectione*. Hal. 1782. Melitsch, *Von der Umbeugung der Gebärmutter*, Prag, 1790. Lohmeier, in *Theiden's neuen Bemerkungen*, &c. bd. iii. Berlin, 1795. John Clarke, *Practical Essays on the Management of Pregnancy and Labour*, Lond. 1793. Murray, in *Uteri Retroversionem Animadversiones*, Upsal. 1797. Denmark's *Introduction to Midwifery*, Lond. 1801. S. Merriman, *On Retroversion of the Womb*, &c. 8vo. Lond. 1810. Jahn, *De Utero Retroverso*, Jen. 1787. Desgranges, in *Journ. de Méd.* t. lxvi. p. 85. Klein, *Chir. Bemerkungen*, p. 235. Baudelocque, *Sur le Renversement de la Matrice*, &c. Paris, 1803. Cockell, *Es-ay on Retroversion of the Uterus*, Lond. 1785. Richter, *Chir. Bibl.* b. iv. pp. 61–70–235–555; b. v. pp. 132–548; b. vii. pp. 292; b. viii. pp. 715; b. ix. p. 182; b. xi. pp. 310–328; b. xii. pp. 45–50; and Weir's *Two Cases of Retroversio Uteri*, with Remarks, in *Glasgow Med. Journ.* vol. i. p. 262, &c. Nägele, *Erfahrungen und Abhandlungen aus dem Gebiete der Krankheiten des weiblichen Geschlechtes*, Mannh. 1812. W. J. Schmitt, *Bemerkungen, &c. über die Zurückbeugung der Gebärmutter bei Nichtschwängern*, &c. Wien, 1820. H. Eichorn, *Von der Zurückbeugung der nicht schwangeren Gebärmutter*, 1822. M. Baynham, *A Case of Retroverted Uterus*, treated by Puncture of that Organ, in *Edin. Med. and Surg. Journ.* No. 103, p. 256. J. T. Ingleby, *On Malposition of the Uterus*, &c. in No. 122 of the same Work, p. 137; and all modern works on Midwifery in general. Moller, *De pronatione uteri post-partum*, 1803. Die Dislocationen der Gebärmutter, 1822; [Virchow, *Verhandlungen der Gesellschaft f. Geburtskunde in Berlin*, 1851. Rochwitz, *ibid.* Valleir, *Des déviations utérines*, 1852. G. Lehmann, *Zur Lehre über die Retroflexio uteri*, *Monatsschr. f. Geburtskunde*, 1856. Martin, *über die Retrov. d. schwangeren Gebärmutter*, *ibid.* 1858. Robert Barnes, *Clinical Lecture on Retroversion of the Uterus in Pregnancy*, *Lancet*, 1859. Scanzoni, *Lehrb. der Geburtsk.* 1867. Halbertsma, *Monatsschr. f. Geburtsk.* 1869.]

UVA URSI, first brought into notice by De Haen, was once considered a powerful remedy in calculus; but, though its virtue in lessening the irritation of the bladder is still acknowledged, its claim to utility on any other principle is quite rejected. Dr. Austin recommended it for lessening the irritability of the bladder, and diminishing the secretion of diseased mucus, which, he supposed greatly contributed to the augmentation of the stone.

[The decoction of *Uva Ursi* may be prescribed with advantage in cases of catarrhus vesicæ, especially in the chronic stages of that complaint and when no active inflammation is present. It is astringent and tonic in its action, but the alteration which it produces is slow, and it requires therefore to be continued for a considerable period.]

**UVULA.** The uvula is subject to several kinds of enlargement, in which it becomes both longer and more bulky than natural, or is simply lengthened. In consequence of such changes, it becomes troublesome in deglutition and speaking, and causes a disagreeable tickling at the root of the tongue, frequent retchings, and annoying cough.

When things have attained this state, and tonic medicines, combined with the application of local astringents, or of the solid nitrate of silver, have proved ineffectual, as is most frequently the case, the only plan of relief consists in amputating a portion of the uvula with a pair of scissors. I lately amputated a gentleman's uvula on account of an obstinate and deep ulceration, extending nearly through its root, and producing a lateral displacement of the part, attended with a considerable degree of irritation and annoyance. The bleeding is usually trifling, and beyond a slight soreness for a few days, the operation is attended with no inconvenience to the patient.

**VAGINA, FISTULÆ OF.**—See RECTO-VAGINAL FISTULA, and VESICO VAGINAL FISTULA.

**VAGINA, IMPERFORATE, ATRESIA OF.** [Atresia (from *ἀ* priv. and *τρῆσις*, a perforation, hole) of the genital canal is congenital or acquired. The congenital conditions consist in abnormal formation, from imperfect or defective or excessive development. Imperforation of the hymen is met with under various conditions: sometimes it is complete; sometimes there are one or more small openings; sometimes, although perforated, the hymen is so thick and resisting as to oppose all sexual attempts. Imperforation of the vagina may be due to fusion of the labia minora. The vagina may be closed by a transverse septum at any depth; sometimes two or more septa exist, forming two or more compartments (Danyau, Nélaton). If imperforate hymen is discovered soon after birth, it is well to divide it at once. A very moderate incision is enough.

Puech distinguishes three kinds of closure of the *vulva*: 1. adhesion of the labia majora, always of accidental origin, the result of inflammation or injury; 2. adhesion of the labia minora, also the result of accident, and like the first chiefly distressing from impediment to micturition; 3. hymeneal atresia, the most common, generally congenital. It may come under notice before puberty from the collection of mucus in the vagina causing distension, or it may be detected soon after birth. I have several times incised an imperforate hymen in infants. The closure of the *vagina* may be congenital or accidental. The congenital kinds may be formed by transverse membranous septa composed of two folds of mucous membrane with some connective tissue or muscular fibres between. In some cases, imperforation of the cervix uteri complicates that of the vagina. The accidental closure of the vagina is far more frequent; it is almost always the consequence of accidental contraction after injury, or inflammation. The walls cohere; the vagina is more or less perfectly obliterated.

True occlusion or atresia is commonly the result of a cicatricial process following upon ulceration, granulation, or laceration of the *os uteri*. The most frequent cause is laceration or sloughing, arising from severe labour with or without instrumental aid. It has resulted from cauterisation of the *os uteri* with potassa fusa; from cicatrization following inflammation in small-pox, scarlatina, typhoid; after amputation of the cervix, for want of sufficient care to maintain the patency of the canal during cicatrization; also from advancing senile atrophy, which produces a kind of concentric obliteration of the *os*. Rokitsansky describes this last form. I have seen many examples of it. Klob describes a peculiar form of obliteration of the *os externum* as following upon prolapsus with inversion of the vagina; in these cases a small pit alone shows the seat of the *os*, and the atresia is caused by a milk-white membrane formed of several layers of vaginal epithelium.

Closure of the *uterus* most frequently takes place at the *os internum* or *os externum*. It may be the result of extrinsic causes; as from external pressure by tumors; from flexions of the uterus, more especially from bending of the body forwards upon the neck so as to form an acute angle at the seat of flexion; from tumefaction of the mucous membrane, as from catarrhal or other inflammation; from the growth of cancerous or fibroid tumor in the substance of the neck; from plugging by clots, membranous substances, or pseudoplasmas. These conditions may be diagnosed from true atresia, and sometimes may be relieved by passing the uterine sound.

Another form of closure is due to the sealing of the *os externum* or *internum* by a false membrane, as described by Nægele. This has been observed to take place during pregnancy, so that at the time of labour, no *os uteri* could be felt.

Absence of uterus, according to Kussmaul, is very rarely complete. Even when exploration is made by finger in rectum and sound in bladder, a rudimentary uterus may evade detection by slipping on one side. In one case (Perkins, by Howship) the uterus containing two pounds of blood was found behind the closed vagina. Even on dissection, unless very carefully conducted, a rudimentary uterus may escape detection.

An apparently absent vagina is no proof of absent uterus. An artificial route has several times been made to the distended uterus. (Amussat.) In some of these cases of absent vagina the *os uteri* has opened into the rectum or urethra, and these canals being used by the intro-mittent organ, impregnation has occurred. According to Dr. Oldham there is in many cases of closure or malformation of the vagina, an original dilatation of the urethra, a circumstance which has embarrassed the examining surgeon. This enlargement of the urethra has been commonly supposed to be the result of accidental or voluntary substitution of the urethra as a copulative organ; but Dr. Oldham no doubt is right in recognising it as pre-existing and independent of this use. Dr. Routh related a case (*Obstetrical Trans.* 1870) confirmatory of Dr. Oldham's view. It may, however, be due in some cases to surgical examination.

Cases have been observed of two-horned, or double uteri, in which one uterus has been occluded and become the seat of retained menstrual fluid,



whilst the other uterus performed its function normally. Decès (*Bull. de la Soc. anat.* 1854) gives a case in which retention in one uterus led to rupture of the horn and fatal peritonitis. Leroy (*Journ. des Connaiss. méd.* 1835) published a case in which there was occlusion of the right uterine neck, retention of menstrual flux, and formation of a tumor reaching to the umbilicus and simulating pregnancy. Rokitsansky relates an important case (*Zeitsch. d. Gesellsch. d. Aerzte* 1860). He dissected a woman who died of symptoms of pelvic inflammation. The uterus had a complete septum. The right half only communicated with the vagina, which was single. The left half was shut off from the vagina and expanded into a pouch containing a dirty ichorous matter. This pouch formed a fluctuating projection into the roof of the vagina. The septum between the two uteri was perforated by ulceration. Rokitsansky concluded that there had been imprisonment of menstrual fluid in the blind half of the uterus, causing, first, distension of the cervix, then inflammation and perforation of the septum, with consensual inflammation of the collateral (left) ovary, leading to abscess and peritoneal effusion. Dr. Beronius relates a similar case (*Mon. f. Geburtsh.* 1862). The distended half of the uterus was punctured; but death ensued from acute peritonitis in thirty-six hours.

Occlusions impeding parturition, not concerning the surgeon proper, may be touched upon lightly. The signs of protracted and obstructed labour lead to examination, when, if the vagina is free, the nature of the occlusion of the uterus is ascertained. The simple agglutination of the os of Nægele will sometimes yield to the pressure of the finger. But if there is any cicatricial or other morbid tissue impeding the opening of the womb, incisions may be necessary. These are best made by a straight blunt-ended hernia knife carried up to the edge of the contracted ring, and made to execute several small nicks at different points of the circumference. By this means the parts will often gradually dilate. This nicking may be alternated with artificial dilatation by help of the writer's caoutchouc bags. If the atresia is very great, and artificial dilatation cannot be carried far enough with safety to permit the child to pass, embryotomy and extraction of the child may be necessary. It has been remarked that repeatedly nicking these cicatrices is followed by their gradual disappearance.

In the senile form of occlusion, pain of an acute kind ensues whenever there is any secretion forming in the cavity of the uterus. In women in whom the menstrual function has ceased, there sometimes exists a form of catarrhal inflammation of the lining membrane of the uterus, giving rise to a mucous or muco-purulent secretion, which, being retained, produces symptoms resembling those from retained menstrual blood. If the fluid is watery, this is called hydrometra. The uterus seldom attains a size comparable to that observed in cases of retained menses. On examining by the finger, the uterus is felt enlarged, often retroflexed; the os externum is sometimes difficult to make out, from the vaginal portion of the uterus being atrophied, and so leaving the os flush with the roof of the vagina. Generally, however, the point of the sound will penetrate a little way; and by persevering with gentle pres-

sure, sometimes a passage is gradually made into the uterus.

The consequences of retention, if not relieved by operation, are:—The distension of the uterus leads to perimetritis, with adhesions to the surrounding parts, especially of the Fallopian tubes, to the ovaries and broad ligaments. The thinning of the uterus may proceed to bursting. The distended Fallopian tubes may burst, or, without bursting, an overflow of blood may escape into the peritoneum, causing peritonitis. (Brodie, Kiwisch.) Bécclard relates a case in which the uterus burst, discharging into the bladder. Scanzoni and Dr. Arthur Farre relate cases in which the distended hymen burst. In Dr. Farre's case death resulted. In other cases the obtruding membrane has given way under a process of ulceration, and a cure has resulted (see cases in Puech).

The constitution suffers from hectic, the result of pain and the absorption of the altered blood from the uterus. In some cases—Lizé relates one (*Union médicale*, 1863)—the impossibility of evacuating the collecting menstrual blood induces amenorrhœa; the ovaries and uterus give up their functions. Lizé believed that in his case atrophy of the uterus was induced. Dr. Murray of Newcastle relates a case (*Brit. Med. Journ.* 1868) of a single lady, æt. twenty-seven, whose vagina was closed by small-pox in infancy. Menstruation had been suspended for fourteen years. The vagina being opened up, no collection was found in the uterus, but exactly a month afterwards menstruation appeared, and recurred with tolerable regularity afterwards. In this case it was clear that the ovaries were not atrophied; but that the uterus ceased to pour out menstrual blood. This is in accordance with what sometimes occurs in apparent amenorrhœa without uterine obstruction. Ovulation may go on without exciting menstrual flow. This returns when a healthy state of the blood is restored. Simon relates (*Mon. f. Geburtsh.* 1851) a case of complete closure of the vagina, with a distended uterus. A vain attempt was made to establish a vagina. The patient maintained good health without the uterus being opened.

The character of the retained blood is remarkable. It is dark-coloured, deficient in fibrine, of treacly consistence, rarely containing coagula; it contains mucus, and often cholesterine scales. It is glutinous, inodorous. The quantity varies with the duration of retention. Occasionally the tolerance and accommodation are surprising; the uterus is expanded to the size of the end of pregnancy. Ten pounds of blood have been collected. I have collected forty ounces; and this, perhaps, is an average amount. Puech deduces from comparison of quantity and time of retention, that, as a rule, the quantity is less than the number of menstrual periods would have produced normally. Letheby (*Lancet*, 1845) analysed forty ounces which gave—water, 87.5.4; albumen, 69.4; globuline, 49.1; hæmotosine, 2.9; salts, 8.0; fat, 5.3; extractive, 6.7. Sometimes the fluid undergoes decomposition; and then gas mixed with the blood constitutes physohæmatometra.

The symptoms of atresia are those which might be expected from obstructed function. "Impeditur coitus, conceptio, et purgatio." Until the advent of puberty, nothing may cause suspicion of abnormality. But with the onset of menstruation, distress begins, due to retention of the menstrual

fluid. At first, perhaps, this is limited to passing attacks of uterine colic, marked by pelvic pain and bearing down or expulsive efforts. Vomiting often attends, as in all cases where the uterine fibre is suddenly stretched. These attacks, more or less periodical, are not attended by the expected appearance of the menses. Occasionally there is a vicarious discharge of blood in the form of epistaxis (Pullen). In Pullen's case, one of absence of the vagina, there were marked menstrual molimina, but no accumulation of menstrual blood in the uterus or neighbourhood. When an artificial vagina was made, menstruation took place periodically by this channel, and the epistaxis ceased. Gradually the distress increases. A sense of fullness in the pelvis arises; the hypogastrium enlarges; the abdomen is visibly larger; perhaps pregnancy is suspected; there is sometimes retention of urine from the pressure of the uterus and vagina, distended with the accumulating menstrual secretion; defæcation is difficult, and the digestive function is disturbed; irritative fever, with a sallow skin, and vomiting—the result of absorption of the watery part of the confined fluid—sets in. On examination, a firm, even tumor is felt, rising from the pelvis behind the symphysis pubis, sometimes as high as, or even higher than, the umbilicus.

The uterus gradually yields under excentric pressure; as in pregnancy, or when it contains a growing polypus, it then grows, its muscular walls as well as its cavity enlarging. This process meets to a certain extent the pressure of the accumulating fluid, but the contained matters receiving fresh increments at every menstrual epoch, after a time require more space; then other compensating processes bring alleviation, and stave off for awhile the critical moment when the strain can no longer be borne; the more watery element of the contained fluid is absorbed, and to supplement the imperfect distension of the uterus, another cavity is formed by the distension of the vagina; and the Fallopian tubes stretching, form further supplementary receptacles, and form tumors which can be felt on either side of the uterus, in the iliac fossæ, or in the vaginal pouch. The obstruction to normal menstruation is sometimes compensated by menstrual deviation—that is, by fluxes from the intestines, bladder, nose, skin, &c. The uterus and vaginal cavities are commonly divided by a strait formed by the cervix uteri. This vaginal pouch may be very large, especially if the occlusion exists at the vulva, when it may so compress the rectum as to obstruct defæcation (Tuckwell). If the occlusion exists higher up the vagina, a pouch is still formed. And it is remarkable that the vaginal wall undergoes hypertrophy in the same way as the uterine wall. In a fatal case, Dr. Sutton (*Lond. Hosp. Reports*, 1867) found the vagina so much hypertrophied that the walls at the upper part were quite as thick as the uterine parietes. Klob contends that, in cases of obstruction at the vulva, it is the vagina that chiefly or almost exclusively forms the sac, the uterus scarcely contributing. This is certainly not always the case; and it may be doubted whether it is even generally so. The uterus certainly enlarges considerably, and the easily distensible Fallopian tubes become greatly distended, forming a distinct tumor readily felt on either side, sometimes, as Bernutz remarks, mistaken for pelvic

phlegmons. But generally the uterine orifices of the tubes are expanded. The Fallopian tubes have been found distended even when shut off from the uterine cavity. There is a valuable specimen (described in Tuckwell's paper) in the Radcliffe museum. Two large pouches exist, vaginal and uterine. The uterus was so distended that its walls were not thicker than those of the bladder. A further stage leads to the escape of blood from the Fallopian tubes at their fimbriated extremities, or through rents into the peritoneum. This event, long ago pointed out by Brodie, has been amply confirmed by subsequent observers. The blood collecting in the Douglas' pouch constitutes retro-uterine hæmatocele. The common effect of this is pelvic peritonitis, sometimes fatal, at others resulting in segregation of the effused blood by plastic matter; a later stage of which is a process of suppuration or necrosis of the posterior vaginal wall, and possibly discharge of the hæmatocele and cure. As Bernutz says, and I venture to add my own testimony in support, the foregoing phenomena of obstructed menstrual flow may result from uterine deviations, especially flexions, from spasmodic contraction of the cervix uteri, and, according to my own observation, from congenital narrowing of the os externum uteri associated with a conical vaginal-portion. The symptoms of abdominal shock and peritonitis following upon those of retention of menses, indicate the occurrence of effusion of blood from the Fallopian tubes into the peritoneum. These symptoms, depending on the same accident, are very liable to follow operations for the discharge of the retained fluid. The diagnosis of the resulting hæmatocele may therefore be conveniently discussed here. A tumor is formed, sometimes of considerable size, in the Douglas' sac. At first this is soft, fluctuating; it gets harder under coagulation and the effusion of plastic matter around it; a firm tumor may be felt rising above the pubes, even to the umbilicus. The abdominal walls can be made to glide over it. The limit of the tumor may be defined by percussion; inferiorly the tumor sinks into the pelvis. By the vagina we find the tumor pushing forward the roof and posterior wall of this canal, shortening it, and compressing it from behind forwards, so that the finger is guided to the os uteri driven forwards and downwards behind the symphysis. The os felt in this position, and a firm rounded mass extending behind it, has been mistaken for retroversion of the enlarged womb, and this the more readily because retention of urine has often been an urgent symptom. The diagnosis is made clear by the uterine sound—if it can be used—which runs up behind the symphysis forwards, and its point may be felt through the abdominal walls and fundus of the uterus, showing that the uterus is erect or inclined forward, or to one side. The nature of the retro-uterine tumor is further made manifest by examination by the rectum. And in retroversion, if the bladder is first emptied, no tumor is felt above and behind the pubes.

One of the most important characters of blood tumors, and of retro-uterine hæmatocele especially, is the successive modifications they undergo. Almost immediately after its formation, a hæmatocele is larger and more distinctly fluctuating. In a few days it has a gummy consistence; later still we find fluctuation in some parts, and hard nodules in



others, showing the separation into clot and serum.

Menstruation invariably leads to an accession of pain in the tumor, and to increase of size and tension.

The tumor usually forms a communication at its lower part with the vagina or rectum, a process of absorption taking place through the walls of these organs. The discharge of the contents brings about quick improvement.

The blood-cyst may be to a great extent absorbed, leaving a serous cyst.

Inflammation and segregation ensuing, it may be transformed into a purulent cyst. When the cyst has been opened, either spontaneously or artificially, diarrhoea or dysentery is apt to follow, owing to the extension of inflammation to the rectum. The return to health is very gradual. Hæmorrhagic fibro-peritonitis is less grave than other forms. The blood is less irritating, and the attendant conditions are freer from blood infection.

Organisation of false membranes may remain, and form adhesions with uterus, tubes, or ovaries, displacing these organs.

If evacuation is not effected, hectic becomes more pronounced. If the uterus succeeds in terminating the retention, the symptoms gradually disappear. But if, on the contrary, it fails, the inflammation runs its course, and pus is formed in the broad ligament, and fluctuation may be felt in vagina or rectum.

Chills and general uneasiness continue until either a free incision is made into the fluctuating part, or nature opens the abscess.

Health is permanent or otherwise according to the success of the treatment directed to the removal of obstruction of the cervix uteri.

As to the treatment of the consecutive hæmatocele, there is a difference of opinion whether the blood cyst should be punctured or not. Nélaton advised puncture, Bernutz strongly condemns it. Now that it is known that the effusion is in the peritoneal cavity, the reason against the practice is strengthened. Death has in many cases followed puncture. I share Bernutz's opinion. Recovery may, as a rule, be expected under a judicious system of rest. In a case under my care at St. Thomas's, Professor White of Buffalo advised me to puncture and clear out the blood, telling me he had so treated cases successfully. I did not puncture, but the patient recovered well, and this is my common experience. It may, however, be desirable to puncture where hectic is very prolonged, and where symptoms of septicæmia supervene.

*Treatment.*—In the case of apparent absence of the vagina, there are three methods of proceeding. The first is to cut a channel through the tissues between the urethra and rectum up to the uterus. The second, adopted by Fletcher (*Lancet*, 1830-1831), by Amussat (*Gazette médicale*, 1835), is to tear or stretch out a canal by the fingers, or other dilating instruments. The third may be called the mixed method, making use both of cutting and dilating. The last combines the advantages of the two preceding, and at the same time reduces their disadvantages. Whatever mode is adopted, the patient is placed in lithotomy position; the space between the urethra and rectum is carefully examined; the index of the left hand is passed into the rectum; the sound is passed into the bladder, and feeling for it by the finger in the rectum, the

amount of tissue available for burrowing, and the position of the uterine tumor are determined. Then the sound is held up under the pelvic arch, whilst the finger carries the rectum away in the opposite direction. A transverse incision is made in front of the anus through the skin; then, cautiously nicking with the knife or scissors, and stretching out with the fingers, working between the finger in rectum and the sound in urethra as guides, a canal is opened to the uterus. If the os is felt, a sound should be tried first; if the os be impervious, it may be perforated by a trocar, or by the knife. It may be desirable to carry out the proceeding at different sittings. It will generally be necessary to place a tent or bougie in the uterine opening, to prevent closure; and the artificial vagina must be preserved by plugging with lint steeped in carbolic acid, glycerine, or the glass or vulcanite dilator of Sim.

When the closure of the vagina is the result of cicatrices from slough, the same cautious mode of dissecting and dilating may be adopted.

Where the vaginal canal exists, and there is closure of the vulva by agglutination of the nymphæ, or from imperforate hymen, the preponderance of testimony is in favour of making an opening into the vagina. The distended fluctuating membrane indicates the spot. This is pierced by a trocar, or better by a knife. A contention exists as to whether the opening should be made free or very small. If the accumulated blood escapes very rapidly, there is risk of sudden contraction of the uterus, stretching, perhaps rending of the Fallopian tubes, especially if they had contracted adhesions, and the entry of air into the uterus leading to decomposition and septicæmia. It is held that these dangers are lessened by letting the blood ooze out very slowly. The fact is, that death has followed both methods, and we are, perhaps, not yet in possession of certain means of rendering even the slightest puncture perfectly safe. I believe the opening should be sufficiently large to admit of easy evacuation; and that to prevent the entry of air a compress should be applied on the uterus, and sustained by moderate pressure with a bandage. In some cases injections of warm water have been used to wash out the uterus. It is doubtful whether this is good practice at the time of the operation; but if there should arise decomposition, the gentle injection of a weak solution of permanganate of potash, or carbolic acid, will be desirable. After a few days it is proper to enlarge the opening in the vulva, by removing a circular piece of the membrane, so as to fit the parts for all their functions. Absolute rest in bed for some days is a wise precaution, notwithstanding the histories of cases where impunity has followed its neglect. Symptoms of peritonitis indicating that retained fluid has suddenly escaped into the peritoneal cavity, have set in on the third or fourth day. The contraction of the uterus leading to this catastrophe does not take place immediately after the operation. The greatest care, therefore, is necessary for some days afterwards.

In cases of occlusion of the uterus, with retention of menses, the indication is to make a passage into the cavity. This may be done by a trocar, or by a bistoury. The fluid evacuated, it is necessary to introduce a tent—a metallic one is best—to preserve the opening, which would otherwise close, and lead to a repetition of the mischief. This

liability is especially great in cases of contraction after amputation of the neck. Lefort cites, however, several instances where death followed the evacuation by puncture.

Some have advised puncturing by the rectum in preference, and even puncture of the uterus above the symphysis pubis has been recommended.

The experience of puncture by the rectum is not so favourable as to show any superiority over opening by the vagina. It is an imperfect operation, for the establishment of a vaginal canal would still be indicated, when relief from hæmatometra had been obtained. In cases where opening up the natural route is impracticable or too hazardous, it may be resorted to as a temporary expedient. Fatal peritonitis followed in cases treated in this way by Antoine Dubois and Dupuytren.

Dr. Oldham (*Guy's Reports*, 1857) reports two cases in which puncture per rectum was practised. In one there was congenital absence of vagina; the os uteri was felt through the rectum; the trocar was made to pierce at this point; the operation was repeated on four occasions; at last the opening continued patent, and menstruation took place by the rectum. In the other case, the vagina was closed by dense cicatrix; the os uteri was felt by rectum, and was punctured; relief followed. A third case at Guy's is reported by Dr. Hicks (*Med. Times and Gaz.*, 1861); here there was absence of vagina: puncture by rectum was followed by relief, and as far as the report goes, there was subsequent amenorrhœa.

In striking for the os uteri by the vagina, it is very possible to pierce the rectum behind the cervix. In such a case menstruation has thenceforward occurred per rectum.

The time selected for the operation should be remote from the menstrual epochs; during the epoch the uterus is more apt to resent interference.]

Robert Barnes.

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#### [VAGINA AND PERINÆUM, RUPTURE OR LACERATION OF.—

Laceration of the female perinæum and vagina in parturition is of not very unfrequent occurrence. Of its causes, and of the most effectual modes of preventing it, it is unnecessary to speak in a surgical dictionary; we shall, therefore, only refer here to the surgical means by which the injury may be repaired, and which, since the last edition of this work was pub-

lished, have been brought to a high degree of perfection.

These lacerations vary greatly in extent, from a slight tear at the fourchette to a laceration of the whole length of the perinæum and sphincter muscle into the rectum, and sometimes of the recto-vaginal septum for an inch or more in the upward direction. It will be convenient for practical purposes to divide perinæal ruptures into: 1. Rupture of the perinæum, varying in extent, but not involving the sphincter ani muscle. 2. Rupture in which the sphincter ani is also torn through. 3. Rupture in which not only the perinæum and sphincter, but the recto-vaginal septum also, are involved; and 4, the very rare case of "central rupture," in which the foetal head is forced through the perinæum, leaving its anterior and posterior margins uninjured. Such a division is practically useful, as in each case some modification in the operative procedure becomes necessary.

The inconvenience suffered by the patient from a laceration of the perinæum depends, of course, on its extent. A slight tear, or one not more than half or three-quarters of an inch in extent, is not of any material importance. When, however, the whole length of the perinæum down to the sphincter ani, is torn through, the loss of support to the pelvic floor is sensibly felt, and a feeling of weakness, of weight, and of bearing down is complained of. The absence of the perinæum predisposes, also, to dilatation and prolapse of the posterior wall of the vagina with the rectum—rectocele—or of the anterior wall with the bladder—cystocele—or even of the uterus itself.

When the sphincter ani is torn through, the inconvenience is greatly increased, as, in addition to the loss of support, there is inability, partial or complete, to control the passage of the feces, which, when fluid, will almost always escape involuntarily, though, when solid, they may be retained tolerably well by the fibres of the internal sphincter. In the more serious case, where both sphincters and the recto-vaginal septum are involved, all fecal matters, whether solid or fluid, as soon as they reach the lower part of the rectum, necessarily escape externally, and the patient is in a most miserable condition.

In former times but little was effected by surgery for the reparation of these lesions. Recently, however, the improvements in the mode of applying sutures, and the introduction of silver and other metallic wires for that purpose, have been the means of saving a large number of women from life-long misery; and when the parts are in a healthy condition, an operation for the repair of these lacerations may be undertaken with almost a certainty of success.

The question arises whether such an operation should be practised immediately after the occurrence of the injury, that is to say, within twenty-four or at most forty-eight hours after delivery, or whether it should be delayed till the torn surfaces have healed, and the parts have been restored to a quiescent and healthy condition. The former plan is recommended by many authorities, and has the recommendation that time is saved by it, and that the patient is spared the inconvenience of a subsequent confinement to her bed for two or three weeks. Against it, however, may be urged, first, that in many of these cases, where the parts are not severely injured, cicatrization may take place by



natural means to a sufficient extent to free the patient from any material inconvenience, without any operation at all; and, secondly, when there is laceration, the parts are in a condition very unfavourable for adhesive union, and the operation will therefore not unfrequently fail, while if it should succeed it is not likely to produce so firm and thick a perinæum as may be obtained if the operation is delayed till a later period.

It is through the writings of Dieffenbach, of Langenbeck, of Fricke, and especially in this country through the persistent advocacy of Mr. Baker Brown, to whose work on the *Surgical Diseases of Women* the reader is referred, that the attention of the profession has been called to this operation, and an immense number of patients, whose cases would have formerly been considered hopeless, have obtained permanent and complete relief.

The method of operating which modern experience has shown to be most efficacious, is the bringing together the torn surfaces, and maintaining them in apposition by means of the quill suture, after the removal of any irregularities if the operation is undertaken immediately, or the careful denudation of the cicatrised surfaces if it is deferred till a later period.

Different operators have suggested various modifications in the details of the procedure, which want of space renders it impossible to dwell upon, but the following is the plan which has been adopted by the writer with almost uniform success in nearly one hundred cases, some modifications being required according to the severity of the laceration.

Referring first to the cases in which the perinæum has been torn down to but not through the sphincter muscle—the patient being placed in the lithotomy position, a portion of skin and mucous membrane is dissected off on each side of the lower half of the vulva, so as to form a raw surface, which should be about an inch and a half in length on each side, the right and left portions being continuous with each other below across the median line. It should be an inch or more in depth antero-posteriorly at the lower part next the anus, but may diminish to about half an inch in depth towards its upper part. It is better first to mark the outline of this raw surface by incisions with the scalpel, and then to dissect off the mucous membrane, the thinnest possible layer of which should be removed. This is better than transfixing the part with a knife, and cutting a sort of flap from within outwards, as recommended by some, as a smaller amount of tissue is removed, and vessels of any size are less likely to be wounded. Care should be taken that the denuded surface is not situated too far outwards upon the buttock, or too far inwards towards the vagina, but just where the opposite sides would naturally and readily come in contact. The deep sutures which are to hold the quills are next to be inserted. For this purpose the most convenient instrument is a strong needle set in a handle, with an eye near the point, and bent at a right angle at about three and a half inches from the point, the part from the angle to the point being slightly curved. This should be entered through the skin on the left side of the patient, about an inch external to the cut surface, and be brought out close to the posterior edge of that surface, taking

hold of as much tissue as possible; and should be then thrust onwards through the opposite side at a corresponding depth. The eye near the point may then be threaded with a strong wire suture, and the needle is withdrawn, carrying the suture with it. I am in the habit of using four deep sutures of silver wire, and of fastening them to perforated ivory bars, which represent the quills. Each ivory bar is perforated with four holes about half an inch apart. One of these should be ready threaded with two pieces of wire, each piece being looped through the two adjacent holes, and when the four sutures have been passed, they are passed through the holes in the second ivory bar, and being drawn tight, the whole is firmly secured by twisting together the ends, first of the two lower, and then of the two upper wires. By having the wires looped on the one side, no fastening is required on that side, while on the other side two adjacent wires are fastened simultaneously, thus saving time, and securing a more uniform pressure on the part. The quill suture serves to hold the deeper part of the cut surfaces in contact, but the cutaneous edges must also be held together by four or five superficial sutures of finer wire. In the case now under consideration, where the sphincter is entire, there is no occasion to divide it, as its action in no way interferes with the apposition of the cut surfaces.

The patient should then be placed in bed on her side. Sufficient opium should be given to prevent the action of the bowels for the first seven or eight days, and the urine should be drawn off twice or thrice daily with a catheter. The deep sutures should be cut and removed, together with the ivory clamps, at the end of forty-eight hours. Some œdematous swelling generally takes place, but soon subsides when the pressure of the quill suture is removed. If left longer than this, irritation and suppuration is apt to be set up, and no compensating advantage is obtained. The superficial sutures need not be removed till the sixth or seventh day, by which time tolerably firm union will in most instances have been obtained. The bowels may now be emptied by a brisk aperient, followed by an enema, and the opiates discontinued. The catheter may also be dispensed with.

In this way a thick and firm perinæum will in most instances be obtained, and if the operation be properly performed, failure will rarely be met with.

In the cases where the sphincter has been torn through into the rectum, somewhat greater care is necessary to secure accurate contact at the lower part, and especially to prevent any aperture being left between the rectum and vagina behind the newly-made perinæum. The latter untoward result may be best avoided by splitting the recto-vaginal septum for a short distance in the horizontal direction, at the point where it forms a sort of éperon at the centre of the torn part. Then, by turning up the vaginal portion of the split septum, and causing the two lowest of the deep sutures to take a slight hold of it on its raw surface as they are passed through, it will effectually cover the spot where otherwise a recto-vaginal communication might probably be left, while it will, at the same time, increase the thickness of the lower part of the new perinæum. In this class of cases, division of the sphincter is beneficial, as

the action of the muscle otherwise tends to separate the surfaces, and especially to open the lower angle of the wound, but an incision on one side only is sufficient for the purpose; it is unnecessary to cut it through on both sides, as has been recommended.

In the still more severe cases in which the recto-vaginal septum is torn for a greater or less extent upwards, the operation above described will be insufficient, as a recto-vaginal communication would be almost certain to remain. It is therefore necessary first to unite the recto-vaginal septum, and afterwards to restore the perinæum. To unite the recto-vaginal septum, the edges must be pared on each side, and a sufficient number of wire sutures inserted. These may be secured by simply twisting their ends, no quill suture being required. When union is complete and firm, which will usually be at the end of about three weeks, the second operation for the restoration of the perinæum may be undertaken on the plan already described.

In the rare case of central rupture of the perinæum, the better plan will be to divide the remaining anterior portion and then to proceed in the ordinary way.]

James R. Lane.

**VAGINA, PROLAPSUS OR INVERSION OF.**—According to Sabatier and Levret, the lining of the vagina is alone displaced; but Richter, Chelius, and other writers describe the vagina as liable to two kinds of prolapsus: in one, all its tunics are included in the protrusion; in the other, its living membrane only is relaxed. In the first case the inversion of the vagina is associated with prolapse of the uterus, and is a necessary consequence of that condition (see UTERUS, PROLAPSUS OF). It is only in the latter case that the uterus may not be involved. (*Chelius, Handb. der Chir. b. i. p. 771.*)

Occasionally a prolapsus of the posterior portion of the vagina is observed in consequence of *vaginal hernia* (see HERNIA); though in some cases of dropsy, a circumscribed protrusion of the vagina, in the form of a cyst filled with fluid, is sometimes observed. [Again, a prolapsus of the anterior wall of the vagina, together with the bladder, is not unfrequent, and constitutes the condition known as vaginal cystocele (see BLADDER, DISEASES OF), while, similarly, prolapse of the posterior wall with the rectum forms a vaginal rectocele (see RECTOCELE).

A prolapsus of the inner membrane of the vagina is seldom more than half an inch or an inch in extent, and is usually limited to the posterior and lower part of the canal, which is somewhat loosely attached to the rectum; whereas the anterior wall being firmly connected with the neck of the bladder, and with the urethra which passes through it, is seldom, if ever, displaced.] This condition, while small and recent, may sometimes be removed by astringent applications. When, however, it is of long standing, much expectation of success from this treatment cannot be entertained, and in such a case a prolapsus of the inner membrane of the vagina, when limited to one part of it, may always be safely extirpated. (See *Richter, Anfangsgr. der Wundarzn. b. vii. chap. 4. J. C. Loder, Progr. 1-3. De Vaginæ Uteri Procidencia. Jen. 1781. M. J. Chelius, Handb. der Chir. b. i. p. 770. Heidelb. 1826.*)

**VARICOCELE** (from *varix*, a distended vein, and *κήλη*, a tumor); sometimes called *Cystocele* (see the word), is a varicose distension and enlargement of the spermatic veins; and, whether considered on account of the pain which it sometimes occasions, or on account of the wasting of the testicle, which now and then follows, it may truly be called a disease. It may readily be mistaken for a descent of a small portion of omentum. The uneasiness which it occasions is a dull kind of pain in the back and testicle, which is generally relieved by suspension of the scrotum. In the course of the cord, an irregular swelling, consisting of several enlarged vessels, can be felt, which swelling has a pyramidal shape, with the broad part towards the testicle and the narrow part towards the abdominal ring. When the patient lies on his back, the tumor diminishes, or disappears altogether, because this posture promotes the return of the venous blood; but when the patient stands up it reappears, because the column of blood in the spermatic vein has then to ascend against its gravity. Moderate pressure with the hand will make the tumor disappear, not all at once, but gradually; and, when the pressure is taken away, the swelling reappears; not suddenly, but in a slow and gradual manner. It has been fancied to resemble a collection of earthworms; but, whoever has an idea of a varicose vessel will not stand in need of an illustration by comparison. It is most frequently confined to that part of the spermatic cord which is below the abdominal ring; and the vessels generally become larger as they approach the testis. M. Blandin refers to instances of varicocele of both sides so large as to conceal the testes and the penis. (See *Dict. de Méd. et de Chir. vol. xv. p. 566.*)

In the greater number of cases, the disease remains stationary and occasions no serious inconvenience, so that many persons have it without being aware of the circumstance. In other instances, however, it produces a sense of weight, and even acute pain in the testicle. Sir Benjamin Brodie had a patient in whom the pain was very severe, in consequence, as was suspected, of the varicose cluster pressing on some nervous filament. (See *Lond. Gaz. Med. vol. xiii. p. 378.*)

[Occasional sharp neuralgic pains are not unfrequent in this affection, but the pain is not dependent upon the size of the tumor, for it is generally most severe in recent and rapidly formed cases where the varicocele has not attained a large size, and is due, no doubt, to the sudden compression of a branch of nerve: the co-existence of varicose veins and neuralgic pain is often met with in the lower extremities and other parts of the body from a similar cause. As a rule, a large varicocele which has been gradually formed is not a painful affection, and is productive of inconvenience simply from its weight and the sense of dragging upon the cord.]

When a varicocele becomes large and is of long standing, it is apt to produce atrophy of the testicle, in consequence of the imperfect circulation of blood through it, resulting from the dilated condition of the spermatic vein and its branches. Pott had seen this organ so wasted as hardly to be discernible; and Mr. S. Sharp noticed the same thing. Pott had also observed the same effect from the injudicious application of a truss to a varicocele; the vessels, by means of the pres-



sure, became enlarged to a prodigious size, but the testicle shrunk to almost nothing. (*Poll's Works*, vol. ii.)

The spermatic veins (M. Velpeau observes) which are tortuous, undulating, very large, and to the number of two, three, four, or even more, are readily distinguishable down to the epididymis, and usually placed in front and at the sides of the other vessels. Long, soft, with defective valves, continually dragged by the weight of the testicle, enveloped in loose cellular tissue, exposed to compression in the inguinal canal in consequence of the double bend which they make, and being also equally pressed upon in the iliac fossa in front of the muscles, by the end of the ileum, or the cœcum, on the right, and by the sigmoid flexure of the colon on the left, it is not surprising that the spermatic veins should frequently be the seat of varicose dilatation, and that a varicocele should become sometimes very large. The kind of knotty chain, which they then form, gradually enlarges as they approach the testicle, because their branches increase in number in proportion as they come nearer to the lower end of the cord. This fact proves, that in order to obliterate them by incision or ligature, as anciently practised (*Paul. Ægin. Sprengel*, t. vii.), and in modern times successfully by Delpech, they should be exposed as high as possible. (See *Alf. Velpeau, Anat. chir.* p. 199. t. ii. 8vo. Paris, 1838.)

[Varicocele is a very common affection; according to Professor Humphry it is present in about one male adult in ten (*Holmes's System of Surgery*, vol. iv. p. 612). It occurs during that period of life when the functional activity of the genital organs is greatest, from fifteen to thirty. It is extremely rare before puberty, and when it commences after thirty, or thirty-five, is usually the result of an injury, or long-continued pressure upon the cord, and it then seldom attains a large size. The affection generally shows a tendency to decrease as life advances.

The formation of a varicocele is due to other causes than those which produce varices elsewhere; as it is exceptional to find this disease co-existing with a varicose condition of the lower extremities, or even with hæmorrhoids. These causes are partly structural and partly accidental.

The accidental or exciting causes are such as promote a frequent afflux of blood to the testicle, or offer an habitual obstacle to its return. These are: venereal excesses; masturbation; hard riding; injuries to the testicle; tumors in the groin or abdomen; a hernia; a badly-fitting truss; various chronic affections of the scrotum and cord; prolonged muscular efforts, &c. The structural causes are: the dependent position of the testicles; the great length of the spermatic veins; their feeble coats and imperfect valves; their large size and plexiform arrangement within the scrotum; the vertical ascent of the column of blood within them, and its continuous pressure upon their lower branches; and the abrupt angles formed by the vessels as they enter and leave the inguinal canal would tend also to impede the current of blood. To overcome these difficulties special auxiliaries are developed to aid in the venous return; of which the cremaster muscle and the dartos tissue are the chief. These structures, by the support and compression they afford to the veins whilst in the scrotum, are of material service in preventing

congestion, and in promoting the onward flow of the blood. This is well shown by the fact that those persons who are the subjects of varicocele are generally of a lax, flabby habit of body, and as the dartos and cremaster share in the general relaxation of the tissues, the testicles lose their necessary support, and distension of the veins results. For the same reason residents in warm damp climates are peculiarly liable to this disease.

Although these causes would operate in the formation of a varicocele equally on both sides of the body, yet in the vast majority of cases the disease occurs on the left side only, and a number of reasons have been assigned to account for this circumstance. Examples of double varicocele are, however, occasionally met with. But in these the right veins are almost always much smaller than the left. (*Landouzy, de Varicocele*, 1838.) Mr. Erichsen, though, alludes to one or two instances where the right veins formed the larger tumor. (*Science and Art of Surgery*, 3rd edit. p. 1118.)

Morgagni remarked that the disease is more frequently in the left than the right spermatic cord; a circumstance which he refers to the left spermatic vein terminating in the renal. (*De Sedibus et Caus. Morb. Epist.* 43, art 34.)

[Sir Astley Cooper adopted this view, and considered that the junction, at a right angle, of the left spermatic vein with the renal, and the horizontal direction of the larger current of blood along this latter, would offer such an obstacle to the free discharge of blood from the spermatic as to cause permanent congestion of that vein, and therefore a tendency to varicocele. Vidal de Cassis also insisted so strongly upon this being the correct explanation, as to assert that when the affection occurs upon the right side, it was owing to a transposition of the internal viscera.]

Mr. Mayo joins J. L. Petit, Callisen, and Richerand, in stating that it is more frequent on the left side than the right, "owing to the position of the sigmoid flexure of the colon over the left spermatic veins. For the same reason (he adds) it is often benefited by purging." (*Outlines of Human Pathology*, p. 562.) M. Blandin also specifies, as one cause of varicocele, the pressure of the large intestine on the spermatic veins. (See *Dict. de Mèl. et de Chir. prat.* vol. xv. p. 562.)

It is sometimes alleged, that even in persons who are not habitually costive, the left spermatic veins are naturally more tortuous and capacious than the right. Cruveilhier also takes into account the generally larger size and lower situation of the left testicle, as possibly concerned. (*Blandin*, vol. cit. p. 564.)

[It is probable that all these causes may conduce to the formation of a varicocele on the left side rather than on the right; but the much greater length of the left spermatic vein is alone sufficient to account for the almost constant occurrence of the affection on this side. For not only is the left vein longer in consequence of the more dependent position of the testicle, as alluded to by Cruveilhier, but its point of junction with the renal is at a much higher level than that of the right spermatic vein with the vena cava; and this circumstance must constitute one of the chief determining causes for a varicose condition of the left vein.]

Varicocele is, more frequently than any other disorder, mistaken for an omental hernia. When

large it dilates upon coughing; and it swells in the erect, and retires in the recumbent, posture of the body. There is only one sure method of distinguishing the two complaints: place the patient in a horizontal position, and empty the swelling by pressure upon the scrotum; then put the fingers firmly upon the upper part of the abdominal ring, and desire the patient to rise; if it is hernia, the tumor cannot reappear so long as the pressure is continued at the ring; but if it is a varicocele, the swelling returns with increased size, on account of the return of blood into the abdomen being prevented by the pressure. (*Sir Astley Cooper on Inguinal Hernia.*)

When the complaint is attended with pain, cold saturnine astrigent lotions may be applied, and, if very severe, blood may be taken away by means of leeches; the bowels should be kept open; the patient placed in the horizontal posture; and the testicle supported by a suspensory bandage.

In general, nothing more is required than the suspensory bandage, cold applications, purgatives, and sometimes leeches, to remove any temporary uneasiness or pain resulting from varicocele; and then the disease remains stationary, the patient merely wearing the suspensory bandage, without which the uneasiness will soon return. Patients with varicocele should also have recourse to cold bathing, and avoid costiveness; which precautions, if not adequate to effect a radical cure, will generally keep the disease from making progress and becoming troublesome.

Gooch and other writers relate cases in which the pain was so intolerable and incurable, that castration was the only means of relief. Putting castration out of the question, let us briefly inquire what expedients have been tried when the disease is productive of unusually severe pain, and resists ordinary treatment. Some practitioners, on the authority of Celsus, have cut down upon the varicose veins and put a ligature round them. In one instance, Sir Everard Home, like Paul Cumanò, at Trieste, performed such an operation in St. George's Hospital. "In this case, venous inflammation took place, attended with so much constitutional disturbance, that the patient nearly died." (*Sir Benjamin Brodie, in Lond. Med. Gaz. vol. xiii. p. 379.*) At the present day, this use of the ligature is abandoned; for if not followed by a dangerous or fatal attack of phlebitis, it would probably be so by atrophy of the testicle.

J. L. Petit, in several instances, cut away the clusters of varicose spermatic veins, as is stated, with such success that, in one instance, where the varicocele had been as large as a child's head previously to the operation, the function of the testicle, which had been in a weakened state, was strengthened by this proceeding. More generally, however, atrophy, or sometimes even suppuration of the testis, might be a consequence of the ligature or excision of the veins. It appears that the latter was what happened to the patient operated upon by Delpech, and by whom this distinguished surgeon was assassinated out of revenge. (See *Blondin, vol. cit. p. 568.*)

In the hope of avoiding both phlebitis and atrophy of the testicle, M. Davat recommended passing under the veins, through the integuments, a pin, over which a ligature was twisted so as to make pressure. With the same view, M. Breschet proposed obliterating the vein by pinching it up

together with the skin, by means of a pair of compressing forceps. Another practice is that of Dr. Fricke, which consists in passing a seton, of three or four threads, through the bundle of varicose veins. In a case of varicocele of such severity as to require an operation, Mr. Mayo would be disposed to recommend the application of potassa fusa to the plexus of veins, having first exposed them by dividing the skin. (*Outlines of Human Pathology, p. 562.*)

The practice advised by Breschet or Fricke has the recommendation of simplicity and mildness. But I believe the necessity for any operation is very rare. In one case, where the pain was excessive, and supposed to arise from pressure of the varix on some nervous filament, Sir Benjamin Brodie divided the skin, and then cut through the varix with a pair of scissors. "A little bleeding took place, but none of any consequence; pressure for a few minutes stopped it. The wound healed; no inconvenience followed the operation, and the patient was entirely relieved of the pain he suffered previously." (See *Lond. Med. Gaz. vol. xiii. p. 379.*) In another case of bad varicocele, in a boy, the same gentleman applied a blister over the tumor, and kept it open, and the varicocele and the pain were considerably lessened by it.

Mr. Wormald has lately mentioned some cases in which painful varicoceles were relieved by means of a ring, about an inch in diameter, made of soft silver wire, of a suitable thickness, padded and covered with wash-leather. "Through this," says he, "I drew the lower part of the scrotum, whilst the patient was in the recumbent position, and the veins comparatively empty. I then pressed the sides of the instrument together with sufficient force to prevent the scrotum escaping. The use of this instrument, every morning before the patient rose from his bed, enabled him to walk nineteen miles on the third day after its application; and although he has for six years worn an instrument of this description, he has never experienced the least inconvenience."

[Many methods of operation have been devised for the relief of this affection, all having for a common object the obliteration of the dilated veins. Ricord has applied to a varicocele the very ingenious form of ligature recommended by Tavignot for an artery, and it has been largely practised. It consists in passing a double ligature through the scrotum between the veins and the vas deferens, and another through the same openings in the skin, but commencing from the opposite side above the veins between them and the integument: the double ends of each ligature are then passed through the loop of the other, so that the veins are included in a sort of running knot; the ligatures are fastened to an instrument with a rack, called a *serre-nœud*, and tightened daily until they cut their way through the veins. Of the many operations which have been suggested, that which seems best to fulfil the purpose of occluding the veins, and to offer less risk and inconvenience to the patient, is the method of Davat, referred to above, which has since been practised by Velpeau, Jobert, Liston, and others. In this a pin is passed through the scrotum beneath the veins, between them and the vas deferens, and a ligature twisted round the ends of the pin in the form of a figure 8, so as to make sufficient pressure to arrest the flow



of blood through them: the pins should be removed after about four days, by which time obliteration of the veins will have been effected by adhesion of their internal coats: if the varicocele be very large more than one pin will be required.

Mr. Henry Lee has recommended compression of the veins by two pins introduced about one and a-half inch from each other, and subcutaneous division of the vessels between them; but this plan does not seem to offer any advantages, whilst it is attended with more risk than the other.

As above stated, an operation is very rarely needed in this affection, and should never be undertaken until all other means have failed. In the vast majority of cases the palliative measures at our disposal are quite sufficient to relieve the inconveniences occasioned by a varicocele; the disease, moreover, has a tendency to diminish with age; and, except in extreme cases, does not prevent the procreative function. On the other hand, very grave and even fatal consequences have at times followed the several operations employed: atrophy of the testicle is not an uncommon result; a gradual recurrence of the affection is not rare, unless a suspensory bandage be permanently worn; whilst phlebitis, pyæmia, and the other dangers which attend operations upon veins are incurred, and anxiety therefore must always be felt as to the issue of this otherwise very simple proceeding.]

G. G. Gascoyen.

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VARIX.—[Synonymes: Ancients, Varix and Circus. French, Varices and Phlebectasie. German, Blutaderknoten; Krampfadern. Italian, Varice.

Definition.—A compressible tumor formed in the course of a vein, and consisting of the permanent dilatation of part of its canal.

Description.—Varices look for the most part like straight or tortuous cords of a blue colour, more or less sacculated and of greater or less size, soft, slightly elastic, firmer at some points than at others; occupying a greater or less extent of a limb; capable of being emptied by pressure (except when occupied by coagula), and refilling rapidly when the pressure is removed, and not generally adherent to the overlying skin. When the capillary vessels are alone affected they will appear as minute red or blue lines permeating the surface, while when the larger vessels are much implicated, several dilatations may coalesce so as to form large bosses resembling a mass of entwined leeches. Varix may affect the capillary or the larger veins alone, or may simultaneously implicate both.

Varicose veins are rendered more prominent by heat and the long continuance in the erect posture. In shape they may be round, oval, or irregular, and the greatest amount of dilatation occurs at the seat of the valves.

Pathology and Morbid Anatomy.—The writer is indebted to Professor Aitken for the following exposition of the morbid anatomy of varices. It is chiefly in the small and medium

sized veins that this part of the subject has been successfully studied. Both the coats of the vessels and the textures around them have been examined.

There are some anatomical and physiological conditions peculiar to the veins which render them liable to those influences which cause the varicose condition. These may be shortly stated to be the small amount of contractile tissue, the sparing development of elastic elements, and the comparatively great preponderance of the fine connecting tissue of filamentous fibres. Readiness to collapse and incapacity to contract are natural properties of the veins. An increase of tissue in and about the coats of the veins, by which they remain open and patent when cut across, is one of the morbid states associated with the condition of varix and which it is necessary to describe.

The structure of the medium sized veins, as that of the vena saphena magna, is best observed by boiling its tissue in diluted acetic acid (one to six) and examining it by sections with the aid of needles. We can then verify the description given by Kölliker. The textural elements may be thus arranged:—(1) common undulating binding tissue, with (2) fine isolated elastic nucleated fibres intermixed, and surrounding (3) a large amount of smooth muscle tissue, composed of long and broad fusiform elements. Kölliker also describes smooth muscle cells in the innermost coat of the saphena. The laminated arrangement of the tissues can readily be detected in successful sections. It is chiefly in the properties of the twig, the elastic and the smooth muscle tissue, that those alterations are to be observed which are associated with the condition of varix in the first instance, or in some cases, as the process of development from one morbid state to another is not clearly made out.

The following three conditions may, however, be stated:—(1) changes in the textural elements of the veins; (2) the exudation of new formations amongst the textural elements of the vein; (3) changes in the tissues immediately surrounding the vein. The secondary effects which immediately result from these changes are:—(1) atrophy of the vein substance; (2) hypertrophy from deposition of new matter; (3) the formation of cysts (hæmorrhoids?); (4) wasting or degeneration of neighbouring textures, and the formation of ulcers commonly termed "varicose."

The obvious physical conditions of varix may be shortly stated to be—(1) turgescence from blood; (2) diffuseness of distribution; (3) convolutions and dilatations. These three morbid states, viz. the altered histological elements, the secondary effects, and the obvious physical conditions, act and react upon each other so that it is difficult, if not impossible, to trace the pathological changes in the order of their succession; but some observations remain to be made regarding the circumstances which are observed to be associated with, or which bring about some of the phenomena described above. The atrophy of the walls of a vein is seen associated with dilatation of its calibre, and degeneration of the histological elements of the middle coat. The contractile cells become granular, and this combined with pressure against the sides of the vessel, caused by the increased volume of blood, gives rise to atrophy and attenuation. Associated with this state the atrophy ad-

vances irregularly and permits the membrane of the vein to project so as to form sacculated dilatations. The hypertrophy of varices is occasioned by the development or deposit of new material. The fibrous texture of the outer coat is sometimes so increased that it cannot be separated from the areolar tissue around. Such veins do not collapse when cut across, and the elastic and contractile tissue of their middle coat undergoes degeneration and paralysis. Such veins no longer yield, like healthy veins, to forces applied to their interior or to their walls. It is in these cases that the surrounding cellular tissue undergoes such important changes—becoming thickened and condensed. The cells of the adipose tissue become infiltrated with a dull white pellucid lardaceous serum, and the fine areolar tissue is so much condensed around the veins, that a crisp feeling is given to the knife when dissecting them out. The function of absorption through the coats is in abeyance, but we do not know what alteration the blood undergoes within them.

A vein may be uniformly dilated or may be bulged at some parts and unchanged at others; and this last irregular condition it is which constitutes true varix.

Many classifications of varix have been attempted. Anchal recognised six varieties of the affection, Briquet three, and Rokitansky two, which, he adds, merge into one another, and are often simultaneously present in the same vessel. The vein, being dilated and elongated, assumes, according to Rokitansky, a winding course, bulging more at one side than at the other; while projections of the venous wall form along the interior and give it a partitioned appearance. The second kind presents itself when a large lateral sac forms at a limited spot, and is connected with a canal of the vein by a greater or less opening. The valves for a time continue to increase with the vein and then cease to enlarge, so that they become no longer capable of closing the vessel, and either remain tense across its channel, or turn, contrary to the usual disposition, towards the periphery, or, giving way, hang in shreds in the blood-stream, till they finally shrink and well-nigh disappear. These circumstances show that the valves cannot prevent the action of the column of blood on the walls of the dilated veins distant from the heart, as Briquet supposed they could.

Phlebolites—the result of a stasis and coagulation of the blood—are occasionally met with in varicose veins, especially in those of the abdomen and pelvis; and calcareous concretions and stratified coagula, similar to those seen in abdominal aneurismal sacs, have been met with. The sacs containing these at times get closed, so as to be shut off from the channel of the vessel, and degenerate into fibrous capsules. The canal of the vein may, however, get blocked up and its varicose condition increased by small coagula, which may either become dissolved and washed away for ever in the torrent of the circulation, or be replaced by others whose presence may give rise to phlebitis. The vein is said to be less elastic and not so compressible at the points occupied by these coagula.

Acute inflammation, with the effusion of its ordinary products, occasionally occurs in varix. Pus may be thus effused, or the vessel may be obliterated as in phlebitis. The latter termina-

tion is of course the more favourable one, and that which entails no evil results except those due to the arrested circulation through the vessel. A chronic form of inflammation, leading to hypertrophy of the coats and their agglutination to the parts around, is more common than acute action of an inflammatory character. Ulceration, too, may become established, and, beginning either in the coat of the vessel or in the surrounding tissue, may perforate the vein and give rise to fatal hæmorrhage. The valves, being insufficient, allow of bleeding taking place from the proximal side. Delpech accounts for this ulceration by ascribing it to the pressure of the clot within the vessel. So, too, he explains the comparative rarity of hæmorrhage in these cases, as the clot has closed or obliterated the vessel before it is opened. Haller and Clive, however, report cases of fatal hæmorrhage from the jugular; Portal and Morgagni from the vena azygos; Portal from the subclavian; Amussat from the saphena; Kyle of Dundee, Hasse, and others from the pudendal veins; Mitchel of Philadelphia from the veins of the stomach; and Velpeau from those of the leg. Mr. Adams, of the London Hospital, has well shown the advantage of elevating the limb in cases of profuse hæmorrhage from varicose veins of the leg, as, from the valves being destroyed, there is nothing to bear the column of blood. Elevation generally succeeds in temporarily arresting the bleeding, and the permanent closure of the vessel is accomplished by compress and bandage. The stasis and sub-acute inflammation to which varices are liable give rise to œdema, hypertrophy, induration, and ulceration in the cellular tissue and skin of the limb, causing them to coalesce, and makes the ulcer so often formed in connection with this condition peculiarly difficult to heal (see VARICOSE ULCER). The skin in these cases changes its colour and becomes red, and ultimately of a dark brown or livid hue.

*Causes, predisposing and exciting.*—The ancients ascribed the varicosity of a vein to its containing bad or effete blood. In modern times mechanical obstructions are generally looked upon as the most common cause of varices, though some writers, as Chaussier, Delpech, Samuel Cooper, and Briquet, deny altogether the general influence of such causes. Obstructions may occur at any part of the venous system; but the nearer they are placed to its centre, the more extensive will the resulting affection be. It is not necessary that such obstruction be complete. If the channel of the main trunk be reduced below that size which is necessary for the transmission of its tributary streams, a state of dilatation in the peripheral vessels will in all probability follow. If the collateral circulation is with difficulty established, from the existence of few branches leading off the obstructed vessel, so much more surely will a varicose condition arise. A tumor within the thorax or in the axilla will in general be found to be the cause of varix of the veins of the head, neck, or upper extremity; and a continued patency of the umbilical vein, with an anastomosis existing between it and the superficial abdominal veins, is a fruitful source of varices on the abdominal wall. "Caput Medusæ" is an appellation which has been applied to varices in the last-mentioned position when they have attained a great development and peculiar arrangement. The long maintenance of the



erect posture, particularly if combined with fatigue, as in marching, is probably the cause why some trades and professions are so obnoxious to the disease under consideration; while exposure to wet and cold, or to great heat, is the reputed source of the affection in the case of others. The frequent establishment of a state of hyperæmia is at least a strong predisposing cause. This is seen in effect in the neck of the bladder of old men, and those who have long suffered from calculous disease. The increased activity of the circulation, and perhaps the pressure exercised on the deep vessels, accounts in all probability for the varicose condition observed in the vessels around diseased joints and scirrhus tumors.

Sub-acute inflammation attacking veins is a strong predisposing cause of phlebectasis. The gravid uterus, uterine polypi, cysts of the ovary, some diseases of the liver, tumors of the groin, ligatures (as tight garters or over-tight lacing), phlebitis terminating in limited obliteration, oft-renewed or long-maintained muscular exertion, by which the blood is forced from the deep into the superficial veins—all these act mechanically in bringing about a dilated condition of the veins. Herapath of Bristol has described a varicose condition of the saphena due to the influence of the falsiform edge of the opening in the fascia lata strangulating the vein. A varicose condition of the veins at the bend of the elbow may be due to the wounding of the artery as well as the vein in venesection, and the establishment of a communication in consequence between the vessels (see ANEURISMAL VARIX). Pigeaux thought that such a communication was the invariable source of varices, founding his opinion on the brighter colour of the blood contained in such dilatations to that which is present in unaffected veins, and the fact that varicose tumors not uncommonly pulsate synchronously with the arterial pulse. J. L. Petit explained the former phenomenon by the rapidity with which the blood passed through the enlarged capillaries, preventing it being decolorised, and the subjacent position of an artery is in most cases the cause of the pulsation. The weight of the column of blood is the probable cause of the prevalence of the affection in tall persons. The gouty diathesis is supposed to act as predisposing, and a critical effort of nature to relieve herself from a severe internal disease has been vaguely set down by some writers as an exciting cause. Gunshot wounds of the lower extremities, especially when the injury has been attended by much deep bruising and little superficial destruction, has been considered by Dupuytren and Hennen as causing the development of varices; and Velpeau mentions simple contusion, and other writers sword wounds and strains, as acting in the same manner. In the case of the lower limbs, it is plain that there are certain conditions which must have a considerable influence in predisposing to or establishing a state of dilatation in the veins. The long column of blood, the pressure of the viscera of the abdomen on the vena cava inferior, and the effect of muscular action—all serve to impede the return of the blood to the heart, and so to bring about that state of matters which is under consideration.

Rima of Venice, judging from the fact that (1) the blood flows from both the upper and the lower orifices of veins when cut, that (2) a com-

pressed vein swells more above than below the position of the ligature, and that (3) the dilatation, in place of disappearing, often goes on increasing above the obliterated point, while it disappears below that point—argues that the cause of phlebectasis is a retrograde movement of the venous blood.

Although in the vast majority of cases one or other of the causes above mentioned will be found in operation, still it is unquestionable that some cases do occur in which none of them is appreciable. The occurrence of the affection in pregnant females at a period of gestation too early to warrant its reference to the mechanical action of the uterus, its limited development in other cases on a limb, or its occurrence in one limb only, will not justify the ascribing all to the dependent position in which the limb has been kept, while the occasional seat of the affection in the unobstructed veins of the head and neck, where the blood-flow corresponds with the direction of gravity, are all as yet unexplained.

Again, though the effect of the obliteration of a venous trunk in giving rise to varix, is in many cases beyond all question; still it is equally true that the opposite condition, that of contraction and obliteration of the peripheral branches, may also follow. The enfeebled muscular and nervous energy, as well as the slower circulation in old people, is more probably the true cause of their proclivity to phlebectasis than any thinning or absolute weakness in the walls of the veins.

*Usual seat of Varix.*—Although much more common in the lower than in the upper half of the body, varix may arise in any part of the venous system. Rokitsky mentions its occurrence in the pia mater of drunkards, and refers to its occasional appearance in the vessels of the choroid plexus. The scalp, face, eye, nose, temple, neck, arm, and thoracic parietes have all been seen thus affected, and the disease in such cases is usually easily enough traceable to causes which are evident, but the vessels on the abdominal walls, those of the spermatic cord, of the rectum, of the prostate gland and neck of the bladder, as well as those around the vesicular seminales, those under the mucous membrane of the bladder, in the vagina, and on the labia majora, those lying between the broad ligaments of the uterus, and more rarely those distributed on the stomach, intestines, and œsophagus, have each and all been observed in a varicose condition. The intercostal and lumbar veins have been found similarly enlarged in cases in which the vena cava superior has been obliterated, and the veins of the urethra are said, at times, to assume a similar condition. The veins around diseased joints and rapidly-growing tumors are also subject to dilatation. It is, however, in the lower extremities *par excellence* that phlebectasis presents itself, but not, as is generally supposed, by preference either in the superficial vessels, or in the internal saphena in particular. Verneuil has on the contrary shown that the saphena is not uncommonly atrophied when the deeper vessels are varicose, and that—so far from the superficial vessels being more frequently enlarged than the deep—the disease in general begins in the latter and extends to the former, and that the inter-muscular twigs are frequently implicated. He has also shown that the affection may be confined to the deep vessels, but that the superficial

veins are never affected without the deep being at the same time diseased. The affection may be confined to one limb or implicate both, and in general one is worse than the other—a result which has been variously explained. Rokitsansky says that it often begins in, and is most developed in the thigh in females, while in men it more frequently extends from the leg upwards. Hasse, again, says it commonly begins in the main vessel in men, and in the minute twigs in women. Both have probably formed their opinion on too narrow an induction.

*Sex and Age.*—The male, according to continental, and the female, according to British authors, is most obnoxious to varix. Rokitsansky believes them to be equally liable to it. The occupations of men would *a priori* lead us to believe them more subject to the affection, yet the influence of gestation in the case of the latter is very considerable in equalising the degree of proclivity. Though it occasionally appears in the young, and may extend to a late period of life, still it is most observed in persons of middle age. The cessation of the menses marks a common period of its development in females, and Nélaton quotes two cases from Briquet, in which a flow of blood from varices was vicarious of menstruation.

*Constitutions and Trades liable to Varix.*—Persons in weak health with feeble hearts and torpid circulations are perhaps most subject to extensive varicose disease, while muscular men of strong circulation are subject to the affection, though in a more limited degree, and from an opposite cause. In the case of the latter, muscular exertion is said to give rise to varix by the pressure to which the deep vessels are subjected, and in this way the affection may be developed in the upper extremity. No temperament appears markedly obnoxious to varix, though many authors, arguing theoretically, say that the bilious peculiarity predisposes to it. M. Begin has concluded from his extensive observations made upon soldiers that the soft lymphatic temperament is not, as is generally believed, that in which varix is most apt to arise, but on the contrary, that in such constitutions the veins are peculiarly straight and narrow. Hasse, again, speaks of “a peculiar habit of body—a preponderance of the venous system which manifests itself through the intervention of influences at once mechanical and dynamical.” It has been said that occupations which necessitate long standing, especially if exposure to wet and cold be also borne, are thought to be a fruitful source of varix; but M. Duchatelet has not found this confirmed among the “*débardeurs*” of the Seine, who remain with their feet long immersed in cold water. Washerwomen, boatmen, printers, coachmen, footmen, masons, cooks, smiths, soldiers, itinerants, dancers on the tight-rope, persons who carry great weights on their backs, as porters, women who have been frequently pregnant, tall persons, and those who suffer from torpid bowels, are all said to be subject to varix. The hereditary transmission of the disease, especially in the hæmorrhoidal vessels, is much insisted on by some German authors, but has not been verified in this country. Hasse lays it down as an axiom that “the offspring of a parent subject to one form of the disease is liable under propitious circumstances to become affected with either of the other forms.”

*Diagnosis.*—From what has been already said,

little need be added under this head. Larger varicose vessels near the heart have been mistaken for aneurism, from their strong pulsation, which motion was first noticed by Morgagni in the jugular. In the vagina and groin many errors of diagnosis have been made between varices, abscesses, and herniary protrusions. M. Bonnet has drawn attention to the undulations which may be caused in a large varix filled with fluid blood when it is gently pressed by the finger, and which fact may be useful as a means of distinguishing such sacs.

*Treatment.*—The frequency of the affection, its inconvenience, and its disagreeable results, together with the difficulty and even danger which attends a cure, are reasons which sufficiently explain the attention which surgery of all times and countries has paid to this affection, and the multitude of devices which have been suggested for its treatment. Without assenting to the long catalogue of evils which M. Briquet has enumerated as growing either directly or indirectly from varix, it is yet unquestionable that even in its slighter forms the uneasiness or pain, and the deformity which is occasioned, and the annoying ulcerations, physical weakness, and suffering, as well as the mental harass which attends the aggravated form of the complaint, are sufficient to impress upon us the importance of all which appertains to its management. In looking over the extensive literature of the subject, we cannot but be struck with the extreme contradictions which prevail between the views held by different writers, not only as to the anatomical characters of the disease, its usual seat and causes, but especially as to the best method of treatment to be pursued. Many recommend as a cure what others set down as a most prevalent and potent cause; thus while there can be little doubt but that the pressure of a tumor on the main vein is a frequent cause of dilatation in the vessels on the capillary side, yet we find cases recorded in which a tumor so placed has been represented as the cause of a spontaneous cure of varices taking place, and means are recommended to be employed in treating the disease, which act on the vein in the same manner.

Before speaking of treatment it will be right to premise that authors worthy of credence detail instances of absorption having been repeatedly produced by the compression used in treating varices of the lower extremity—of the disease being vicarious with the catamenia—of its appearance relieving, while its continuance warded off, other serious complaints, mental as well as bodily.

It will of course be a main point towards the treatment to discover and remove, if possible, the cause of the disease. To this end the clothes, profession, and occupation of the patient must in the first instance be examined; then the local relations and conditions of the parts affected, and the state of the digestive organs in particular must be ascertained. It is, however, unquestionable that the source of the disease is not always to be ascertained, even by the most careful examination.

Constitutional remedies will in the majority of cases be of little use, but their employment will be easily suggested by the particular case under observation. Tonics and good diet are often of use, while Dupuytren's long experience countenanced general blood-letting, to prevent abdominal congestion, in many cases in which pressure was applied.



The treatment of varices has been divided very properly into palliative and curative.

The *palliative* treatment in all the many forms which it has assumed aims at the support of the dilated vessels, without obliterating them, by the application of evenly and carefully graduated pressure. Such pressure must be applied from the extremity of the limb and extend above the seat of the disease, as well as being most evenly applied, otherwise the affection which it aims at alleviating will be aggravated. Various elastic substances are in use to fulfil this end. Elastic stockings are used by some, and elastic drawers by others in varix of the lower limbs, while both are reprobated by other surgeons, and the laced stocking, or Churton's elastic bandage or rollers of flannel, or woven texture, preferred. Some report the best results from bandages which exert a considerable amount of pressure, as those impregnated with gypsum or starch. Cold, the application of tincture of iodine, or the use of flying blisters, have also been locally applied and have their advocates. The success attending the use of such agents has not, however, been encouraging in the hands of others. Perhaps Mr. Chapman's suggestion, to use strips of wet lint or calico to support the vessels, is the best which has been made. Gottschalk employed paste rollers in the same way. Chapman recommends strips of cloth two or three inches broad and from twelve to sixteen inches long, applied as Scott does adhesive plaster; a roller is applied afterwards, and the whole wetted several times a day with cold water, a solution of alum, Goulard's lotion, or some such liquid. Friction and the cold douche are used when the bandage is reapplied. Over the sacculated expansions which occur on the vessels, he exercises pressure by means of leather cones and glass buttons. The propriety of continuing the pressure above the knee when the veins of the thigh are varicose was long ago pointed out by Boyer. In fitting elastic stockings Chapman recommends that the measure of the limb should be taken in the morning, when it is unswollen, and perhaps after a few days' application of a roller. This point is of considerable practical importance. In order to take off the weight of the column of blood from the dependent vessels, Brodie draws strips of adhesive plaster across the vessel at various points, and the same end is aimed at in the elastic garters of some surgeons, and the elastic ribbons of others.

Such applications as the foregoing, combined with rest and the avoidance of such exciting causes as fatigue, cold, wet, excessive heat, &c., may be reasonably expected to ameliorate the disease in all cases, by preventing further enlargement, ulceration, and effusion, besides obtaining the absorption of much of the existing exudation; but that vessels in a state of dilatation will return to their normal diameter, need hardly be looked for. Some have objected to the bandaging in such cases from its inconvenience, the difficulty of applying it properly, the excoriations and irritations which at times arise from the imprisonment of the perspiration, and the atrophy and loss of power which occasionally results in limbs long so treated. Such objections are not, however, of much weight. Leeches, as recommended by Boyer, or lancet punctures, as proposed by Petit, may be called for in rare cases.

*Curative Treatment.*—When the disease has

become much developed, and the inconvenience caused by it great, when those grave results which sometimes follow the establishment of the affection have appeared, or threatened to appear, when the palliative measures before mentioned have failed, or cannot be employed, then it becomes a question whether more decisive steps should not be taken to relieve the patient than any above enumerated. The chances and risk must, however, be well considered, and the case judged of by the aid of a careful review of the age, habits, and constitution of the patient.

Of the many modes of treating varix which have been suggested, some, it will be seen, aim at the obstruction of the main vessel, others at the obliteration of the branches.

The ancients destroyed the vein by the actual cautery, or excised part of its continuity. They preferred the latter method when there were many convolutions, and the former when the vessel was straight. The oft-quoted case of Caius Marius serves to illustrate the pain of the burning process. Extirpation was revived in modern times by Boyer, Richerand, and others, but soon fell again into desuetude. The severity and frequent failure, and its uselessness in those cases in which the deep vessels were engaged, are the chief causes which led to its abandonment.

As in the cases of spontaneous cure of varix on record, the favourable result has been produced by a coagulum forming and plugging the vessel, and the final atrophy of the vein into a fibrous cord; and as this effect has been often seen to follow inflammatory action seizing upon the vein, or has resulted from the pressure of a tumor on the vein, or has been occasioned by the sheer debility of the patient, it has been the object in most of the curative methods of treatment proposed of late years to produce a manageable amount of inflammation—of adhesive inflammation, as it is often loosely termed—and in this way to bring about the formation of a coagulum within the vein, the conversion of this into a fibrinous plug, and thus the obliteration of the vessel. The danger which attends all these methods consists in the overstepping of due bounds in the inflammation set up, and the formation of pus, as a consequence, within the vein, and thus poisoning of the constitution by the entrance of the purulent secretion being brought about.

A. Paré, Beclard, and Sir Everard Home revived the ancient method of operating with a ligature on the main vein in the same relative situation as Anel ligatured the main artery in aneurism, i.e. close above the affected point. A double ligature was generally employed, and the vessel tied between them. Dupuytren, again, only used one thread, and divided the vein immediately above the place where it was applied. Wise and others, observing that a firm coagulum formed in from 36 to 48 hours after the application of the thread, recommended the removal of the ligature about the expiry of the time mentioned, so as to diminish as much as possible the chances of inflammation and suppuration. Not always successful, often followed by most grave results, as troublesome ulcers, wide-spread inflammation, purulent absorption, and death, this mode of treatment fell into abeyance. That recurrence of the disease after the ligature of the vein was common, is easily understood, when we consider that the branches which join the main vein

between the ligature and the affected part, and which take up the collateral circulation, are found to prevent the formation of a clot, and while the main vessel may become obliterated, the smaller vessels parallel to it take on the diseased action. Sir B. Brodie made the next step in proposing the ligature of the branches in place of the trunk, and he re-introduced also the section of the vessel, but improved on the old practice by doing it subcutaneously. This plan, however, disappointed its ingenious contriver, as the cure was seldom complete, and fatal results sometimes followed the proceeding. The vessel sometimes escaped division, and even when divided became not unfrequently reunited, and thus allowed the circulation to be re-established. Beclard, again, tried compression on the heart's side after the division of the vein. Lisfranc, in order to obviate the unsatisfactory results which followed on the division of the vein, as well as to remove all contact of air with the wound in the vein, to which contact he ascribed much of the danger which attended the proceeding, excised a small part of the vessel after it had been cut across, so as to allow of the retraction of the ends of the vein within the surrounding parts. Brodie also tried the actual cautery, but thought that any advantages it might hold out were more than counterbalanced by the pain and obstinate ulcer which resulted. Caustics have been at various times largely employed in the treatment of varix. Clocquet, Berard, Skey, Langier, and Clay used the Vienna Paste; Mayo, Ashton, Key, and Bonnet of Lyons caustic potash; and Von Froriep fuming nitric acid. Bonnet incised the eschar formed, and re-applied the caustic many times, thus allowing of its deep action. Langier premised an incision through the skin, while Berard, having marked with ink or nitrate of silver the position of the veins when dilated by exercise, applied the caustic in long rolls parallel to them. He thus destroyed at once all the tissues down to the vessel. As the eschar takes long to separate, the danger from hæmorrhage is very great. Of the different caustics which have been employed, the zinc paste, known in France as the "*pâte de Canquoin*," seems to be least liable to be followed by dangerous results. Verneuil, quoting from an unpublished memoir of M. Valette, tells us that in more than 2,000 cases in which it has been employed, neither death nor serious accidents followed. Gross, of Philadelphia, says that he has found the use of caustic potash and quicklime to "possess the great advantages of being entirely free from danger, and always perfectly successful." The pain which attends the use of caustics appears always to be very great.

The objections which present themselves to the use of caustics in the treatment of varix are, the great difficulty of limiting their action both as regards the vessel and the parts around, the fear there is of suppurative phlebitis, the pain the application causes, and the difficulty of healing the ulcer which they leave, especially in persons of such habits of body as those in whom varices are commonly met with. The occurrence of hæmorrhage also is not rare, especially if the limb be at all used while the eschars are separating, besides which there is the uncertainty of a final cure, and the entire failure or imperfection of the result in very many cases. For these reasons it is that few surgeons now employ this method of treatment.

Again, the occlusion of the vein has been aimed at by Davat by transfixing it with two needles in such a way as that they will cross one another within the vessel—the one being inserted parallel and the other transversely to the vein—and then uniting the whole by twisting a thread round them. The object Davat had in view was to produce a solution of continuity in the inner coat, without which he thought cohesion would not occur even though the vessel be compressed. The great violence done to the vein, and the extreme probability of an unmanageable amount of inflammation following, are the great objections to this method, as they are also to Fricke's proposal to pass a thread-seton several times through the vein, and leave it there for some days. Velpeau, again, suggested a mode of treatment which is much followed in this country. He passes a pin behind the vein, taking great care not to pierce it, and then causes compression by twisting a thread round the pin and a piece of elastic bougie, which he lays on the surface over and parallel to the vessel. In this way, as the thread is applied as in the twisted suture, the two extremities of the pin are engaged in the loop of the figure-of-eight form assumed by the thread, while the vein and the bougie lying over it are compressed by the centre. The bougie is so placed to prevent injury to the surface. This operation should be a bloodless one if properly performed, as the appearance of blood at the point where the pin has been inserted, or escapes, shows that we have penetrated the vein, and in that case the pin should be withdrawn, and re-inserted with greater care behind the vessel. The pin used should be of unoxidised iron, so as to prevent any irritation from its rusting, and the thread should be not too small or hard, and not applied over tight. The operation is repeated at various points of the vessel, beginning at the part nearest the trunk which is affected. The pins are best employed in pairs, having about an inch and a half between them. The pin and bougie are left *in situ* for about ten days, and then removed, a bandage being applied to the limb, and left on for some time after.

Dr. Bozeman, of America, has lately recommended his metal buttons and silver-wire sutures to be used in the same way as the pin and bougie, and reports good results in the cases in which he has tried it.

Mr. Lee, again, employs the subcutaneous division of the vein, besides the use of the pin as in Velpeau's method. He divides the vein at points intermediate between those at which the vessel is compressed by the pins, and he withdraws the pins two days after the vessel has been divided. By the section of the vein all stagnant blood existing between the two points of compression is removed, and the evils which he attributes to this blood remaining avoided, while the operation itself is quickly recovered from. Rest during treatment, and bandaging afterwards should be employed.

It has been objected to the method of treatment by the pin that there is a fear of transfixing the vein; that nerves and lymphatics may be included in the grasp of the ligature; that it is difficult to get fairly behind the vessel; that the succeeding inflammation may be very severe; and that the cure is not permanent, as the varicose



condition is just established in other vessels. These objections are, however, more apparent than real. The last-mentioned applies equally to all methods of curative treatment. Velpeau thus treated 150 cases before he met with any disagreeable result, and many surgeons of large experience in this country, though employing it, frequently report no unfavourable consequences.

Other modes of compressing the vessel have been proposed. Reynard of Toulon passed a thread behind the vein, and tied it so as to include both the vessel and the overlying tissues. Ricord's method of strangulating the spermatic veins has also been applied to those of the extremities. He passes a needle and thread behind the vessel, and bringing it out through the skin on the opposite side, repasses it by the same openings on the surface, but carrying it on its return in front of the vessels, and between them and the skin. The ends of the thread are then tied over a piece of bougie, and the vessel is thus firmly grasped in the loop of the thread. Tavignot used two loops to accomplish the same end, one being tied at either side. The coagulation of the blood in the affected vein by electricity was suggested by Bertani, but has not been found to answer.

The puncture of the dilated vein, or the more extensive opening of it, and the extraction of the clot, are methods of treatment of great antiquity. Petit, in modern times, thought much of unloading the vein, and Richerand put the method of extraction into practice—a proceeding which may be attended with benefit if the dilatation be very circumscribed, but the fear of hæmorrhage and phlebitis is very considerable. Heister let out "the grumous blood," after having passed a double wax thread under the vessel, and tied it tightly round it. Delpech dissected out the vein, and compressed it against a roll of plaster inserted behind it. Sanson, imitating Breschet's method of treating varicocele, exerted compression on the vessel by means of a peculiar description of forceps, which he took care to shift in position frequently, so as to prevent any injurious effect on the skin. The difficulty of applying the forceps rightly, especially when the circumvolutions of the vessel are considerable, and the parts much bound together; the inconvenience attending it, and the unsatisfactory results arising from the subsequent absorption of the coagulum, have prevented the general adoption of this proposal. Colles of Dublin compressed the saphena in cases of varix by means of a truss, and others have fulfilled the same end by straps of india-rubber pressing on buttons, the object in either case being to divide the column of blood, and make the valves act.

Mr. Startin has described a very ingenious "bar-needle and clasp," for employment in the treatment of varicose veins. The needle, which is sickle shaped at one end, is passed below the vein, and then drawn through till part of the long stem remains behind the vessel. The portion of the stem so placed is then cut off from the needle, and left, the vein being further secured by having the "clasp" applied in front to the piece of stem, completing an application which, when *in situ*, resembles a brooch—the piece of stem representing the pin. He leaves this applied for forty to sixty hours, and by inserting a piece of lint below the clasp prevents it injuring the surface.

The injection of varices with various salts which

coagulate the blood has attracted much attention of late years, and is now much followed on the Continent. M. Pravaz, in 1851, suggested the use of similar means for the treatment of aneurism, and the surgeons of Lyons employed it in varix. The perchloride of iron is the coagulant which they employed, and it has as yet given the best results. A solution of 30° of Baumes' hydrometer, or at the specific gravity of 1.26, is found to answer best. A very small glass syringe, graduated on the barrel, and having a very closely-fitting piston and a minute canula, which screws on to the barrel, is the instrument used for the introduction of the solution into the vein. The amount thrown into the vessel can be exactly calculated by the scale on the barrel. Before performing this little operation, some make their patients walk about, so as to dilate the vessels. A bandage is applied to the limb some distance above the point to be operated on, and this is left on the limb for some time after the injection has been performed. This bandage serves the double purpose of rendering the veins prominent, and causing the column of blood to be stationary, so that the clot which is formed is not driven away in the torrent of the circulation. The canula, with its small trocar, is then introduced into a prominent vein previously fixed by the fingers of the left hand. The trocar is withdrawn, and the syringe, which has been carefully filled with the solution, and having its piston so screwed down that all air is excluded, is attached to the canula, and the quantity of solution required is thrown into the vein. Half a turn of the piston is then made backwards, to withdraw the fluid from the point of the canula, which is then removed, and a small piece of adhesive plaster is put over the aperture in the skin. The operation must be repeated on several of the more prominent dilatations, and it is possible that the injection must again be repeated in a few days. Experiment has shown that if the solution be thrown into a pouch on a vein, the coagulation will be confined to the pouch, while if a straight part of a vein be chosen, the coagulum will extend in the direction of the heart, and the capillaries both, and the end aimed at will be better secured. Several operations may be performed on the same limb, or on both limbs on the same day, if necessary. It need hardly be said that if any amount of phlebitis be present in the veins, the injection cannot be performed. The quantity of the fluid introduced will vary with the size of the vessel. From two to fifteen drops is about the range. Ten drops is in general sufficient for the largest vessel. Care must be taken to prevent any of the fluid escaping into the areolar tissue, either when we are introducing or withdrawing the canula. If the vein be transfixed, the introduction of some of the fluid into the cellular tissue will be sure to occur. We can satisfy ourselves that the canula is within the canal of the vessel by the direction it assumes, by the flow of blood through it, and by its feeling free. Till we are assured that the canula is thus placed, the piston should not be screwed down. In about three-quarters of a minute, the coagulation will have taken place, but there is plenty of time before this occurs to inject before the canula becomes blocked up. To obviate all fear of obstruction from the coagulation of the blood flowing into the canula, M. Lenoir recommends the use of a second canula which accurately fits into the first, and which,

being attached to the syringe, can be inserted at once into the vein through the first so soon as the trocar is withdrawn. The inflammation which succeeds this operation is very slight, but no further interference should be had recourse to during its continuance. In the *Thesis* of M. Carron, and in a paper by M. Desgranges in the 4th vol. of the *A.ém. de la Soc. de Chirurgie de Paris*, the different steps of the foregoing operation are minutely detailed.

The success which has attended the above method of treatment is undoubted. The writer has seen it largely employed with signal advantage. Small abscesses in the cellular tissue are the only disagreeable consequences he has had occasion to observe, but fatal results are on record, and show the necessity of care and caution. The fatal cases are, however, extremely few in proportion to the enormous number of persons who have been treated. The chief danger seems to arise from the vein being transfixed, and the solution being injected into the cellular tissue, when thrombus, abscess, or diffused suppuration, or even gangrene, may possibly be occasioned; but nearly all observers are agreed that, with proper precaution, severe inflammation and erysipelas are very rare, that hæmorrhage never occurs, that suppurative phlebitis is almost unknown, and that the pain which is occasioned is very trifling. As to the permanence of the cure, many cases are on record which have been confirmed by years. The persulphate of iron has also been used in the same way, with good results.

It must, however, be confessed that no mode of curative treatment hitherto devised, numerous as they have been, is always successful, nor devoid of danger. However slightly the vein is interfered with in some of these operations, the results have been, at times, most lamentable. Veins, especially those affected with varix, are peculiarly subject to inflammation; and when that condition is once set up in them, it is well known how great is the danger. Many of the methods of treatment succeed marvellously for a time, and seem to fulfil every end, and then, without any apparent difference, either in the patient or in the mode of operation, a succession of unfortunate results occur. Berard, in his monograph on the use of the Vienna Paste, says he had only one fatal case of phlebitis in the first 500 cases he treated, and yet shortly afterwards he had to lament many. So it has happened in the experience of many. Velpeau had 150 successful cases with the pin before any unfavourable occurrence shook his faith in its infallibility. What has been successful, too, in the hands of one, fails in the practice of another. Thus Malgaigne tells that Fricke, in asking Velpeau to try his mode of treatment with the seton, stated that it had been successful in thirty cases in which he had used it, yet violent inflammation was set up in the two first instances in which Velpeau employed it; and thus it is that a much wider induction than can be supplied by the experience of any one man is required to decide such questions.

It must also be remembered, when judging of the various methods of curative treatment, that it by no means follows that because a coagulum has been formed in a vein, that therefore its continued obliteration has been secured. Clots of very great extent have become absorbed or dissolved, as was shown in the case of Hesse, related by himself, in

which a coagulum filling "the whole system of the saphena up to its insertion into the crural vein" became absorbed in five weeks from the subsidence of the inflammation which caused it. Besides this source of uncertainty in the permanence of the cure, it has been shown by many writers that when the main vessel has been obliterated the disease becomes established in other vessels running parallel to it, and thus it would appear that the constant support of the leg by an elastic stocking is a wise precaution even after the closure of the vessels chiefly implicated.

Finally, in reviewing the different methods of treatment to obtain a radical cure, it will be evident that there are three which are much superior to the rest—viz., that by caustic, pins, and injection. The disagreeable results which may follow any operation are chiefly—(1) pain; (2) severe inflammation—it may be, ending in suppuration; (3) erysipelas, superficial or deep; (4) extensive cicatrices on the surface; and (5) hæmorrhage. When caustic is employed, we have seen that all these accidents may and do frequently occur, while the first and fourth are necessarily caused, and the fifth is not rare. When pins are used again, 2, 3, 4, and 5 may arise, and are not very uncommon results; while, when injection is employed, though 2 and 3 may occur they have appeared very rarely, and 1, 4, and 5 have never been seen. When it is considered also that the treatment by injection cannot implicate either lymphatics or nerves, that it is very simple, that it produces a very sure and extensive coagulum within the vessel, and that, consequently, the final results are more satisfactory than those following any of the other methods of treatment, it must be conceded that of all the plans of treatment hitherto devised, that by injection holds out the greatest advantages.]

George H. B. Macleod.

VEINS, DISEASES OF.—[The peculiar interest which attaches itself to disease of the veins depends in a very great degree upon the connection which they naturally have with every part of the vascular system. So long as this communication exists, the results of any disease in a vein may be communicated to the general system. The conditions under which this may occur, and the results produced, have already been fully considered in the article PYÆMIA. We have, therefore, now only to treat of the local symptoms and treatment of the diseases of the veins themselves. If a vein be isolated from the general circulation, as it may be either artificially or naturally, it may be injured in any way without any probable serious consequences. The inflammation which ensues being strictly local is not likely to be followed by more serious symptoms than the inflammation of any other structure.

From whatever cause phlebitis may arise, whether from the nature of the morbid contents, from mechanical injury, or from the extension of inflammation from surrounding parts, the evidence of that inflammation is in the cellular coat of the vein, and, to a less degree, in the circular fibrous coat. No one has yet succeeded in producing unequivocal marks of inflammation of the lining membrane only of a vein.

In acute phlebitis the cellular coat is preternaturally vascular, presenting a red appearance of



greater or less intensity. It becomes at the same time distended with inflammatory products. These consist of serum, lymph, and pus, according to the kind of inflammation, either separately or mixed together in different proportions. Fluids secreted in the outer surface of a vein readily extend along it, permeating the areolar tissue which connects it with surrounding parts. This may be particularly noticed where a vein is surrounded by a sheath, as is the case with the jugular. The circular fibrous coat also becomes injected, and thickened by deposit. The inner coat soon loses its natural transparency, and becomes wrinkled and even fissured. It may be seen of a dull, opaque, dirty white colour, stained more or less by the contents of the vein. It will consequently, in different cases, assume every hue of red, violet, or brown; the intensity of the colour following very accurately that of the coagulum in contact with it.

Exudation often occurs between the inner and the outer coats, and the different layers of the former then become disintegrated, or the lining membrane may be cast off in large portions into the interior of the vessel. All the coats of the vein may, under these circumstances, be easily detached from each other, or may be separated by serous, fibrinous, or puriform exudation. When these form under the lining membrane, they may be seen as patches of various sizes and shapes through the transparent structure, so long as this retains its integrity. Afterwards they may be poured, together with the fragments of the disintegrated membrane, into the cavity of the vessel. The inflammatory exudation between the different coats of the vein destroys its natural pliability, so that when divided it will remain open like an artery.

The coats of veins, when mechanically injured, would appear to be as little susceptible of inflammation as any structures in the body. The same vessel may be opened several times in succession, and, provided it be properly closed after each operation, no inconvenience will result. The way in which veterinary surgeons unite the edges of veins after bleeding, by means of a pin and twisted ligature, shows the amount of injury which these vessels will bear with impunity, and the same point is frequently illustrated in the present day by the operation of dividing large veins for the cure of varicose ulcers. These remarks apply to instances in which the veins are mechanically injured only; the case is widely different when any irritating fluid has entered their cavities. The amount of disturbance which is then produced, apparently with the object of getting rid of the noxious element, offers the strongest contrast to the simple process of union, by which the coats of the vessels are repaired after injury. The internal surface of veins reacts upon the application of extraneous matter as quickly and extensively as the serous membranes of the body, yet, in order that this effect may be produced, it is necessary that the morbid matter should be maintained for a certain period in contact with the lining membrane, which cannot be the case as long as the circulation of the blood through the vessels is continued.

When the blood coagulates in one of the larger veins on the surface of the body, the affection is recognised by the cord-like induration of the vessel. There is at first no swelling, or tender-

ness of the limb, and no constitutional irritation. The subsequent changes depend very much upon the nature of the coagulum which has formed. If this be composed of healthy blood, such as may be produced by introducing a needle connected with the negative pole of an electric battery, or by passing a ligature round a vein, then, when the original cause of the obstruction is removed, the coagulum will slowly dissolve, and be carried in the course of the circulation. There will generally be but little local, and no constitutional disturbance, and the circulation through the vein will become completely restored. In a few cases, the coagulum, instead of becoming dissolved, will remain and obstruct the vessel to a greater or less extent. Other changes will then supervene. The coagulum will lose its colouring matter, and become tunnelled by numerous channels of blood, or it will remain in unorganised, perhaps concentric layers, moulded to the shape of the contracted vessel for an indefinite period. Sometimes it will become organised, but this will seldom happen so as permanently to obstruct the passage. If the coagulum be small, it may be attached to one side only of the vessel, to which it will become so intimately connected that, after a certain time, it will be impossible to distinguish the inner lining of the vessel from the inner surface of the newly-organised substance. If the coagulum be large, the outer layers will be firm, and sometimes organised. Coagula will often assume the form of dark blood-stained masses, adhering to the lining membrane of the veins for a considerable distance. The more fluid parts generally disappear, being probably carried in the course of the circulation, and the passage through the vein is re-established. The venous channel may then be lined on one side, or on every side, by the newly-formed membrane. In the earlier periods of these formations the layers of fibrin may be peeled off the inner coat of the vein, but subsequently they become inseparable from it.

When an artery is tied, the base of the internal coagulum comes into contact with the outer coat and the lymph effused around the internal and middle coats divided by the ligature. During the subsequent stages, vessels extend from these parts into the clot, and organic union ensues; but the circumstances are different in the case of a vein. It is difficult in this case to account for the way in which a coagulum may become united to adjacent parts, and the mode in which the vessels are formed that pass from one to the other. It is probable that some are generated in the coagulum itself, and are subsequently met by others, which shoot out from the adjacent parts to inosculate with them. This idea is in accordance with that which is known to take place in the original organisation of parts in the embryo. During the process now described there may be little or no thickening of the parietes of the vein, and little constitutional disturbance.

When the coagulum is composed of vitiated blood, it will become a source of irritation, and its presence will give rise to the symptoms of acute inflammation of the vein in which it is contained. The parts of the venous system in which stagnation of vitiated blood is most likely to take place, are those connected with the part originally injured, for here any vitiated fluid acts with the greatest intensity; and here also, pro-

bably some of the veins have been mechanically injured, and therefore a mechanical impediment is offered to the circulation. For this reason, when any of the larger veins of a limb have been interfered with, the distal veins become distended, and are liable to be injuriously influenced. We have thus the solution of the fact observed by Hunter, but not explained by him, or by subsequent observers, viz. the tendency that inflammation of a vein so frequently manifests to spread in a course opposite to that of the circulation.

The treatment naturally divides itself into local and constitutional. Whatever tends to favour the healthy healing of a wounded vein may be regarded as affording security against any subsequent disease; and the chief point in the local treatment is, to prevent any accidental circumstances from interfering with the natural process of repair. When the powers of the constitution are enfeebled, even the natural motions of a part may interfere with recovery, and rest sometimes becomes an important object in the treatment. How necessary this is after childbirth, when the divided veins are being closed, every one who has attended such cases practically knows. Again, after bleeding, the arm will inflame in a much greater proportion of cases when the patient is obliged to follow his usual occupation, or when, from accidental circumstances, the arms are kept in motion. In all such cases, any external violence, or even the motion of the body, may loosen the coagula formed either between the wounded edges, or in the cavities of veins.

Hunter remarks that when inflammation takes place beyond the orifice of a vein so as to alarm the surgeon, he should immediately make a compress upon the vein at the inflamed part, to make the two sides adhere together; or if suppuration has taken place, then the compress should be put upon that part of the vein just above the suppuration. (*Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge*, p. 29.) Now, as lymph is not effused in the early stages of phlebitis as a secretion from the lining membrane of the veins, the adhesion produced by Mr. Hunter's method of treatment would be by coagulum of blood only. This would not, under ordinary circumstances, become organised. It would adhere only to the sides of the vessel, and it would be constantly liable to become displaced. Such a bond of union, although it might prevent, for a time, the morbid contents of a vein from entering the general circulation, could scarcely be looked upon as a permanent union of the sides of the vessel.

In cases where the affected vein is seated superficially, a much more certain and effectual way of closing its canal, and of barring the entrance of its contents from the general circulation, may be used. This method, which, when properly performed, I believe to be free from danger, is one which I have now in several instances adopted. Two needles are introduced half an inch apart below the vein above the inflamed portion. An 8-ligature is then placed over the ends of the needles so as to compress the veins, and the vein is then subcutaneously divided between the needles; at the end of two or three days the needles are removed. The vein is obliterated, and the inflammation is arrested at that point. As the process of reparation in veins has

been variously described by authors, so the different theories propounded have led to different kinds of treatment. At the Veterinary College, even within the last few years, it was publicly taught that a coagulum in a vein was a foreign substance, and ought to be removed; and the jugular vein in horses which had been bled was sometimes slit up for several inches, in order to remove the coagula which formed in successive portions of its course.

To remove coagula in ordinary cases, however, is to remove the very means prepared by nature for the restoration and safety of the parts. Position, topical applications, bandages, and temperature may all have their influence in producing healthy action. As the wounds which precede purulent deposits are generally characterised by feeble powers, those conditions which most tend to invigorate the parts are principally indicated. The irritability of a wound may be appropriately termed a teased action; it frequently appears to be nothing else than a series of attempts to bring about a result, which at first is more or less imperfectly accomplished. As soon as that is fulfilled which the necessity of the parts demands for their healthy condition, irritation will cease. But no local applications are likely to accomplish this object, unless the powers of the constitution are supported at the same time. It is evident that the treatment of phlebitis ought to be concentrated on the first period of the disease. So soon as portions of a disintegrating or decomposing clot, or the septic products of a wound, have become mixed with the circulating blood, medicine is generally of little avail. It is doubtless true, unfortunately, that in a large number of cases, the contamination of the blood takes place through minute vessels hidden from our sight; and the occurrence of severe constitutional symptoms is the first signal of a malady to which, only too often, there is but one end.]

Henry Lee.

VENEREAL DISEASE (*Lues Venerea*; *Morbus Gallicus*; *Syphilis*).—About the year 1494 or 1495, the venereal disease is said to have made its first appearance in Europe. Some writers believe that it originally broke out at the siege of Naples; but most of them suppose that, as Columbus returned from his first expedition to the West Indies on March 13th, 1493, his followers brought the disorder with them from the new to the old world. Other authors, however, among whom are Mr. Beckett (*Phil. Trans.* vols. xxx. and xxxi.), Mr. B. Bell, and Dr. Swediaur, maintain the opinion that the venereal disease was well known upon the old continent, and that it prevailed among the Jews, Greeks, and Romans, and their descendants, long before the discovery of America. One writer of high reputation believes that, though syphilis was brought to Europe by the followers of Columbus, there existed previously to that event throughout the old continent venereal disorders, both local and constitutional, which strongly resembled the newly imported disease, and were, for more than three centuries, confounded with it. (*R. Carmichael, On Venereal Diseases*, p. 33. 8vo. Lond. 1825, ed. 2.) My friend, Mr. Bicot, has bestowed great pains on an examination of all the passages in old works affording any ground for the opinion that syphilis existed in ancient times: he finds in them



allusion to many local complaints of the genitals, warts, discharges, ulcers, pustules, &c., sometimes clearly ascribed to impure coition, but no distinct reference to any constitutional symptoms. "Surely," says he, "I may be allowed to say, that if there is any historical fact that can be said to be proved, it is that of the origin of syphilis being referrible to the latter years of the fifteenth century; for I cannot understand, otherwise, why, at that precise period, we all at once hear of ulcers on the parts of generation in both sexes, followed speedily by excruciating nocturnal pains, by corroding ulcers over the whole body, by affections of the throat and nose, and very frequently by death; when not one word that can be construed into any similar affection is to be met with distinctly stated by any writer before that period." (*J. Bacot*, in *Med. Gazette*, vol. ii. p. 100.) But, while this writer will not admit the truth of the existence of the venereal disease in times of antiquity, he allows that a disorder resembling gonorrhœa has been known from the remotest periods of history.

Although many considerations lead me to coincide with Hunter, Sprengel, Pearson, and Bacot, in rejecting the common history of syphilis as fabulous, I mean that account which refers its origin to America, or the French army in Italy, it does not appear to me that any utility would be likely to result from agitating this question in modern times; because, if it be true, as the most candid and intelligent surgeons of the present day generally acknowledge, that they cannot precisely define what the venereal disease is, nor always point out the exact circumstances in which it differs from some other anomalous complaints, even when the cases are before their eyes, how can such discrimination be attempted from a mere review of old descriptions, not accompanied with the advantage of a view of the living patients themselves? But, so far as the nature of the venereal disease has been unravelled, and it is allowable to judge from such comparisons, I may be permitted to remark that, in degree of severity, acuteness of symptoms, rapidity of propagation, and extent and quickness of fatality, no forms of disease now ever conjectured to be venereal, bear the least resemblance to the destructive malady with which the army before Naples was afflicted at the close of the fifteenth century; nor will any ignorance of the uses of mercury, as will be presently noticed, explain differences so strongly marked. With reference to the contagious disorder which scourged a great part of Europe at the close of the fifteenth century, there is a decree of the parliament of Paris, dated 1496, in which the disease is mentioned to have been then prevalent in that city two years; consequently, it was known there in 1494; yet the conquest of Naples by Charles the Eighth was not effected till 1495. It is clear, therefore, that the disease here alluded to could not have been derived from America. It appears to have been communicated from one person to another by the mere touch, residence in the same chamber, &c.; and, in fact, unless some other mode of propagation, besides coition, be supposed, its extension throughout Europe in two years would imply a depravity of manners quite extraordinary, and beyond all credibility. Another fact is, that whatever the disorder might be, it was not of long continuance; and Guacardini, the historian, who wrote a few years after its breaking

out, assures us that it had already become much milder, and undergone of itself a change into kinds different from the first.

[The editor is already committed to the opinion (*Lectures on Syphilis*, in the *Lancet*, in the year 1841), that the venereal disease had existed for centuries prior to the siege of Naples, not only in South America, but in all parts of the world wherever promiscuous sexual intercourse, unrestrained by religion or by the customs of society, was carried to great excess; that it was first generated spontaneously, and that could we destroy the whole of the existing virus, it would again appear under similar circumstances. He is persuaded that the discovery made at this period consisted simply in the recognition of a peculiar animal poison as the cause of various symptoms affecting different tissues of the human body, at considerable intervals of time, which symptoms had not previously been known to have any relation to each other.

That the medical men of that day should be mistaken as to the existence or not of a disease of an entirely new character, would at first sight appear an impossibility. But the instant it is admitted that the picture they represented to themselves of the horrible and destructive nature of this malady, all the symptoms of which they considered equally contagious, was not only very incorrect, but indeed resembled as a whole no disease which had existed previous to or since their time, it will no longer appear an idle question to examine how far they might have been misled as to the previous existence of the milder set of symptoms, which are now recognised as referrible to the venereal poison acting either primarily or secondarily on the human system.

The general impression of the nature of the disease, on its first discovery, may be judged of by the public ordinances in reference to those infected by it, both in Paris and in Edinburgh. In the *Arrêt* of the Parliament of Paris, dated March, 1496, it was decreed that all strangers infected with this malady were to leave Paris in twenty-four hours, under pain of being hanged. Four sous were to be given to each of them as they passed the gates of Paris. The inhabitants themselves labouring under this disease were forbidden to leave the house, under penalty of the same capital punishment. All intercourse with them was also forbidden: persons disobeying this latter interdict were to be sent to prison, or to be expelled from the city. James IV., king of Scotland, in 1497, issued a proclamation by which all those infected with the disease were expelled from the city. They were sent to the island of Inch Keith, where provisions were to be supplied to them till God provided for their health. Any person disobeying this ordinance was to be burnt on the cheek with the marking-iron.

Amongst the earliest writers on syphilis, Widman (*Tract. de Pustulis*) writes:—"Sævitia hujus passionis et detestatio ejus maxima, ut homines a civili conversatione separantur saltem quoad curati sint;" and (*Lawr. Phriseius de Morbo Gal.* chap. 1):—"Pauperes hoc malo laborantes expellabantur ab hominum conversatione, tanquam purulentum cadaver derelicti a medicis (qui se nolebant intramittere in curam), habitabant in arvis et silvis." That the disease was not really different in its symptoms, or in its degree of severity, we cannot have better authority than that of Marcellus Cu-

manus and Alexander Benedictus, who were both in the Venetian army at the time of the siege of Naples. They both published on the venereal disease a year after its first supposed appearance, and gave an account of the primary and secondary symptoms pretty exactly resembling those which we now observe.

It will be admitted that all the simple and non-venereal, with some of the pseudo-syphilitic, affections, attacking either the genitals, the skin, the throat, or the bones, which in the present day it is difficult, sometimes impossible, to distinguish from the effects of the true syphilitic poison, had existed previous to the year 1493. Of this nature would be excoriations and simple ulcers of the penis, followed by sympathetic buboes; vaginal and urethral discharges, the latter accompanied by all the distressing symptoms attendant on a gonorrhœa arising from a specific poison; buboes resulting from this, or from other local or constitutional causes; stricture, urinary abscesses, inflammation of the genitals, followed by phimosis, paraphimosis, and mortification, even phagedænic ulcerations attacking those parts; warts, excrescences, &c.—all of which differ so slightly in their external characters from venereal affections, that medical practitioners of the fifteenth century might well be pardoned if they failed to distinguish them; indeed, their non-contagious character, which time alone could establish, furnishes to this day the principal criterion by which they may be separated from the specific disease. Add to these the numerous tribe of cutaneous affections, papular, pustular, tubercular, and scaly, which the practised eye of a surgeon of the present day can recognise when caused by the presence of the venereal poison in the system; yet the character which this imprints upon them is so slight, that the attempt to convey in words the difference between a simple and a syphilitic eruption in either of the above classes of skin-disease, would prove altogether fruitless to those previously unacquainted with them. The distressing catalogue of affections of the bones, attributed even in the present day by many to the influence of mercury, by some to the poison of syphilis, and by others to the combined effects of both these powerful agents, would add greatly to the difficulties of the first observers of this multiform disease; and even these affections of the bones, the caries, the exfoliations, the thickening of periosteum, &c., assume the same external character as when arising from causes other than the poison of syphilis or mercury.

The individual symptoms, then characterising this disease, had undoubtedly been met with before; but the knowledge that there existed an animal poison attacking especially the human species, which was found to produce in regular sequence many of the symptoms above enumerated, and which was transferable by commerce between the sexes, was indeed a new fact of the first importance, and well deserving the name of a discovery. It was forced into notice probably at this time by the notorious priggacy of the age, as well as by the transfer of masses of men into other countries necessarily giving rise to a greater amount of promiscuous sexual intercourse.

The notion of a new and contagious disease, when once presented to the human mind, under the alarm and panic which it was calculated to produce, spread with surprising rapidity; and as early

as the year 1496 we find the disease not only mentioned, but its presence recognised in all quarters of the globe.

Under the supposition that the disease was of recent introduction, it would be difficult to account for the extraordinary rapidity of its spread and increase; but there would be no surprise that it should be thus quickly recognised all over the world, had it existed previously under the form of its various isolated symptoms, now for the first time grouped together as forming one complete disease arising from an animal poison, whose existence had hitherto been overlooked.

A disease, however, supposed to produce such varied symptoms, and spreading with such frightful rapidity, it must be admitted, was well calculated to hurry the medical man into too ready an acquiescence in the notion that the disease itself was entirely new in this quarter of the globe. The historian relying implicitly on the assertions of the physicians of the day, that the disease was altogether new in Europe, could hardly avoid the conclusion come to by Gonçalo Fernandez, who, while President in Hispaniola, ascertained distinctly from the natives that the malady of which the Europeans seemed to entertain so great a dread, had long been known amongst them.

There is no difficulty in procuring evidence that intractable ulcers on the genitals, attributed to intercourse with a diseased person ("cum fœda muliere"), had been noticed by medical writers centuries before the supposed appearance of the venereal poison in Europe. Dr. Weatherhead, in his second chapter on this subject, gives many instances in point: one or two we shall select as showing the kind of testimony that may be brought to bear on the side of the question we are now advocating. Amongst the Arabian physicians, Avicenna, Albucasis, and some so far back as the eighth century, mention ulcers and warts on the penis. Avicenna divides the ulcers into recent, inveterate, and malignant; some of them, he says, may require amputation of the member. Gulielmus de Saliceto, who died in the year 1280, treats of buboes arising from disease of the penis, contracted by intercourse with an infected prostitute ("et fit cum homo infermatur in virga propter fœdam meretricem." (*Chirurgia*, lib. 1, chap. 42.) He also states that these ulcers sometimes become phagedænic, and destroy the patient; and recommends the actual cautery to them. Lanfranco, a pupil of Saliceto, in the year 1296, wrote his *Ars completa totius Chirurgiæ*, in which he speaks of abscesses in the groin supervening on impure intercourse, and which were again communicable between the sexes:—"Ulcera veniunt ex pustulis calidis vergæ supervenientibus quæ postea crepantur, ex commixtione cum fœdâ muliere quæ cum aegro talem habente morbum de novo coierat." (Tr. iii. doct. iii. chap. 2.) Lanfranco also had recourse to the actual cautery in treating these ulcers, and recommended a lotion of vinegar and water as a preventive against the infection. In the year 1302, Doglione informs us (*Cose Notabili de Venetia*) that diseases of the genital organs had become so common in Venice at that period, that a fine of twenty soldi was imposed each time on whoever communicated such affections. A noted professor at Montpellier—Valesco—at the close of the fourteenth century, mentions pustules and ulcers of the penis, which he attributes to "coitus



cum foetida, vel immundâ, vel canerosâ muliere.” John of Gaddesden, an Englishman, who wrote his *Rosa Anglica* between the years 1305 and 1320, mentions ulcers on the penis arising from intercourse with an unclean woman, and gives the following caution in order to escape the disease:—“Si quis vult membrum ab omni corruptione servare cum recedit a muliere quam suspectam de immunditiâ, lavat illud cum aquâ frigidâ cum aceto mixta, vel de urinâ propriâ interius vel exterius intra preputium.” (*Rosa Anglica*, fol. 107.) It will be observed that the evidence here brought forward on medical authority refers solely to the primary symptoms, and that the ulcers were all cured without mercury. With those who have formed for themselves a test for the venereal poison, viz. its curability by mercury, and by mercury only—amongst whom may be mentioned the high authorities of Astruc, Hunter, and Pearson—these quotations would appear beside the question, and could have no avail. Whilst with others, as Mr. Bacot has judiciously observed, the silence of the authors before quoted with respect to the secondary affections so characteristic of this disease, must greatly invalidate their weight, as tending to prove the existence of the venereal disease from the remotest times. But it should be borne in mind that the primary and secondary affections would have appeared at different periods, and might have been observed, although not considered as related to each other; nor should it be forgotten that the secondary affections, even when the primary ulcer was not treated, would supervene in one case out of ten only in the skin or throat, and but in one case perhaps out of a hundred in the bones or fibrous tissues.

With respect to the secondary affections, it should be noticed that, previous to the date of the supposed first appearance of the venereal disease, many dissimilar cutaneous affections were classed under the general term of leprosy, which seems to have had a signification as extensive as the French word “*dartre*.” Some of these leprosies are described as contagious; and Avicenna especially states that ulcers on the penis and heat of urine were symptoms by no means uncommon in the leprosy, and that this disease might be communicated by connection between the sexes. Aëtius also, in speaking of the contagious nature of leprosy, warns his patient to avoid coition. Gilbertus Anglicus, about the year 1360, mentions a contagious leprosy contracted by intercourse with a diseased woman, through the malignant matter which is lodged in the vulva; and, at a still earlier date, John of Gaddesden alludes to the same circumstance. So common was the leprosy even as late as the reign of Henry VIII., that there were then, according to Matthew Paris, as many as six leprosy-houses in the immediate vicinity of London, viz. at Knightsbridge, Hammersmith, Highgate, Kingsland, Mile-end, and the Lock outside St. George’s Gate.

It is also most remarkable, that as the venereal disease became known, the contagious leprosies disappeared. Joannes Widman, in 1497, and Joannes Naclerus, in 1501, observing this circumstance, supposed that the supervention of the one disease had caused the disappearance of the other; and Joseph Grunbeck, who wrote on the venereal disease in 1496, informs us that some considered it a kind of leprosy. Nor should we

omit to observe the extraordinary coincidence that the contagious leprosy was curable by mercury, while the lepra of the present day is occasionally hereditary, but never contagious, and that mercury fails to effect its cure. The first observers of the venereal disease had their attention more particularly drawn to the cutaneous affections, which they considered to be contagious, and many of them overlooked altogether the primary sore. Such are the principal arguments which have induced the present editor to differ from Mr. Cooper and from most writers on Syphilis as regards the period of the first discovery, and the mode of introduction into Europe of the venereal disease.

Having finished with the historical part of our subject, we now turn to the consideration proper of the article before us.

With regard to the opinions entertained by the best authorities of the nature, habits, pathology, and treatment of the venereal disease, from the time of John Hunter up to the date of the last edition of this work, Mr. Cooper’s own narrative is so full and replete with instruction, that the present editor has thought it better to retain, with some slight omissions and alterations, the original text. But the more modern views on this important and much disputed subject, as influenced principally by the great discovery of M. Anzeas Turenne, will necessitate an additional and separate description, in order to complete the history up to the present day of our knowledge with respect to the venereal disease in all its bearings.

After these more general considerations, the individual features of this disease in its primary, secondary and tertiary phases, and as affecting the several tissues and organs of the body, will be successively treated of in detail.]

With some dissentients (see *Bru, Méthode nouv. de traiter les Mal. vén.* t. i. chap. 3, p. 45, Paris, 1789; *J. B. F. Caron, Nouv. Doctr. des Mal. vén.* Paris, 1811; *Jourdan, Traité des Mal. vén.* 2 vols. 8vo. Paris, 1826) the venereal disease is believed to arise from a specific morbid poison, which when applied to the human body, has the power of propagating or multiplying itself, and is capable of acting both locally and constitutionally. Whoever wishes to be fully acquainted with the arguments for and against the existence of a venereal poison, will find them considered by the late Mr. Wallace (*On the Venereal Disease*, chap. 1, 8vo. Lond. 1833); and still more fully by M. Ricord (*Mal. vén.* 8vo. Paris, 1838).

Mr. Hunter was of opinion, that the effects produced by the poison arise from its peculiar or specific irritation, joined with the aptness of the living principle to be irritated by such a cause, and the parts so irritated, acting accordingly. Hence, he considered, that the venereal virus irritated the living parts in a manner peculiar to itself, and produced an inflammation peculiar to that irritation, from which a matter is produced, peculiar to the inflammation.

The venereal poison is capable of affecting the human body in two different ways: locally, that is, in those parts only to which it is first applied; and constitutionally, that is, in consequence of its absorption.

In whatever manner the venereal disease was first produced, it began, says Mr. Hunter, in the human race, as no other animal seems capable of being affected by it. In the Venereal Hospital of

Paris, experiments were publicly made by M. Ricord on dogs, rabbits, guinea-pigs, cats, and pigeons; and on all these animals the results were negative. "All the experiments, repeated in every possible mode of inoculation, and infection, and with every requisite precaution, were made in every instance with pus, which, in the human subject, had given positive results, so that from these experiments, joined with others previously known, the conclusion may be drawn, that the inoculable principle of syphilis is restricted to the human subject, and cannot be transmitted to the brute creation." (See *Ph. Ricord, Mal. vén.* p. 78.) [It will be seen by the sequel that this opinion was erroneous, and that M. Auzéas Turenne has fully proved that the venereal virus may be transferred from man to animals, and from them to man again, without change or alteration.]

According to Mr. Hunter, the venereal poison is commonly in the form of pus, or some other secretion. In most cases it excites an inflammation, which (to use his language) is attended with a specific mode of action, different from all other actions attending inflammation, and accounting for the specific quality in the matter.

The formation of matter, though a general, is not a constant attendant on this disease; for, inflammation, produced by the venereal poison, sometimes does not terminate in suppuration. But, if Mr. Hunter's sentiments are correct, it is the matter produced, whether with or without inflammation, which alone contains the poison. Hence, a person, having the venereal irritation in any form, not attended with a discharge, cannot communicate the disease to another. In proof of this doctrine, he states, that though married men often contract this disease, and continue to cohabit with their wives, even for weeks, yet, in the whole of his practice, he never once found that the complaint was communicated under such circumstances, except when connection had been continued after the appearance of the discharge.

The late Mr. Hey, of Leeds, however, gave it as his opinion, that a man might communicate lues venerea after all the symptoms of the disease had been removed, and he was apparently in perfect health. (See *Med. Chir. Trans.* vol. vii.) Mr. Hey also joins in the belief of the possibility of the venereal disease being communicated through the blood of the mother to the fetus in utero, though in what manner the infection is transmitted is a question not yet entirely settled. An universal desquamation of the cuticle; a hoarse, squeaking voice; copper-coloured blotches; a scaly eruption upon the chin; an unnatural redness of the anus; are the common symptoms which he sets down as proofs of syphilis in very young infants. As these complaints yield to small doses of the chloride of mercury, or of hydrargyrum cum creta, and either the nurse, or parent, has had some venereal disease at no very distant period, the cases are now usually admitted to be syphilitic.

The venereal poison would appear to be very irregular in its effects, different persons being variously affected by it; and hence, probably, one cause of a great deal of the uncertainty yet prevailing about its distinguishing characters. Thus, as Mr. Hunter mentions, two men sometimes have connection with the same woman; both catch the disease; but one may have very severe, the other exceedingly mild, symptoms. He knew of

an instance, in which one man gave the disease to different women, some of whom had it with great severity, while the others suffered but slightly. On the same point, I find an interesting statement, made by Dr. Hennen, in his *Obs. on Syphilis in the Military Hospitals in Scotland*:—"We have had (says he) frequent opportunities of remarking two or more sores of different kinds, existing at the same time: an irregularly-shaped diffused sore; an elevated sore, covered with a light-coloured slough, as if a bit of chamois leather had been stuck on by some tenacious substance; a groove, or streak along the glans, as if made by a scraping instrument, filled with purulent matter; and the true and perfect chancre, according to Mr. Hunter's definition; or the true syphilitic ulcer, according to Mr. Carmichael. This last has, in some cases, occupied the glans; in some, the prepuce; while the sores of another description have been on the same part close beside it, or on another part at a distance. Three of these cases I particularly selected for examination and public demonstration, at the Castle Hospital; in one, the Hunterian chancre was on the glans, and a sore, without any hardness, on the prepuce; in another, it was on the prepuce, and a simple ulcer on the glans; in the third, a most perfect specimen of Hunterian chancre occupied the internal prepuce, close to the corona glandis; and, at about half an inch from it, near the frænum, but farther from the glans, was an elevated ulcer. In all these cases the Hunterian chancre healed (without mercury) several days before the others.

"Soldiers (says Dr. Hennen) are gregarious in their amours, and we have frequently several men at the same time in hospital infected by the same woman, with whom they have had connection in very rapid succession; some of them have had one kind of sore, some another, and some both." (*Principles of Military Surgery*, ed. 2, p. 525.) But, if these facts, which agree with my own observations, be decidedly adverse to the theory of a plurality of venereal poisons (see *Carmichael's Essays on the Venereal Diseases*, &c.), they still leave difficulties, which cannot be entirely solved by reference to peculiarities of constitution and different states of the health, because no explanation, on this principle, would account for a man having at the same time, upon the penis, two or three different kinds of ulcers, apparently excited by one cause. Neither will any difference of texture afford the needed explanation, though the utmost latitude be given to the doctrine, that the appearance and progress of sores are considerably modified by the nature of the parts.

It is only necessary to consider the above passage from Dr. Hennen's work, to perceive that the particular texture, whether prepuce, skin, glans, or corona glandis, does not always communicate to sores one invariable character, even when they arise, as the evidence would incline one to suppose, as nearly as possible under the same circumstances and from the same source of infection.

Authors of high reputation still entertain the conviction that the same woman, having connection with several men, may communicate to some of them chancres, to others gonorrhœa, and again buboes to others. This belief was adopted by Fabre, Pressavain, the late M. Cullerier, and has been subsequently professed by MM. Capuron, Lagneau, Gilbert, &c. From this view the infe-



rence has been also arrived at that these several affections are identical in their nature, the principle being the same in all, and the differences depending only upon the form, which is determined by the seat, and the greater or lesser intensity in the mode of action of the cause. "If (observes M. Ricord) such reasoning could once be admitted, and continue without a peremptory refutation, it is at the present day no longer tenable. In fact, since I have made use of the *speculum uteri* in the investigation of venereal diseases (see *Mém. sur quelques Faits observés à l'Hôpital des Vénériens*, par P. Ricord, inséré dans le 2me fasc. t. ii. des *Mém. de l'Acad. royale de Méd.*), the enigmas, which until then were inexplicable, have been reduced to ordinary and simple facts. With the assistance of this instrument, I have seen that a woman may be affected at the same time with gonorrhœa and deep chancres in the vagina or uterus, the gonorrhœa alone manifesting itself externally. Under these circumstances, though the woman be regarded as a gonorrhœal patient, she is very capable of communicating both chancre and gonorrhœa at the same time, or only one of these affections, according to the predisposition of the persons exposed to contamination. But, what we can affirm, and the observations have been numerous, is, that whenever we have had the opportunity of examining women who had communicated the disease, we have never found that a chancre arose from a discharge unaccompanied by ulceration in the genital organs of the person who had communicated such sore." (See *Ph. Ricord, Traité pratique des Mal. vén.* p. 117, 8vo. Paris, 1838.)

But whether the statements of M. Ricord be confirmed by the investigations of others or not, and be capable of accounting for the exact cause of the diversity of effect produced in different persons, and even on different parts of the same individual, by one kind of virus, not a doubt can be entertained that, generally, climate and constitution have vast influence over the venereal disease. In all warm countries the disorder, so far as regards the natives and those who have been long settled there, is not only much milder in its symptoms, but far more easy of cure. In the West Indies, the Brazils, &c., it has for a long period of time been very commonly cured by means of sarsaparilla, guaiacum, mezereon, &c., without a grain of mercury. It is alleged, however, that this mildness of syphilitic complaints, and their facility of cure in warm climates, do not extend to strangers recently arrived there, who are said even to suffer more from the virulence of the disease than in their native climate. In Portugal, during the late war, the dreadful ravages of the venereal disease amongst the British soldiers, and its comparatively milder phenomena amongst the inhabitants of the country, were particularly noticed. "In the British army (says Dr. Fergusson) it is probable that more men have sustained the most melancholy of all mutilations, during the four years that it has been in Portugal, through the disease, than the registers of all the hospitals in England could produce for the last century; while venereal ulceration has not only been more intractable to the operation of mercury than under similar circumstances at home; but the constitution, while strongly under the influence of the remedy, has become affected with the secondary symptoms in a proportion that could not have been expected. With the natives,

on the contrary, the disease is very mild, curable for the most part by topical treatment alone, or wearing itself out when received into the constitution, after running a certain course, not always a very destructive one, without the use of any adequate mercurial remedy, &c. The bulk of the people, and of all the military at the hospitals, even though a general order has been given out enjoining the use of mercury, cure themselves, or get cured, by other means. I have now been upwards of two years at the head of their hospital department, and I can declare that it never occurred to me, amongst all the venereal patients whom in that time I have seen pass through the hospitals, to meet a single one under the influence of mercury, excepting those cases wherein I myself have personally superintended its administration. They go out cured by topical remedies alone; and I have lived long enough amongst them to ascertain that their return to hospital under such circumstances for secondary symptoms is far from being an universal, or even a frequent occurrence." (*Med. and Chir. Trans.* vol. iv. p. 1, 2.)

The inference at which Dr. Fergusson arrives is, that in Portugal the disease is exhausted, and has lost much of its virulence, in the same manner as the natural small-pox, unresisted by inoculation, appears to have changed, in the same country, into a very mild disease, which does well under any mode of treatment.

"Yet (says Dr. Fergusson) I have no doubt that were this mild disease, or the mildest that was ever produced from the improved inoculation of England, communicated to a tribe of Indians, or to a plantation of negroes, or any other class of people, who had never before known the small-pox, it would desolate with all the fury of pestilence, destroying wherever it could find victims, and never ceasing until it had destroyed the whole." And on the same principles, Dr. Fergusson attempts to explain the severe effects of the inoculation of the exhausted syphilitic virus of Portugal into the constitution of the British or other stranger, and the impossibility of curing the disease by the same treatment which answers for the natives themselves. (*Med. Chir. Trans.* vol. iv. p. 7, 10.) On the other hand, Mr. Guthrie does not admit that the disease which the troops contracted in Portugal was more violent than the same complaint in England; or rather he admits the fact, but gives a different explanation of it from that of Dr. Fergusson; and refers the severe effect of the disease upon the soldiers in Portugal to the operation of the climate upon their northern constitutions, and their irregularity and intemperance, vices to which the natives are not addicted. (See *Med. Chir. Trans.* vol. viii. p. 563.)

The opinion that the venereal disease was continually changing in its nature, and that, in the end, it would entirely cease, is one that has been brought forward at various periods ever since its supposed importation into Europe. Von Hutten would lead us to suppose that its original violence did not last more than about seven years from the assumed period of its birth:—"Qui nunc vagatur facilitate tolerabilior qui nunc grassatur vix illius generis esse putetur." J. Benedictus also writes:—"Tempore isto, non reperiuntur gallicantes cum tam sævis accidentibus sicut apparuerunt ante aliquot annos." (*De Morb. Gallico*, cap. iii. anno 1508.) The idea that syphilis would at some period be

extinguished, is as ancient as the times of Fracastorius:—

*Cum fata dabunt labentibus annis  
Tempus erit, cum nocte atra sopita jacebit interitu  
data.*

From the testimony of these and other writers, especially that of A. T. Petronius (lib. i. cap. 3) and B. Tomitani (lib. ii.), no doubt can be entertained that the severe, rapidly spreading, and frequently fatal disease, which broke out in Italy at the close of the fifteenth century, did not continue many years with its original violence; but changed so much as even to justify the opinion, defended by many able men, that it was a totally different disorder from any complaint now reputed to be venereal. And the historical fact of the gradual change in the nature of the disease, which broke out in the French army before Naples, at the close of the fifteenth century, might be taken as an argument against its having been syphilis by those who will not admit that the latter disease has undergone any alteration of character. Amongst the moderns, Peyrilhe has denied the correctness of the doctrine that the nature of the venereal disease is changed: he treats of two sorts of change, or degeneration as it was termed—one general, the other particular. He denies the first, and maintains that the venereal disease is as destructive now as in past times. As for the degeneration of the poison in an individual, he admits it: "Perhaps (says he) *spontaneous cures* will be doubted; *numerous facts attest them* to those who know how to see, and we have tried to demonstrate them to others. For our own part we cannot doubt that the venereal poison becomes weaker and weaker in the infected person, becomes milder, and as it gets older loses its principal character, its property of communicating the disease." (See *Remède Nouveau*, &c. Montp. 1786.)

It has been a contested question whether the venereal disease and gonorrhœa arise from the same poison. Mr. Hunter acknowledges that the opinion of their originating from two distinct poisons seems to have some foundation, when the difference in the symptoms and method of cure is considered. But he asserts that if this question be taken up on other grounds, and experiments be made, the result of which can be safely depended upon, this notion will be found to be erroneous. As the arguments of Mr. Hunter, in support of the doctrine that both diseases are produced by the same virus, are noticed in the article GONORRHOEA, I shall not here repeat them.

On the other hand, Mr. B. Bell relates experiments from which the conclusion is made that the poisons of the venereal disease and gonorrhœa are entirely different and distinct.

Matter was taken upon the point of a probe from a chancre on the glans penis, before any application was made to it, and completely introduced into the urethra. For the first eight days, the gentleman who made this experiment felt no kind of uneasiness; but, about this period, he was attacked with pain in making water. On dilating the urethra as much as possible, nearly the whole of a large chancre was discovered, and, in a few days, a bubo formed in each groin. No discharge took place from the urethra during the whole course of the disease; but another chancre was soon perceived in the opposite side of the urethra,

and red-precipitate was applied to it, as well as to the other, by means of a probe previously moistened for the purpose. Mercurial ointment was at the same time rubbed on the outside of each thigh, by which a profuse salivation was excited. The buboes, which, till then, had continued to increase, became stationary, and at last disappeared entirely; the chancres became clean, and, by a due continuance of mercury, a complete cure was at last obtained. If this case, and another to which I shall presently advert, could be entirely depended upon, they would tend to disprove the part of Mr. Hunter's theory accounting for the different effects of the same poison by its application; in the case of chancre, to a non-secreting surface, covered with cuticle, and that of gonorrhœa to a secreting mucous membrane. The occasional formation of chancre just within the orifice of the urethra, is now recognised as not a very uncommon event.

The next experiment was made with the matter of gonorrhœa, a portion of which was introduced between the prepuce and glans, and allowed to remain there without being disturbed. In the course of the second day, a slight degree of inflammation was produced, succeeded by a discharge of matter, which, in the course of two or three days, disappeared.

The same experiment was repeated; but no chancre ever ensued from it.

Two medical students were anxious to ascertain the point in question; and, with this view, they made the following experiments, at a time when neither of them had ever laboured under either gonorrhœa or syphilis; and both in these and in the preceding experiments, the matter of infection was taken from patients who had never made use of mercury.

A small dossil of lint, soaked in the matter of gonorrhœa, was by each of them inserted between the prepuce and the glans, and allowed to remain on the same spot for the space of twenty-four hours. From this it was expected that chancres would be produced; but, in one, a very severe degree of inflammation ensued over the whole glans and præputium, giving all the appearance of what is usually termed *gonorrhœa præputialis*. A considerable quantity of fetid matter was discharged from the surface of the inflamed parts, and for several days there was reason to fear that an operation would be necessary for the removal of a paraphimosis. By the use of saturnine poultices, laxatives, and low diet, however, the inflammation abated, the discharge ceased, no chancre took place, and the case got entirely well. In the other gentleman, says Mr. B. Bell, the external inflammation was slight, but in consequence of the matter finding access to the urethra, he was attacked on the second day with a severe gonorrhœa, with which he was troubled for more than a year.

The next experiment was made by the friend of the latter student: he inserted the matter of gonorrhœa, with a lancet, beneath the skin of the præputium and likewise into the substance of the glans; but, although this was repeated three different times, no chancres ensued. A slight degree of inflammation was excited; but it soon disappeared, without anything being done for it. His last experiment was attended with more serious consequences. The matter of a chancre



was inserted on the point of a probe to the depth of a quarter of an inch or more in the urethra. No symptoms of gonorrhœa ensued; but, in the course of five or six days, a painful inflammatory chancre was perceived on the spot to which the matter was applied. To this succeeded a bubo, which ended in suppuration, notwithstanding the immediate application of mercury: and the sore that was produced proved both painful and tedious. Ulcers were at last perceived in the throat, nor was a cure obtained, till a very large quantity of mercury had been given, and the patient kept in close confinement for thirteen weeks. (*On Gonorrhœa Virulenta and Lues Venerea*, vol. i. edit. 2, p. 438, &c.) Mr. Evans, it appears, has also several times inoculated with the matter of gonorrhœa, but in every case it failed to produce any effect. (*On Ulceration of the Genital Organs*, p. 81, 8vo. Lond. 1819.)

Some other facts on record have been thought to support Mr. Hunter's inference, if any conclusion can be ventured upon without the aid of the most minute details. Such inference must indeed be invalidated, if the statements of M. Ricord respecting the information which he derived from the use of a speculum uteri in his investigation of the venereal disease prove to correspond with the observations thus made by other inquirers. M. Ricord's statements, in fact, interfere with the deduction that otherwise might be made from occurrences of the following kind. M. Vigaroux mentions an instance in which six young Frenchmen had connection with the same woman, one after the other. The first and fourth in the order of connection had chancres and buboes; the second and third gonorrhœa; the fifth chancre; and the sixth bubo. (*Œuvres de Chir. pratique*, Montp. 1812, p. 8.) And Dr. Hennen, who refers to this case, mentions a similar one in which the first person escaped; the second had true chancres and elevated sores; and the third gonorrhœa. The connection took place within an hour. (*Military Surgery*, ed. 2, p. 526.) These facts would indeed be much more interesting, if the disease with which the women were affected had been ascertained, in M. Ricord's manner; and one could securely calculate upon the men not having exposed themselves, within a given time, to any other source of infection. In short, without a perfect history and description of cases of this kind, from their beginning to their end, no light is thrown by them on the question about the venereal and gonorrhœal poisons. Nor does Dr. Hennen quote them with this view; but for the purpose of exemplifying the variety of effects produced on different individuals apparently by the same infection; though the same considerations which prevent any certain inference from such observations, in regard to the identity of the venereal and gonorrhœal poisons, seem also to interfere with the other conclusion. In the experiments detailed both by Hunter and B. Bell, there is also one point assumed by both parties, though it is far from being determined, viz. that the matter discharged from the urethra is always of one kind in respect to its infectious principle, whatever this may be; and that the secretion from every chancre contains one, and only one, species of infectious matter. From the candid and very practical work of Mr. Evans, it would appear that some ulcerations on the penis, such as would usually be called chancres, though they have of late

years been sometimes named elevated ulcers, arise from an altered secretion, without any breach of surface, or discernible disease, in the female organs. The same gentleman was also frequently present at the examinations of the public women in Valenciennes, and always surprised at the small portion of disease to be found amongst them: "At one which I attended (says he) no less than 200 women of the lowest description, and of course the most frequented by soldiers, were examined, and not one case of disease was found among them: nevertheless the military hospitals had, and continued to have, their usual number of venereal cases (ulcerations)."

"At an inspection I have since attended, where 100 women were examined, only two were found with ulcerations: I noticed several with increased secretions, and one with purulent discharge, but these were taken no notice of by the attending surgeons, as they did not come sufficiently under the head of virulent gonorrhœa."

"That the two women above-mentioned as having ulcers, infected the whole of the men diseased in garrison during the preceding fifteen days, no one can for a moment admit even as likely; but if it be allowed that an altered secretion be sufficient for the production of this disease (the *ulcus elevatum*), we shall at once have an explanation of how it happened that the military hospitals continued to have their usual number of venereal cases, &c." (*Evans, On Ulcerations of the Genital Organs*, p. 72, 73, &c.) From the investigations of the same author, the *ulcus elevatum* is the most frequent of all the sores met with on the genitals, and besides being excited by diseased secretions, and gonorrhœal matter, is capable of being transferred by inoculation, and even of originating spontaneously. (P. 67-81, &c.) Yet with regard to these accounts, M. Ricord might remark, that the speculum uteri not having been employed for ascertaining the state of the interior of the vagina, Mr. Evans's inferences are not to be depended upon.

Mr. Travers considers it possible that, in some cases, women are merely passive instruments of infection, and that a sound female, after having had connection with a man that has disease about his genitals, may for a time retain within the pudenda some of the venereal matter received from him, and that such matter may come into contact with her next visitor, who may contract the disease, though she herself may entirely escape. (See *Travers, On the Pathology of the Venereal Disease*.) The same idea is entertained by M. Ricord, who declares that he has known it verified. He adds another case which lately came under his notice. "A young man had connection with a woman who had chancres; on the same day, he cohabited with his usual mistress, who contracted the disease, though he himself was not attacked by it. The young man, it is to be observed, had not washed himself after coition, and his prepuce was very long." (See *Ph. Ricord, Mal. Vén.* p. 98.)

Lagneau admits that gonorrhœa may not always proceed from the same poison as the venereal disease; but he believes that, in the greater number of instances, the virus is of the same quality. He is led to this opinion by the consideration of several women having been infected by the same man with both complaints, and of the two diseases

having been communicated to several men who had cohabited with one woman, and, *as is presumed, with her alone*, at least, inasmuch as may relate to the possibility of any other infection weakening the conclusion attempted to be drawn from the case; a point which has only been assumed, and by no means ascertained. Mr. Guthrie also expresses his belief that the evidence adduced on the point under consideration, justifies the opinion "that ulcers will arise on the penis from the matter of gonorrhœa; that gonorrhœa will in its turn be caused by the matter of these same ulcers; and that both occur in consequence of promiscuous or uncleanly intercourse. *That many of the ulcers produced in this manner will occasionally assume every character of chancre, and cannot be distinguished from it*, I am perfectly satisfied of, from repeated observation; but I am equally certain, that a gonorrhœa in men, with the worst appearance and symptoms, can, and often does, arise from irritating causes common to parts free from any specific disease, or poison; is not distinguishable from one that has arisen from promiscuous intercourse; and that both complaints are curable in the same way, and without mercury." On the question, whether gonorrhœa, or the ulcers resulting from the matter of gonorrhœa, can produce constitutional symptoms, Mr. Guthrie believes that they generally do not, although he does not affirm that they cannot under particular circumstances of constitution; and he is further of opinion that if such symptoms ever really arise, they become serious only in consequence of the exhibition of mercury. (See *Med. Chir. Trans.* vol. viii. p. 554.) Delpech considers the possibility of a general infection from the effect of what he terms a *syphilitic* gonorrhœa, completely proved; though he admits, that there are numerous instances in which this consequence does not happen. He owns that the distinction of one class of cases from the other is, *à priori*, extremely difficult, and most frequently quite impossible. Yet widely dissenting from established modern practice, he inclines to ancient maxims, and considers it prudent to destroy the first effect of the infection without delay; his aim being to shorten the duration of the discharge with cubebs, or copaiba, and then to introduce mercury into the system, through the same channel as conveys the virus into it, by rubbing the ointment on the integuments of the penis. (*Chir. clinique*, p. 292.) The late Mr. Wallace had so complete a conviction that one species of gonorrhœa depended upon the syphilitic poison, that he actually proposes to denominate it *catarrhal primary syphilis*; and, with respect to this and the ulcerating forms of primary syphilis, he asserts (what is much disputed), "we know that they are capable of reciprocally producing each other, and of causing analogous secondary effects in the constitution." (See *Wallace, On the Ven. Dis.* p. 240.)

This interesting question, whether the gonorrhœal virus is identical with that of syphilis, has been investigated by M. Hernandez, of Toulon, who first inoculated three healthy men in the vigour of life with gonorrhœal matter taken from three galley-slaves. The inoculation was repeated several times on the glans and the prepuce. Slight ulcerations regularly ensued without any chancreous appearance, and these were easily cured by simple dressings. Two other individuals, with strong disposition to scurvy, were then inoculated, and

rebellious ulcers were the consequence, which resisted all local remedies, and did not yield till stimulants combined with acids were given. One of them had wandering pains; and the pus of his ulcer was sanious, and the granulations fungous. In three out of four other young scrofulous subjects, the ulcers were very obstinate; in two, they had almost all the syphilitic characters, and were followed by herpetic eruptions. In these two, calomel was required to effect the cure; yet M. Hernandez expresses his conviction that there was nothing venereal about them. In another young man of gouty constitution, the sore continued troublesome till warm weather began, and was attended with wandering pains, and debility of the digestive organs. In another, the sore put on a venereal appearance, but soon healed on the return of bleeding from some hæmorrhoids. After mentioning the particulars of some other cases, M. Hernandez observes, "My experiments are a proof that ulcers which are produced by inoculation with gonorrhœal virus are not syphilitic, and they explain, at the same time, the sources of errors likely to render experiments of this kind, which appear so simple and decisive, far from being conclusive. They show how many circumstances may change the nature of ulcers, and give them such a masked character as is calculated to deceive those who are inattentive, and do not advert to these causes of complication." (See *Hernandez, Essai analytique sur la Non identité des Virus gonorrhéique et syphilitique*, Toulon, 1812; and *Ph. Ricord, Mal. vén.* p. 110, &c.) The objections which many would make to some of these inferences, would of course be founded on the fact, that a venereal ulcer cannot always be known by its appearance; nor is the spontaneous cure of a sore without mercury, even though followed by no secondary symptoms, now regarded as any proof of its not having been venereal.

Dr. Tongue, of Philadelphia, was inoculated in the right arm by Dr. Barton, with virulent gonorrhœal matter; but the result was not even any inflammation. Inoculation with the same matter was repeated on three others, without effect. Lint, wetted with fresh gonorrhœal matter, was laid behind the glans under the prepuce, and left there two days and a half; but neither chancre nor inflammation was produced. The prepuce and glans of a young man were also inoculated, without effect. On the other hand, cases are detailed in which inoculation with venereal matter taken from chancres, undiluted, or diluted with an equal quantity of gum-water, gastric juice, or a solution of one scruple of sulphate of copper or sulphate of iron in an ounce of water, were all followed by the formation of chancres. Dr. Harrison also inoculated with the matter of chancres, and found an ulcer and constitutional symptoms ensue. These and other particulars are noticed by M. Ricord. (*Op. cit.* p. 114.)

Much of the incongruity of the results of inoculations with what is termed gonorrhœal matter, would certainly be accounted for, if gonorrhœa were frequently associated, as is sometimes asserted, with chancres within the urethra. Indeed, M. Ricord infers, that whenever a discharge from the male urethra communicates a chancre to a woman, there is something more than a clap, and that the urethra is the seat of ulceration in some point of its course. "The existence of every kind of



ulceration (he observes) has been denied; and what has led to this denial of the liability of the urethra to ulcerate, under the influence of causes which produce this result in other mucous membranes, is, that Morgagni never observed ulcerations in gonorrhœa—that very Morgagni, who, however, had seen chancres in the meatus urinaris and cicatrices in the urethra, which must have proceeded from previous destruction; that Hunter, in the dissection of two executed criminals who had gonorrhœa, found no ulcerations in the urethra; and that M. Cullerier and Ph. Boyer, each of them in a single examination, also met with no ulceration.” M. Ricord afterwards notices cases, where the introduction of the pus of chancre into the urethra produced blennorrhagia: here (says he) it is certain, “one of two things must have occurred; either the matter of chancre acted as a simple irritant in exciting the discharge, or else, operating specifically, it caused an urethral chancre, which, in consequence of its situation, being what I call *un chancre larvé*, only occasioned the symptoms of blennorrhagia.” (*Op. cit.* p. 121–124.)

In support of the doctrine, that mere gonorrhœal matter never produces chancre, M. Ricord adverts also to the fact that the muco-purulent secretion of gonorrhœal ophthalmia never occasions chancres by inoculation or otherwise, although the eyelids are susceptible of being infected by chancre. (P. 131.) Amongst other points, he has also ascertained, that the pus of a sympathetic bubo, or of an abscess of the testicle, from inflammation of this organ, in consequence of gonorrhœa, may be used for inoculation without any venereal effects being the result. (P. 132.)

I need not repeat, that many controverted doctrines and opinions will be much affected, if the observations made by M. Ricord with the speculum uteri, and supported by the results of inoculations with gonorrhœal matter, and the pus from chancres, be found to agree with general experience.

One of the greatest obstacles to our arrival at a satisfactory knowledge of the nature of lues venerea, is the fact that, under this denomination, various diseases are comprised and confounded, the particular distinctions of each of which are not yet sufficiently made out to enable surgeons to form a well-founded and practical classification of them, satisfactory to every impartial observer, and agreeing with general experience. As Mr. Rose has observed—Long before syphilis is supposed to have commenced its career in the world, some of these diseases were frequently met with; and Mr. Pearson thinks that, in addition to those formerly known, new forms of disease have occasionally arisen, “which are succeeded by a regular series of symptoms nearly resembling the progress of lues venerea.” (*Obs. on the Effects of various Articles of the Materia Medica in the Cure of Lues Venerea*, 1d. ed. Introd. p. 53; and Rose, in *Med. Chir. Trans.* vol. viii. p. 418.) Mr. Hunter also, in the seventh chapter of his Treatise on the Venereal Disease, speaks of many examples of new-formed disease, arising from peculiar poisons, quite different, he supposes, from every other virus previously known, or judged of by its effects. But though Mr. Rose appears to join in the belief of a plurality of poisons, he is very far from considering it settled how far the variety in the symptoms of venereal cases is to be attributed to different

poisons, or how far the symptoms of the same poison may be modified and altered by constitution, climate, and habits of life. He remarks, that we seldom have an opportunity of tracing different cases to the same source of infection, and of comparing their progress with each other. (*Vol. cit.* p. 419.) And, I may add, that so far as observations of this nature have been made, and can be trusted, or are not invalidated by the researches of M. Ricord and his mode of explaining the facts, they rather tend to prove, as already noticed in the foregoing columns, that different individuals, when infected nearly at the same time and by the same woman, are very far from having any uniformity in their complaints; some having one kind of sore, some another, and others claps, &c. And the tenor of the remarks made likewise by Mr. Evans, so far as he has entered into the subject, lead equally to the conclusion, that one primary complaint, when it produces another, does not always occasion one resembling itself. Thus the *ulcus elevatum* on the penis, though capable of being communicated by inoculation, appeared sometimes to be the effect of one kind of infection, sometimes of another, and sometimes even to have a spontaneous origin. Who shall unravel all these intricacies, I know not, whether he bring to his assistance plurality of poisons, or states of the parts and constitution, climate, neglect, intemperance, wrong treatment, or any other circumstance which can possibly be conceived to have influence over the appearances, progress, and consequences of the disease. Nay, it would appear from some of the curious and perplexing histories mentioned in the preceding pages, that one kind of primary complaint in an individual may impart to other persons primary complaints of a different nature; so that even the hope of elucidating parts of this abstruse subject, by adverting to a plurality of infections, and a vigilant observation of their characteristic effects, meets with discouragement almost at its very birth; and though the doctrine of several kinds of poisons being concerned in the production of venereal diseases is still partially entertained, an absolute proof of its correctness can hardly be said to have been yet afforded; nor indeed could it be obtained, unless the inoculation of healthy individuals with the matter of the different forms of disease were justifiable for the elucidation of the question. And, as this is not the case, I think, with Mr. Carmichael, that it might be a benefit to society if criminals were sometimes permitted to commute a heavier punishment by submitting to such experiments; without which the inquiry into the reality, number, nature, and effects of the morbid poisons under consideration, can perhaps never be brought to a satisfactory termination. “I am perfectly aware (says Mr. Carmichael) how much the state of the human constitution will modify local disease, and am willing to attribute, to a certain extent, the great variety of appearances we witness daily in venereal complaints to this cause alone. But, we observe, that many of these primary ulcers evince, from their very commencement, such peculiar and distinct characters, that it would be quite an absurdity to believe that the virus is always the same, and the variety of characters dependent alone upon constitution. Thus, nothing can be more opposite from the commencement than the common chancre, with its hardened base, like a piece

of cartilage under the skin, and the sloughing ulcer. The first is slow and chronic; the latter begins with a mortified spot, extends by alternate sloughing and phagedænic ulceration, and makes more progress in three days than the former in as many weeks.

"The phagedænic ulcer is equally distinct from chancre, as it does not evince at any period a hardened base, but gradually creeps from one part to another of the penis, leaving those parts to heal which, in the first instance, it attacked; so that when the disease has existed for some months, the glans is seen to exhibit its entire surface furrowed over with ulcerations and cicatrices.

"There is a raised ulcer also with elevated edges, approaching the nature of the phagedænic ulcer, yet whose characters are sufficiently distinct to be considered as a separate species. But the most common venereal primary ulceration presents such various appearances in different individuals, that until a more exact knowledge is obtained, it is better described by its negative than its positive qualities; and it may be designated an ulcer without induration, raised edges, or phagedænic surface.

"If (continues Mr. Carmichael) the plurality of venereal poisons is supported by the variety of primary ulcers, it is equally so by the multiplicity of constitutional eruptions. A primary ulcer, which was not phagedænic, or sloughing at first, may afterwards, like any other ulcer, become so by irritation, neglect, or inflammation. But, I do not conceive that we have grounds for supposing that the state of the constitution can so modify morbid poisons as to cause the same virus to produce in one person the chronic scaly lepra and psoriasis, and to assume in another a decided pustular form, each pustule spreading rapidly into a deep ulcer." (*On the Symptoms and Specific Distinctions of Venereal Diseases*, p. 6, &c. 8vo. Lond. 1818.)

The same gentleman, in another earlier publication, gives his reasons for believing, that certain primary appearances are followed by a corresponding train of constitutional symptoms. 1st. That the syphilitic chancre gives rise to scaly eruptions, lepra, and psoriasis; an excavated ulcer of the tonsils, and pains and nodes of the bones. 2dly. That the ulcer, without induration, raised edges, or phagedænic surface, gonorrhœa virulenta, an excoriation of the glans and prepuce, are followed by a papular eruption, which ends in desquamation, pains in the joints resembling those of rheumatism, soreness of the fauces, and frequently swelling of the lymphatic glands of the neck; but without any nodes of the bones. 3dly. That the ulcer, with elevated edges, in the few instances in which it was traced by Mr. Carmichael to its constitutional symptoms, was followed by a pustular eruption, which terminated in mild ulcers, pains in the joints, and ulcers in the throat, but no appearance of nodes. 4thly. That the phagedænic and sloughing ulcers are generally attended with constitutional symptoms of peculiar obstinacy and malignity; viz. pustular spots and tubercles, which form ulcers, generally spreading with a phagedænic edge, and healing from the centre; extensive ulceration of the fauces, particularly of the back of the pharynx, obstinate pains of the knees and other joints, while nodes are frequently present, and the bones of the nose are occasionally affected.

(See *Carmichael's Essays, and his Obs. on the Symptoms, &c. of Ven. Diseases*, p. 9.)

The observations of other writers coincide with those of Mr. Carmichael, respecting the great variety of character in primary venereal sores; but the hypothesis of various kinds of venereal poisons, or infectious matter, is perhaps rather losing ground. Indeed, on some of the principal points connected with the latter subject, little similarity of opinion prevails between him and other gentlemen who have entered into the disquisition. And, in the first place, without adverting again to certain statements already premised, which render it probable that differences of the virus, or, at all events, differences in the forms of the primary complaints in the contaminating individuals, would not always explain the reason of the diversified appearances and nature of the primary forms of disease in the contaminated, I shall lay before the reader other evidence, having an immediate relation to Mr. Carmichael's sentiment, that each kind of primary venereal sore is followed by a peculiar and corresponding train of constitutional symptoms. In the cases recited by Mr. Rose, "most of the papular eruptions followed ulcers which were not very deep, and which healed without much difficulty. Several of them had a thickened, but not a particularly indurated margin. This corresponds with the observations of Mr. Carmichael:—*I could not, however, discover any decidedly uniform character in such sores*; and the 16th case I should have considered as a well-marked instance of chancre." (*Med. Chir. Trans.* vol. viii. p. 399.) In another place, it is stated, that the appearances of sores can seldom be relied on in parts of such vascular structure, and in the midst of sebaceous glands. (P. 419.) With respect to the phagedænic ulcer, Mr. Rose expresses his belief, that it is rarely followed by secondary symptoms, though he inclines to the opinion, that it arises from the application of some morbid matter, acknowledging, however, the great difficulty of deciding "whether the great degree of erethismus, excited by the local affection, should be attributed to any peculiarity in that matter, or to the peculiar state of the constitution." (*Med. Chir. Trans.* vol. viii. p. 372.) And he then refers to the case reported by Dr. Fergusson, where "the infection was communicated by an opera-dancer at Lisbon, apparently in perfect health, who continued on the stage for several months afterwards, occasionally infecting others, without anything extraordinary, as far as he could learn, in the nature of the symptoms." (*Op. cit.* vol. iv. p. 12.) And, on the same subject, Mr. Guthrie does not think "that Mr. Carmichael's opinion as to the secondary symptoms, peculiar to the phagedænic and sloughing ulcer, receives any support from what occurred to the troops in Portugal; because it did not appear, that either of them, following sexual intercourse, were dependent on the cause which produced the ulcer. Where many men have had intercourse with the same woman (and with no others?) they have not all had the same complaint, although one of the ulcers, so originating, has become phagedænic or sloughed; neither has the same woman herself suffered from this distemper: indeed, the nature of an ulcer of either kind must, after a short time, effectually prevent any intercourse; and we often find that its peculiar characters only appear after the ulcer has existed



for several days. I firmly believe also, that, in the greater number of cases of sloughing ulcer, *where mercury is not given, no secondary symptoms would appear*: and in those cases in which they did appear, I apprehend, they would be equally dependent on the state of the constitution, as to the mode of cure, and their destructive characters. In other words, my observations lead me to conclude that *these ulcers do not depend upon a specific poison, but on the state of the constitution, under particular excitement*; and that, *when secondary symptoms occur, they are not dependent on the state of the ulcer*; although I am ready to admit that, in a constitution where an ulcer will readily become phagedænic, the secondary symptoms, when they occur, may be different to a certain extent from those that follow more simple ulcers, in a healthier habit of body." (*Med. Chir. Trans.* vol. viii. p. 564.) Repeated and careful observations make me also believe, that primary *sloughing* ulcers do not depend upon any peculiar poison; and I am also disposed to join in the opinion, that, when hurtful local treatment is out of the question, they are chiefly owing to the state of the constitution. According to my experience, all kinds of ulcers on the genitals may, from particularity of constitution, impairment of health, and sometimes from the pernicious effects of the immoderate and indiscriminate employment of mercury, assume in their progress a sloughing disposition, and even have it from their very commencement. Mr. Rose mentions a case, in which a *healthy* young man was affected with a sloughing sore on the penis, in consequence of a suspicious connexion. It was not attended with any constitutional disturbance, and yielded readily to mercury. The same patient, twice afterwards, at a very considerable interval, had a fresh infection. and the sores each time had precisely the same character as the first. This, says Mr. Rose, is no uncommon occurrence, and it is not probable that the sloughing and appearance of the sores arose from the peculiarity of the poison. (*Med. Chir. Trans.* vol. viii. p. 420.) And another intelligent surgeon, who has particularly attended to this investigation, declares his conviction, that "many varieties of sore, independently of the sloughy chancre mentioned by Mr. Carmichael, lead to constitutional symptoms, differing in no respect from those he has described, and admitting of the same mode of cure." Nor does he believe, with Mr. Carmichael, that only one particular species of sore is capable of producing the true secondary symptoms of lues. (*J. Bacot, On Syphilis*, p. 51.)

From these observations, I think, we may safely infer, that with respect to the *sloughing ulcer*, it neither arises from the application of any one specific poison to the part, nor is it connected with any regular train of secondary symptoms.

Dr. Hennen frequently had occasion to observe that eruptions of the same nature and character succeeded to the foul indurated, excavated ulcer, and to the simple excoriation. "In fifteen cases of eruptions unaccompanied by any other symptoms, which succeeded the Hunterian sore, six were tubercular, five exanthematous, two pustular, one tubercular and scaly, and one tubercular and vesicular.

"In four cases, following the same sore, but in which the eruptions were complicated with sore-throat, two were tubercular, one was tubercular and scaly, and one was tubercular and exanthematous.

"In twelve cases following the *non-Hunterian*

sore, and in which eruptions were the only symptoms, six were pustular, three were exanthematous, and one was tubercular and scaly.

"In seven cases, where the eruption was accompanied with sore-throat, three were exanthematous, two were tubercular, one was papular, scaly, and tubercular, and one was pustular and tubercular." Dr. Hennen also recites an instance in which a Hunterian chancre was, at the distance of ten weeks, succeeded by a *papular eruption*, which, in the course of a month, was removed by low diet, purgatives, and the decoction of sarsaparilla. In two months afterwards, an eruption of a similar nature appeared without any fresh infection. This was treated with mercury, which was administered five weeks, so as to excite a moderate salivation. Under this treatment, the eruption faded, having, during its progress, assumed the appearance of *vesicles* and *pustules*, and at length falling off in amber-coloured *scales* with livid bases. Notwithstanding this mercurial course, the patient was a third time admitted, ten weeks afterwards (without any intervening primary affection), with a *pustular eruption*, which was finally cured without mercury, and the pustules falling off in squamulæ. In another month, without any fresh infection, he was a fourth time taken into hospital with a very thickly dispersed *pustular eruption*, somewhat different from the former, the pustules being more numerous, smaller, and acuminate. They yielded to non-mercurial treatment. During all these attacks, there was apthous sore-throat, and occasional flying pains in the joints. The inference drawn from this case is, that even a full and judiciously conducted mercurial course does not prevent the reappearance of venereal eruptions, and that they assume at different times, different characters, notwithstanding the interruption they receive in their natural progress by the use of that remedy. (*On Medical Surgery*, ed. 2, p. 528-530.) After these accounts, I can have no hesitation in coming to another conclusion; which is, that, with the exception of the partial confirmation of Mr. Carmichael's doctrine by Mr. Rose, so far as relates to the frequency of papular eruptions after superficial primary ulcers, the regular connexion of particular forms of secondary symptoms with any given descriptions of primary sores is so far from being supported by the testimony of other observers, that one kind of primary ulcer may lead, in the same patient, to eruptions of several different sorts, either existing together on various parts of the body, or breaking out in succession; and no regular connexion can be traced between any one species of primary sore and any determinate class of secondary symptoms. These truths, I believe, must be admitted, disadvantageous as they are to the prospect of bringing the diagnosis of syphilis to a final settlement, so as to enable the writer to describe the disease with accuracy, and the practitioner to recognise and treat it with certainty. The first essential step to the elucidation of this subject, however, is undoubtedly the subversion of every doctrine relative to it, which is repugnant to general experience. The same facts, which may render it necessary for Mr. Carmichael to retract some of his inferences, and which facts were first established, beyond all doubt or possibility of successful contradiction, by the very impartial, disinterested, and extensive investigations made in the hospitals of the British army, would

have obliged even Hunter himself, had he been alive, to confess the mistaken views which he sometimes took of the nature of the venereal disease.

In opposition to Mr. Carmichael's theory, Mr. Bacot brings forward several arguments:—"Mr. Carmichael (he says) gives us an example of a phagedænic sore, followed by those appearances which should attach to the raised ulcer; he admits that the papular and pustular diseases are sometimes mixed; in some of his phagedænic cases, we find that that character has been given to the ulcer by the action of mercury; in still more of them, the original character of the sore is not preserved throughout, so that the form of secondary symptoms, which ought to succeed to the classification, is very difficult to divine; in short, he frequently departs from his own arrangement. His description of a phagedænic ulcer includes, unless I am much mistaken, two very distinct kinds of sore; and, in more than one instance, a phagedænic surface and elevated edges are united in the same description of ulcer. Nay, more, he tells us, that occasional difficulty is encountered in distinguishing the phagedænic ulcer from the other primary ulcers. It displays, however, its character of phagedæna so early, that, he thinks, it cannot often be confounded with an ulcer that becomes phagedænic from irritation; and, he adds, that neglect, local irritation, and even constitutional irritability, will cause any ulcer to become phagedænic. What, then, should prevent me from assuming, that an early irritation may produce an early change in the character of the sore? And then what becomes of the phagedænic ulcer and its appropriate, consecutive, constitutional symptoms?" (*J. Bacot*, in *Med. Gazette*, vol. ii. p. 422.) Notwithstanding this reasoning, however, if it were proved that the primary phagedænic ulcer, not made so by irritation, neglect, &c., always, or even generally, was followed by one train of secondary symptoms, and not by another, Mr. Carmichael's researches would have materially contributed to enlighten this obscure subject. As I do not believe that sores, which are originally phagedænic, necessarily depend upon any one peculiar virus, of course much difficulty presents itself to my mind in the adoption of this part of Mr. Carmichael's views.

As this part of the inquiry into the nature of the venereal disease is one of the most interesting, I will here notice the objections of Mr. Wallace to the hypothesis of a plurality of venereal poisons, who reduced to the following heads all the arguments used in support of it.

1. Some of the diseases which result from venereal intercourse, require mercury for their cure or removal, while others are curable without this remedy. Therefore, the former class of diseases must be of a totally different species from the latter, and produced by distinct poisons.

2. Historical evidence demonstrates, that certain forms of venereal disease existed from the earliest ages, and that to these was added, after the discovery of America, a new and peculiar disease.

3. Certain diseases, nearly allied in their general characters to each other, and to venereal diseases, have been observed in Canada, Scotland, and the West Indies, &c.; yet they are considered the product of different morbid poisons; and as these diseases do not differ more widely from one another than the varieties of venereal diseases

differ from each other, we have the same reason for supposing that the varieties of venereal disease result from poisons specifically distinct, as we have for supposing that the diseases in question arise from different poisons.

4. The symptoms of all diseases which are caused by morbid poisons, are regulated by laws so fixed or determined, that they are always uniform in their appearance and progress; but the diseases which result from venereal intercourse, if considered as the consequence of one morbid poison, exhibit the most dissimilar characters, and must, therefore, be owing to the action of dissimilar poisons.

5. The symptoms of venereal diseases, though numerous and varied, form certain determinate groups, in which we observe peculiar forms of primary symptoms, followed by corresponding forms of constitutional disease; and the primary and constitutional symptoms of each group resemble one another in their general character or in their degrees of mildness and severity; while the primary and secondary symptoms of any one group are, in their origin, as well as in their progress, altogether different from the corresponding symptoms of the other groups; and these circumstances cannot be explained except by the supposition, that each group is produced by its own peculiar specific cause.

Mr. Wallace examines each of these arguments separately.

1. The results of modern experience seem to him evidently to refute the first argument, by demonstrating that *every form of venereal disease with which we are acquainted, has been cured without mercury*: hence, says he, we have no proof that there are two classes of venereal disease distinguishable from each other by the one requiring mercury for its cure, while the other is curable without this remedy.

2. "Let it be admitted (observes Mr. Wallace, as if demonstrated by satisfactory evidence) that many forms of venereal diseases have existed from the earliest ages, and that a new disease was introduced from America by the followers of Columbus, what proof have we that this new disease at present exists? Those (says he) who support this doctrine, that a new disease was introduced into Europe, after the discovery of America, are compelled to admit that it is impossible to distinguish the symptoms of this new or real syphilitic disease, as they denominate it, from those of other forms of the venereal disease; and they affirm that a line of distinction can be drawn between them only by the influence which mercury exercises over their progress. Thus, Mr. Abernethy says, that 'the fictitious disease in appearance so exactly resembles syphilis, that no observation, however acute, seems to be capable of deciding on its nature.' (*On Dis. resembling Syphilis*, p. 44.) And at p. 54 he admits, that all his reasoning is founded 'upon the presumption that diseases, which spontaneously get well, are not syphilitic.'" "It is true (adds Mr. Wallace) that Mr. Carmichael has attempted a diagnosis of these diseases, founded upon their symptoms; but he has not succeeded. We must therefore conclude, that, as we know of no disease incurable without mercury, we cannot admit that the disease, imagined to have been introduced into Europe, by the followers of Columbus, at present exists."



3. Mr. Wallace deems it unnecessary to examine the third argument, because, supposing yaws, sivens, and some other diseases to exist in other countries, and that each of them arises from a specific and distinct morbid poison, no argument can be deduced from these circumstances of the plurality of venereal poisons.

4. In relation to the fourth argument, Mr. Wallace observes, that it does not follow of necessity that, because the disease produced by one morbid poison exhibits great uniformity of character, that produced by another should follow a similar course. Waiving, however, the consideration of this question, and granting to the advocates of the doctrine of a plurality of venereal poisons every advantage afforded by the analogy of other diseases produced by morbid poisons, Mr. Wallace proceeds to inquire whether diseases caused by morbid poisons are, as stated in the argument, always uniform in their appearances and progress. He begins with noticing the admitted truth, that impressions which result from causes exactly similar, produce upon different persons very dissimilar consequences, as illustrated in the effects of punctured wounds. In cow-pox and small-pox, which depend upon specific morbid poisons, he points out the numerous varieties and anomalies to which these diseases, as well as the venereal, are liable. Amongst other inferences made by Mr. Wallace are the following:—1. The effects of the morbid poison which produces the vaccine disease are subject to numerous varieties; and therefore analogous varieties in the appearance of the symptoms which result from the syphilitic virus, cannot be considered as any proof of the existence of different venereal poisons.

2. However various the eruptions may be which are caused by the venereal poison, they do not exhibit greater varieties than those produced by the variolous poison; and as this poison, influenced by extrinsic circumstances, is sufficient to produce all the varieties of small-pox, one poison, if influenced by similar circumstances, may produce analogous varieties of syphilis. "Should it be urged against the above conclusion, that remarkable varieties of vaccina and variola are seldom to be met with, but that remarkable varieties of syphilitic diseases are of daily occurrence, I would answer, that this circumstance will be easily explained to the reflecting reader by the number of modifying causes, which influence venereal maladies, being much greater than those which influence variola or vaccinia.

"To adduce one illustration: when the matter or lymph of small-pox or cow-pox is used for inoculation, the greatest care is in general taken, not only to obtain it at a certain age, and from a vesicle or pustule, possessed of what are considered the specific characters, but also to insert it into a healthy subject; whereas the venereal infection is applied during various states of the health of the recipient, and the poison is taken during every stage, and from every possible form of disease."

This last remark may not, however, strengthen Mr. Wallace's views, as it implies differences and modifications of the virus itself, which is, in reality, an approximation to the doctrine of a plurality of poisons. The same idea was long ago suggested, and especially by Mr. Wellbank, as will be presently seen.

5. The assertions in the fifth argument, for the doctrine of Mr. Carmichael, Mr. Wallace sets down as not having been verified by the experience of other practitioners. (See *W. Wallace, On the Ven. Dis.* p. 14–24.)

In a very ingenious paper by Mr. Wellbank, I find several observations well deserving attention. Amongst other things, he suggests a plan of investigating venereal diseases, which, if carefully followed up, might throw considerable light on their diagnosis. "Instead of recording with laboured minuteness the resemblance or dissimilarity, confessedly sometimes fallacious, of primary sores, of eruptions, or of other really or seemingly consecutive diseases, in the cases of *different individuals*, we should (says he) faithfully chronicle the diversity of disease existing at the same time *in the same person*. We should note, for instance, the various character and progress of a phagedænic sore, as it attacks different tissues, or the phenomena of several of these sores, when they have occurred at the same time, in different situations, from the same infection. Let us also record the multiform secondary effects of the same disease, contemporaneous in their appearance or coexistent in the same system, and various as they are manifested in absorbents, mucous membrane, skin, cellular tissue, fibrous membrane, or in the bones. From repeated observation of collective phenomena, we shall soon arrive at the inference that many affections, often noticed in conjunction, but various in their apparent characters, are in reality the constant result of one or other distinct stimulus, acting upon a diversity of organisation. By a patient and unbiassed prosecution of this mode of inquiry, we cannot fail soon to acquire diagnostic data, which will enable us to solve some of the most difficult problems in the distinction of venereal complaints." (*Med. Chir. Trans.* vol. xiii. p. 566.)

Amongst other doctrines, Mr. Hunter inculcates that the venereal matter, when taken into the constitution, produces an irritation, which is capable of being continued, independent of a continuance of absorption, and the constitution has no power of relief; therefore a lues venerea continues to increase." The same criterion was proposed by Mr. Abernethy, who states that the "constitutional symptoms of the venereal disease are generally progressive, and never disappear unless medicine be employed." (*Surgical Obs.* p. 137.) And notwithstanding some dissent may be traced in both old and modern writers, from the belief that mercury was absolutely essential to the cure of the venereal disease, and an opposite conclusion might easily have been drawn from the whole history of this subject, including the practice of former and present times, the contrary hypothesis was that always taught in all the great medical schools of this country, even down to so late a period as fifty years ago. But the error no longer prevails; and no facts are more completely established, than that mercury, however useful it may frequently be in the treatment of the venereal disease, is not absolutely necessary for the cure either of the primary or secondary symptoms; and that the disease, so far from always growing worse, unless mercury be administered, ultimately gets well without the aid of this, or any other medicine. If any man yet doubt the general truth of this statement, let him impartially consider the many facts and arguments brought forward in

proof of it in the anonymous tract, "*Sur la Non-existence de la Maladie vénérienne*," and in the writings of Mr. Carmichael, Dr. Fergusson, Mr. Rose, Dr. Hennen, Dr. Thomson, Mr. Guthrie, Mr. Bacot, and other practitioners. Perilhe, as I have already noticed, distinctly admitted the frequency of spontaneous cures, and so does Delpech. "Observation seems to prove (says he) that there are some individuals in whom the lymphatic system appears to be endued with the fortunate property of extinguishing the syphilitic principle, so that merely primary symptoms occur." (*Chir. Clinique*, t. i. p. 341.) In short, if there be such a sceptic now living in this country, let him peruse the returns made by the surgeons of the whole British army, documents which will be noticed in the sequel of this article; let him consider the evidence of the surgeons of other countries, especially that of Cullerier, who used annually to demonstrate to his class of pupils the cure of venereal ulcers without mercury; and the testimony and practice of the German surgeons, who were attached, during the war, to regiments of their countrymen in the British service. The fact is therefore indisputable that the venereal disease, in all its ordinary and diversified forms, is capable of a spontaneous cure, and consequently that the question whether the disease is syphilitic or not, can never be determined by the circumstance of the complaint yielding, and being permanently cured without the aid of mercury. Yet, as Mr. Rose has observed, the supposition that syphilis did not admit of a natural cure, and that mercury was the only remedy that had the power of destroying its virus, was of late so much relied upon, that where a disease had been cured without the use of that medicine, and did not afterwards return, such fact alone, whatever might have been the symptoms, was regarded as sufficient proof that it was not a case of syphilis. And, as the same writer judiciously remarks, the refutation of these notions is of considerable importance, "not so much in reference to the treatment of syphilis, under common circumstances, for the strikingly good effects of mercury will probably not render it advisable in general to give up the use of that remedy, but from the change it will produce in our views of the diagnosis of the disease. The distinction, which has engaged such a share of attention of late years, and which is evidently so important between syphilis and syphiloid diseases, has been made to depend so much on the former admitting of no cure, except by mercury, that, if this principle should be found to be erroneous, the difficulties which have attended it will in a great measure be explained." (*Med. Chir. Trans.* vol. viii. p. 350, 351.) That it is erroneous, will appear more clearly when the treatment of syphilis falls under consideration.

Excluding from present attention works of ancient date, it is curious to find how very nearly several writers, within the last thirty or forty years, arrived at the same point to which modern investigations have led. Thus, Mr. B. Bell observes that "a chancre might frequently be cured with external applications alone, and as we know from experience that the virus is not always absorbed, the cure would in a few instances prove permanent; but, as we can never with certainty know whether this would happen or not, while, in a great proportion of cases, there would be rea-

son to think that absorption would take place, we ought not in any case to trust to it." (*On Gonorrhœa Virulenta*, &c. vol. ii. ed. 2, p. 325, 8vo. Edin. 1797.) And, in some reflections upon a case of doubtful nature, Dr. Clutterbuck long ago remarked: "Supposing even that the diseased appearances had after a time got well of themselves, I should deem even this no absolute proof of their not being of a venereal nature. I have seen cases which induce me to believe, that the venereal disease, in some of its stages, and in certain circumstances, may get well without mercury or any other remedy. But this is contrary to the doctrine of Mr. Hunter, who supposed that venereal actions go on increasing, without any tendency to wear themselves out.

That lues venerea is much modified by climate and other circumstances, is generally allowed; that it has been cured by other means than mercury, we have also very sufficient evidence in the older writers on the subject: not to mention the late successful trials with acids, and other substances. *Many of the appearances on the skin go off spontaneously.* When purple spots appear on the skin (Mr. Hunter observes, p. 319), giving it a mottled appearance in this disease, many of the spots disappear, whilst others continue and increase." (*H. Clutterbuck, On some Opinions of John Hunter*, p. 27, 8vo. Lond. 1799.) If Dr. Clutterbuck had advanced one step further, and declared that the venereal disease might be cured without mercury, or any other remedy, in all, or nearly all, its forms, and not merely in some of them, he would actually have anticipated the most important fact, established chiefly by the meritorious labours of the army surgeons, whose opportunities of going through the investigation were better, on several accounts, than those of private practitioners, who generally soon lose sight of their patients, and never have them sufficiently under their control and observation to render a full perseverance in any method a matter of certainty. At all events, Dr. Clutterbuck may justly claim the merit of having distinctly marked the fact, that *the circumstance of a disease giving way, and being cured without mercury, is no proof that the case is not venereal.*

One of the most ingenious theories ever devised for explaining all the perplexities and irregularities of syphilis, is unquestionably that of the late Mr. Hunter; for it accommodated itself almost to everything, and every believer in it fancied he could account satisfactorily for many puzzling occurrences, which admitted of no good explanation on other principles. Mr. Hunter inculcated, that the parts contaminated by the absorption of the venereal poison do not immediately begin to be palpably diseased, but only acquire a disposition to take on the venereal action. He further believed, that when this disposition was once formed in a part, it necessarily changed into action, or manifest disease, at some future period. That mercury can cure the disease when positively formed, but not the disposition to it. That although mercury cannot destroy the disposition already contracted, yet that it can prevent it from being formed at all. That the disposition never becomes the real disease, or, in Mr. Hunter's language, goes into action during the use of mercury. That the action having once taken place, always increases; never wearing itself out. That



parts, once cured, never become again contaminated from the same stock of infection. And, that the matter of secondary ulcers, or those which break out in consequence of absorption, is not infectious. What Mr. Hunter meant by the term *disposition*, I think, is better explained than the ground for the adoption of the theories connected with it: viz. the presumption of its being formed in all the parts, capable of contamination; the certainty of its future change into actual disease; the impossibility of curing it by mercury, previously to such change; but the possibility of preventing its formation at all by the timely use of that remedy.

Dr. Clutterbuck has well observed, that the only foundation for all these hypotheses, connected with the phrase *disposition*, is the fact, that *secondary symptoms sometimes arise, notwithstanding a full use of mercury*. If, says this gentleman, we were to suppose with Mr. Hunter, that all the parts which are susceptible become at once contaminated, and mercury has no influence over them in this state, the constitution should become affected in almost all cases: for absorption probably always precedes the application of remedies. Either, therefore, mercury does prevent the future action, or a more frequent absence of susceptibility to the disease must be supposed than there are grounds for imagining. (*Remarks on the Opinions of Mr. Hunter*, p. 9-12.) But surgeons of the present day, enlightened by many new facts, unequivocally determined since Mr. Hunter's time, know very well, that a *disposition* to the disease is in many instances not produced at all, even though the matter of a chancre be supposed to be absorbed; since in a large proportion of cases of chancres, which had all the characteristic appearances of such ulcers, according to Mr. Hunter's own description, no secondary symptoms followed, though the patients were treated and cured without any mercury. Yet, if Mr. Hunter's theory were true, the disposition must have been produced, the action or disease itself, in the form of secondary symptoms, must have ensued, sooner or later, and no cure could have been ultimately effected without mercury. Fortunately for mankind, unsound as some of the theories seem, which are attached by Mr. Hunter to the supposed *disposition of the venereal disease*, or its latent form, there was one piece of advice given by him, which may be said to have had a beneficial effect in practice, though founded upon these very doctrines; and it was this: "that we should push our medicine no farther than the cure of the visible effects of the poison, and allow whatever parts may be contaminated to come into action afterwards." (*On the Venereal Disease*, p. 334.) This maxim, I know, has been regarded by some admirers of long salivations as the cause of many relapses, and imperfect cures; but when I advert to the dreadful mischief which formerly attended protracted courses of mercury for latent and imaginary complaints, my mind regrets that Mr. Hunter himself should not have strictly adhered in practice to his own principle, from which he undoubtedly deviated with his patients, and even in certain other parts of his writings. However, the effect has been to discourage long courses of mercury; and perhaps, in this way, the world has been benefited by the counsel, though not rigorously adopted by him who gave it.

*Chancres*.—The penis, which in men is the common seat of a chancre, is, like every other part of the body, liable to diseases of the ulcerative kind, and on some accounts is rather more so than other parts. When attention is not paid to cleanliness, excoriations, or superficial ulcers, often originate. The genitals, also, like almost every other part that has been injured, when once they have suffered from the venereal disease, are very liable to ulcerate again. Since, therefore, the penis is not exempted from common diseases, every judgment of the nature of ulcers upon it, as Mr. Hunter truly remarks, should be formed with great attention, particularly as all diseases upon this part are suspected to be venereal. But, for a particular description of the many ordinary complaints which are apt to occur on the genitals, either preceded or unpreceded by sexual intercourse, I refer to Mr. Evans's treatise. (*On Ulceration of the Genital Organs*, 8vo. Lond. 1819.) From facts already mentioned, however, it would appear that primary syphilitic ulcers, or chancres, by which I imply sores capable of giving rise to the secondary symptoms of the venereal disease, have no determinate external character, are extremely diversified in their appearance, and absolutely cannot always be distinguished by their mere look from sores which are of a common, or at least a very different nature. This is another important fact, for which every man in the profession who seeks only truth, and the expulsion of errors from the doctrines of surgery, must feel obliged to the army surgeons. Nor is their merit lessened by the consideration that the detection of mistake on this point, like the discovery of the error concerning the invariable progress of the venereal disease from bad to worse, unless medicine be given, has taken place in opposition to the tenets of Mr. Hunter. "*Venereal ulcers* (says he) *commonly have one character*, which, however, is not entirely peculiar to them; for many sores that have no disposition to heal (*which is the case with a chancre*) have so far the same character. *A chancre has commonly a thickened base*, and although in some the common inflammation spreads much further, yet the specific is confined to this base. (P. 215.) And elsewhere, he observes, a chancre first begins with an itching in the part. When the inflammation is on the glans penis, a small pimple, full of matter, generally arises, without much hardness or seeming inflammation, and with very little tumefaction; for the glans penis is not so apt to swell, in consequence of inflammation, as many other parts are, especially the prepuce. Mr. Hunter also explains that chancres situated on the glans are not attended with so much pain and inconvenience as sores of this nature on the prepuce. When chancres occur on the frænum, or particularly on the prepuce, a much more considerable degree of inflammation soon follows, attended with effects more extensive and visible. These latter parts, being composed of very loose cellular tissue, afford a ready passage for the extravasated fluids. The itching is gradually converted into pain: in some cases, the surface of the prepuce is excoriated, and afterwards ulcerates; while, in other examples, a small pimple or abscess appears on the glans, and then turns into an ulcer. *The parts become affected with a thickening, which at first, while of the true venereal kind, is very circumscribed; not diffusing itself*, as Mr. Hunter ob-

serves, gradually and perceptibly into the surrounding parts; but *terminating rather abruptly. Its base is hard, and the edges a little prominent.* When it begins on the frænum, or near it, that part is very commonly wholly destroyed, or a hole is often made through it by ulceration.

When venereal matter is applied to the body of the penis, or front of the scrotum, where the cuticle is thicker than that of the glans penis and prepuce, the chancre generally makes its appearance in the form of a pimple, which commonly forms a scab, in consequence of evaporation. The first scab is generally rubbed off, after which a second, still larger one, is produced.

When the disease is more advanced, it is often attended with inflammation peculiar to the habit, becoming in many instances more diffused, and often producing phymosis and paraphymosis. However, according to Mr. Hunter, *there is yet a hardness around the sores, which is peculiar to such as are caused by the venereal virus*, particularly those on the prepuce.

Mr. Carmichael also, in his arrangement of primary ulcers on the penis, considers the true chancre as being particularly distinguished by its hardened base, which he compares to a piece of cartilage under the skin. It is to be observed, however, that, by the true chancre, or primary syphilitic ulcer, he does not signify that it is the only sore from which secondary symptoms may arise; but his observations lead him to regard it as the cause of such constitutional effects as belong to what he deems the true form of syphilis, or that in which the use of mercury is the most decidedly indicated. It would give me sincere pleasure to find any agreement, on this part of the subject, amongst other observers. The reader, indeed, must already know that the hardened base, which both Hunter and Carmichael have regarded as a distinguishing characteristic of a true chancre, is not found to be so by other gentlemen, who have most impartially investigated this point. Thus, Dr. Hennen observes, "We are not in possession of the knowledge of any invariable characteristic symptoms, by which to discriminate the real nature of the primary sore, and we are equally at a loss in many of the secondary symptoms. I am well aware that some practitioners have assumed to themselves the possession of a 'tactus eruditus,' by which they can at once distinguish a chancre, or a venereal ulcer, or eruption, in which mercury is indispensable, from one of a different nature; but I have seen too many instances of self-deception to give them all the credit that they lay claim to. It would be by no means difficult to show that the high round edge, the scooped, or excavated sore, the preceding pimple, the loss of substance, the hardened base and edge, whether circumscribed or diffused, and the tenaciously adhesive discharge of a very fetid odour, are all observable in certain states and varieties of sores unconnected with a venereal origin. The hardened edge and base, particularly, can be produced artificially by the application of escharotics to the glans, or body of the penis, of a sound person, and, if any ulceration, or warty excrescence, previously exists on these parts, this effect is still more easily produced." (*On Military Surgery*, 2nd ed. p. 517.) Now, if it be asked whether the chancre with a hardened base and prominent edge is distinguished by its not admitting of cure without

mercury, and by any regularity or peculiarity in the nature of the secondary symptoms when they originate from such an ulcer, modern experience denies the validity of both these criteria. If Mr. Rose's excellent paper be consulted, the reader will find that this gentleman certainly cured, without the aid of mercury, ulcers which had a decidedly marked induration of the margins and bases, by which the syphilitic chancre, according to Mr. Carmichael, is easily distinguished. (*Med.-Chir. Trans.* vol. viii. p. 421, &c.; also *Guthrie*, vol. cit. p. 576.)

Sufficient evidence has already been detailed to satisfy any impartial mind that, so far as the eye can teach us, no kind of primary sore has yet been satisfactorily proved to be the cause of only one set of peculiar constitutional symptoms; but, on the contrary, that a great variety of appearances in the skin, throat, &c. may follow sores which, inasmuch as their external characters are concerned, seem exactly alike. The only partial exception to this remark is the great frequency of papular eruptions after superficial sores—a point on which both Mr. Carmichael and Mr. Rose agree, though the latter gentleman does not represent even this connection as constant.

Dr. Colles joins several other modern writers in the statement, that "*primary venereal ulcers present an almost endless variety of character. I would define a primary venereal ulcer (he observes) to be one which is remarkably slow in yielding to ordinary, mild, local treatment, but which is curable by mercury, and which, if not so cured, is likely to be followed, in two or three months, by secondary symptoms, which again are also curable by mercury.* If then there be, as I affirm there is, an almost endless variety in chancres, how can we decide on the nature of primary ulcers, so as to pronounce some to be syphilitic, and others to be mere common sores, or simple excoriations? I reply, that we are to be guided in our decision, by observing, first, that *many of these suspicious ulcerations cannot be referred to any class of common ulcers, as they strikingly differ from them; and, secondly, by attending to the course which these take, when not interfered with by any stimulant, or caustic application, and when treated only with some mild ointment, or cold water.* If, under these circumstances, we find that, *after eight or ten days, such ulcers show no disposition to heal, and if, at the same time, there be a total absence of any cause, such as defect in the general health, to account for this obstinate condition of the local disease, we may then pronounce them to be syphilitic.* But I repeat that the local applications must have been of the mildest kind; for almost any primary venereal ulcer may be made to heal by the use of stimulating applications, even for so short a time as one or two days." (*Dr. Colles, On Ven. Dis.*, p. 75.)

These remarks of Dr. Colles appear to me judicious, though they involve some questions at which we shall presently arrive.

On this part of the subject, Mr. Wallace took great pains to throw useful light, and especially by attempting a classification of primary phagedenic venereal ulcers. For some forms of these diseases, he may, however, have been too partial to mercury, as it was one of his maxims sometimes to aim at bringing the patient as rapidly as possible under its influence. "When (says he) a phage-



denic form of syphilis, wherever seated, is presented to us, our first object should be to ascertain whether it spread by ulceration or slough; and, if by slough, the colour of the slough. If that colour be white, if the disease be making a rapid progress in parts of much importance, and, above all, if the patient be not in a state of mercurial excitement, or cachexia, produced by the irregular, or injudicious employment of mercury, which is not infrequently the case, we may instantly employ this medicine, not only by local fumigation, but also at the same time, in any other manner the case may dictate, so as to bring the patient, as rapidly as possible, under its constitutional influence; and this practice should be adopted, whether there be much inflammation or not. If there be inordinate inflammation, antiphlogistics and evacuants, proportioned to the nature of the case, are to be combined with mercury, just as in cases of iritis; and having put a stop, by these combined measures, to the further extension of the disease, which is sometimes done almost in a few hours, the mercurial treatment should be intermitted, and the patient allowed time to recover from the excitement produced, on the one hand by the disease, and on the other by the mercury. But as soon as the system and part are tranquillised, the mercurial treatment may be again resumed, without fear, but in a milder form, and continued with caution as long as may be necessary." (Op. cit. p. 171.) Whenever Mr. Wallace gave mercury, in cases of inflamed white phagedena, he particularly directed his attention, throughout the treatment, to the character of the slough at its junction with the living parts; and if it changed from white to black, in consequence of the intensity of the inflammation, or from any other cause; and if the inflammation increased while the patient was under the influence of mercury; or if the sore became free from slough, without any diminution of the inflammation and irritation; or lastly, if the system became deranged, while he found extraordinary difficulty in exciting the mercurial action;—Mr. Wallace directly discontinued the mercury. (P. 173.) I introduce Mr. Wallace's view of the usefulness of bringing the patient quickly under the influence of mercury in certain states of phagedenic ulceration; not with any intention, however, of joining in its praise; for such is my conviction of the fatal mischief which I have repeatedly seen result from mercury in such cases, that I have long abandoned it, and find every reason to be satisfied with the results.

Mr. Hunter computed that claps occur more frequently than chancres, in the proportion of four or five to one. I am not prepared to offer any opinion on this calculation, in reference either to chancres, as defined by that interesting writer, or under the more comprehensive view of them to which the results of later investigations would lead. One intelligent writer, however, has observed that present experience does not justify Mr. Hunter's conclusion respecting the infrequency of chancre compared with gonorrhœa. (*J. Bacot, Obs. on Syphilis*, p. 54.) Yet, in Dublin, if Mr. Carmichael's statement be correct, the frequency of gonorrhœa, as compared with that of what is sometimes termed the true venereal chancre, must be so great as to defy all computation; for he informs us that, since the descriptions of the success of the non-mercurial practice fell into his

hands, he has been anxious to ascertain, by personal observation, whether true syphilitic chancres did really admit of being cured without mercury; but, says he, "This disease, as described by Hunter, has diminished in so extraordinary a degree in this country that, strange to say, I have, from that period, met with only one case of true chancre." (*Obs. on the Symptoms, &c. of Venereal Diseases*, p. 14.) As this chancre remained stationary a month, it was thought proper to employ mercurial frictions, and it then soon healed, leaving a callosity which continued two months longer. However, after the above passage was written, Mr. Carmichael met with two cases of "well-marked chancre," each of which was attended with psoriasis syphilitica, scaly from its commencement. No mercury was given. For five weeks the disease gained ground; but, in the end, both cases were cured, merely by the administration of sarsaparilla. The following observations, contained in the appendix to Mr. Carmichael's work, do him infinite credit. "Although (says he) these two cases cannot fail to make a due impression, yet, if they stood alone, their evidence could not be deemed sufficient to establish a belief that true syphilis, like the papular disease, is capable of yielding to the powers of the constitution, or to remedies in which mercury does not form an ingredient. But this deficiency seems to be in a great measure supplied by the testimony of Mr. Rose, Dr. Hennen, and other equally intelligent surgeons, who had the advantage of serving with our army on the Continent; and if, in the preceding pages, I appear to be sceptical with respect to the accuracy of their observations, and doubted that it was true chancre and true syphilitic eruption which yielded to their prescriptions unaided by mercury, these two cases have satisfied me that every attention is due to the exactness and discernment of these respectable individuals; and, if I hesitated until I saw with my own eyes and judged with my own understanding, I claim for my own observations no larger a measure of faith from others." And he afterwards adds, "In thus relinquishing my opinion that true syphilis differs from other venereal complaints by always requiring mercury for its cure, it is necessary to reduce the doctrine I hold to this proposition: that, with respect to the use of that medicine, it differs from them only in not being injured, but decidedly benefited by it in all its symptoms and stages." (Pp. 218, 219.)

According to Mr. Hunter, there are three ways in which chancre may be produced: first, by the poison being inserted into a wound; secondly, by being applied to a non-secreting surface; and, thirdly, by being applied to a common sore. A wound, it seems, is much more readily infected than a sore. To whichever of these three different surfaces the pus is applied, it produces its specific inflammation and ulceration, attended with a secretion of pus. The matter, produced in consequence of these different modes of application, he says, partakes of the same nature as the matter which was applied; because, he observes, the irritations are alike. How the alleged examples of very different primary sores being sometimes communicated by the application of the matter of chancre, are to be reconciled with the Hunterian doctrines, it is difficult to suggest, unless Mr. Carmichael's observation about the present excessive

rarity of the true syphilitic chancre can furnish the explanation. However, so far as I can believe my own eyes and judgment, I now see in London the same forms of chancre which used to prevail during my apprenticeship at St. Bartholomew's Hospital, as far back as 1808. And if any difference can be particularised, it is only that which depends upon their being less rarely converted into worse diseases than mere syphilitic ulceration, by the dreadful effects of immoderate courses of mercury.

With respect to the three modes in which Mr. Hunter speaks of the venereal poison being applied and taking effect, I know not why he should have altogether excluded secreting surfaces; for of this nature (as Mr. Bacot remarks) are the glans penis and corona glandis (*On Syphilis*, p. 55); and of a similar kind are the insides of the labia, the surfaces of the nymphæ, &c., where sores are common enough. Whatever may be the truth of the supposed impossibility of the formation of chancres within the urethra, the latter considerations certainly tend to prove that the secreting nature of its membrane is not the only reason for the alleged fact.

I shall not here detain the reader with descriptions of the primary ulcer with elevated edges, the phagedenic and the sloughing chancre; nor with the statements of Mr. Carmichael respecting the train of constitutional symptoms appertaining, as he believes, to each form of ulcer. It is an interesting disquisition; but, so far as my observations and inquiries go, it has not yet reached any degree of certainty or precision; and, as I have already explained, the reports published by other gentlemen engaged in this investigation do not by any means confirm the much-desired intelligence that such progress has been made in the knowledge of all the diversified symptoms of the venereal disease, that its varieties can now be classed, both in regard to the primary ulcers and the secondary symptoms connected with each description of chancre.

I firmly believe that, with respect to all the appearances of this disease, both in its primary and secondary forms, a great deal depends upon constitution, independently of the nature of the virus. On this point I feel much more certainty than on the disputed question whether syphilitic diseases depend upon a variety of poisons, and whether some of the perplexity of these cases can be thus explained.

The varieties in the appearances of chancres badly comprehended, or wrongly interpreted, are noticed by M. Ricord as sometimes taken up as an argument against the identity of the venereal poison, and sometimes as a proof of the plurality of venereal poisons; but (says he) "If a chancre be rightly studied with reference to its cause, which is always the same, and to its mode of development and consequences, in regular and uncomplicated examples, the apparent differences are easily accounted for, and all contradictions cease; for whatever may be the actual form of chancre from which the pus is taken, *provided it be only taken at the right period*, already specified, a regular characteristic pustule is the result when the infectious matter is conveyed under the cuticle or epithelium; an ulcer at once when it is applied to denuded textures; or an abscess when it is introduced into the cellular tissue, or a lymphatic vessel or gland. Allowance being always made

for the difference depending upon the situation and the particular tissues affected, the same identical aspect, the same regular and characteristic appearance, always attend the ulcer at its commencement; and this whether the sore follows the rupture of the pustule, the opening of a virulent abscess of the cellular tissue, or of the lymphatic system, or whether the ulcer is formed at once. The *deviations, or particular forms only happen, or are developed afterwards, and under the influence of conditions foreign to the specific cause*; such as the peculiar constitution of the individual, his prior or concomitant diseases, the great or little care he may take to preserve his general health, or the constitutional or local treatment to which he is subjected. Hence, *patients are seen with phagedenic chancres, who caught the disease from persons whose sores were mild*; and hence the absolute falsehood of the notion *that an aggravated form of the disease is contracted by connection with a person who has it severely.*" (*Ph. Ricord, Mal. Vén.* p. 135.)

The local or immediate effects of the venereal disease are seldom wholly specific, but are usually attended both with the specific and constitutional inflammation. Hence, Mr. Hunter advises particular attention to be paid to the manner in which a chancre first appears, and to its progress. If the inflammation spreads in a quick and considerable way, the constitution must be more disposed to inflammation than natural. When the pain is severe, he would infer that there is a strong disposition to irritation. Chancres, also, sometimes, soon begin to slough, there being a strong tendency to mortification. Here he adverts to what are now usually called phagedenic venereal sores; of which the reader may find a minute description, and an attempted classification of them, in Wallace's treatise, chap. iv.

It is observed by Mr. Hunter that when there is a considerable loss of substance, either from sloughing or ulceration, a profuse bleeding is no uncommon circumstance, more especially when the ulcer is on the glans. The adhesive inflammation does not appear to take place sufficiently to unite the veins of this part of the penis, so as to prevent their cavity from being exposed; and the blood escapes from the corpus spongiosum urethræ. The ulcers, or sloughs, often extend as deeply as the corpus cavernosum penis, and similar bleedings are the consequence.

With respect to chancres in women, the labia and nymphæ, like the glans penis in men, are subject to ulceration; and the ulcerations are generally more numerous in females than males, in consequence of the surface on which the sores are liable to form being much larger. As Mr. Hunter observes, chancres are occasionally situated on the edge of the labia, sometimes on the outside of these parts, and even on the perineum. When the sores are formed on the inside of the labia or nymphæ, they can never dry, or scab; but, when they are externally situated, the matter may dry on them, and produce a scab, just as happens with respect to chancres situated on the scrotum, or body of the penis.

Mr. Hunter remarks that the venereal matter from these sores is apt to run down the perineum to the anus, and excoriate the parts, especially about the anus, where the skin is thin, and where chancres may be thus occasioned.



Chancres have been noticed in the vagina; but Mr. Hunter suspected that they were not original ones, and that they had spread to this situation from the inside of the labia. M. Ricord (who assures us that, with the aid of a speculum, he has frequently detected them in this situation in women who had also gonorrhœa) believes that this combination accounts for those otherwise perplexing facts, to which I have already adverted as taking place in individuals who contract venereal complaints by intercourse with one woman, and, as is assumed, with no others.

Before any of the virus has been absorbed, and conveyed into the circulation, a chancre is entirely a local affection. From the Hunterian doctrines, however, it would appear that absorption must generally soon follow the occurrence of the sore; though it may be remarked that, as the first effect of such absorption—the production of a bubo—does not usually take place in the early or ulcerating stage of a chancre, and not till granulations have formed, such doctrines may not be correct. I know, however, that rather an opposite conclusion has been arrived at by M. Ricord, as will appear from the latter part of the following passage:—"A chancre (says M. Ricord), which is, in relation to constitutional syphilis, what the bite of a rabid dog is in relation to hydrophobia, does not, however, produce a specific pus, except at a certain epoch of its duration; and it is certainly from so simple a fact not being recollected that the results of inoculation have been disputed, or rendered uncertain. It is very manifest that a primary venereal sore cannot be the same in all its stages, and that, if it did not pass into the state of a simple ulcer by the destruction of the cause which tended to keep it up, it would never heal. Similar characters and similar results cannot be expected from these different phases: it is at the period of progress or of the *statu quo* of ulceration, when there is no work of cicatrization going on, that the chancre secretes the venereal virus." (*Ph. Ricord, Mal. Vén.* p. 85.)

Notwithstanding the admitted fact that a chancre frequently loses its venereal character, and becomes a simple ulcer before it heals, so that the pus secreted by it, after a certain time, does not contain the venereal poison, there would appear to be exceptions, unless we are to set down certain accounts as incorrect; and, so far as the absorption of the poison is concerned, I believe, with Mr. Aston Key and Mr. Wallace, that the production of a bubo from this cause rarely or never occurs until at least some points of the chancre have begun to granulate. Another experienced surgeon informs us, that he has known some young men led to suppose that "when a chancre had lost its venereal characters, and had got into the state of a granulating ulcer, it was devoid of all venereal virus, and therefore incapable of conveying infection. In the early part of my professional life, I have known more instances than one which proved the fallacy of this notion. I had once an opportunity of learning that a chancre, even when recently healed, was still capable of communicating the venereal disease, if the cuticle chanced to be rubbed off. A young man whom I was treating for a chancre had the imprudence to marry privately in a day or two after his chancre had healed; the cuticle was rubbed off, and I was called upon, in a fortnight after, to treat

his wife for a chancre and bubo." (*Abr. Colles, M.D., On the Ven. Dis.* p. 80.)

When no secondary symptoms take place after the cure of chancre without mercury, I believe few surgeons of the present day would attempt to account for the fact by the hypothesis of the matter not having been absorbed; and this observation is made with every disposition on my part to express my assent to the truth of another circumstance, viz., that some persons appear much more susceptible of the effects of the venereal disease, than other individuals. It is remarked by Mr. Hunter that the interval between the application of the poison and its effects upon the parts is uncertain, but that, on the whole, a chancre is longer in appearing than a gonorrhœa. However, the nature of the parts affected makes some difference. When a chancre occurs on the frænum, or at the termination of the prepuce in the glans, the disease, in general, comes on earlier; these parts being more easily affected than either the glans penis, common skin of this organ, or the scrotum. He adds, that, in some cases, in which both the glans and prepuce were contaminated from the same application of the poison, the chancre made its appearance earlier on the latter part. Mr. Hunter knew of some instances in which chancres appeared twenty-four hours after the application of the matter; and others, in which an interval of seven weeks, and even two months, elapsed, between the time of contamination and that when the chancre commenced.

It was one of Mr. Hunter's opinions that the ulceration arising from venereal inflammation generally, if not always, continues till cured by art; and his theoretical reason for this circumstance was, that, as the inflammation in the chancre spreads, it is always attacking new ground, so as to produce a succession of irritations, and hinder the disease from curing itself.

It was, no doubt, the foregoing opinion of Mr. Hunter, which formed the authority for the position which was always forcibly insisted upon in the surgical lectures of Mr. Abernethy, which I attended many years ago, viz. that all truly venereal complaints, when not counteracted by remedies, invariably grow progressively worse, which is not the case with pseudo-syphilitic diseases. But modern experience apprises us that this doctrine is completely erroneous; that truly venereal complaints will get well without mercury; and consequently that the phrase *pseudo-syphilitic* has, in this respect, no foundation. As I have noticed in the foregoing pages, Dr. Fergusson assures us that, in Portugal, the disease, in its primary state amongst the natives, is curable without mercury, and by simple topical treatment; that the anti-syphilitic woods, combined with sudorifics, are an adequate remedy for constitutional symptoms; and that the virulence of the disease has there been so much mitigated that, after running a certain course (commonly a mild one) through the respective orders of parts, according to the known laws of its progress, it exhausts itself and ceases spontaneously. (*See Med. and Chir. Trans.* vol. iv. p. 2-5.) In the third edition of the *First Lines of the Practice of Surgery*, it was sufficiently proved, from several conclusions drawn from the writings of Mr. Pearson (*Obs. on the Effects of Various Articles in the Cure of Lues Venerea*), that venereal sores might be benefited, and even healed, under

the use of several inert insignificant medicines. And, as I have previously explained, the possibility of curing chancres and other venereal complaints without mercury was long since remarked by Dr. Clutterbuck, who thence very justly inferred that the healing of a sore without this remedy was no test that it was not venereal. (See *Remarks on the Opinions of the late John Hunter*, 1799.)

But, although the whole history of the venereal disease, and of the various articles of the materia medica, if carefully reflected upon, must have led to the same conclusion, the truth has been only of late years placed in such a view as to command the general belief of all the most experienced surgeons in this and other countries of Europe. I do not mean to say that the truth was not seen and remarked by several of the older writers; for that it was so any man may convince himself by referring to several works quoted in the course of this article. But it is to be understood, all indecision could never be renounced so long as prejudices interfered with the only rational plan which could be adopted with the view of bringing the question to a final settlement; I mean experiments on a large and impartial scale, open to the observation of numerous judges, yet under such control as insured the rigorous trial of the practice. Nor could such investigation be so well made by any class of practitioners as the army surgeons, whose patients are numerous, obliged to follow strictly the treatment prescribed, without any power of going from hospital to hospital, or from one surgeon to another, as caprice may dictate, or of eluding the observation of the medical attendants after a seeming recovery. And here I must take the opportunity of stating that, as far as my judgment extends, the most important and cautious document yet extant, on the two questions of the *possibility and expediency* of curing the venereal disease without mercury, is the paper of Mr. Rose. For let it not be presumed that, because the army surgeons find the venereal disease curable without mercury, they mean to recommend the total abandonment of that remedy for the distemper, any more than they would argue that *possibility and expediency* are synonymous terms. At the time when Mr. Rose published his observations, he had tried the non-mercurial treatment in the Coldstream Regiment of Guards, during a year and three quarters, and had thus succeeded in curing all the ulcers on the parts of generation which he met with in that period, together with the constitutional symptoms to which they gave rise. "I may not be warranted in asserting (says this gentleman) that many of these were venereal, but, undoubtedly, a considerable number of them had all the appearances of primary sores, produced by the venereal virus, and arose under circumstances where there had been at least a possibility of that virus having been applied. Admitting that there is nothing so characteristic in a chancre as to furnish incontrovertible proof of its nature, it will yet be allowed that there are many symptoms common to such sores, although not entirely peculiar to them; and whenever these are met with, there are strong grounds to suspect that they are the effects of the syphilitic virus. In a sore, for instance, appearing shortly after suspicious connection, where there is loss of substance, a want of disposition to granulate, and an indurated margin and base, there is certainly a

probability of that poison being present. Amongst a number of cases of such a description, taken indiscriminately, the probability of some being venereal is materially increased, and must at last approach nearly to a certainty. On this principle, some of the sores here referred to must have been venereal. They were also seen by different surgeons, on whose judgment I could rely, who agreed in considering many of them as well-marked cases of true chancre." (*Rose, in Med.-Chir. Trans.* vol. viii. p. 357, &c.) The men thus treated were examined almost every week, for a considerable time after their apparent cure, "both that the first approach of constitutional symptoms might be observed, and that any deception from an underhand use of mercury might be guarded against." (P. 359.) Sixty cases of ulcers on the penis were also cured by Mr. Dease in the York Hospital, by means of simple dressings, the only general remedy being occasional purgatives. The practice was likewise extensively tried by Mr. Whympster and Mr. Good, surgeons of the Guards, with the same kind of success. In Mr. Rose's practice, all idea of specific remedies was entirely laid aside. The patients were usually confined to their beds, and such local applications were employed as the appearances of the sores seemed to indicate. Aperient medicines, antimony, bark, vitriolic acid, and occasionally sarsaparilla, were administered. (P. 363.) "Upon an average (says Mr. Rose), one out of every three of the sores thus treated was followed by some form or other of constitutional affection: this was in most instances mild, and sometimes so slight that it would have escaped notice, if it had not been carefully sought for. The constitutional symptoms were evidently not such as could be regarded as venereal, if we give credit to the commonly received ideas on the subject. Caries of the bones, and some of the least equivocal symptoms, did not occur. In no instance was there that uniform progress, with unrelenting fury, from one order of symptoms and parts affected to another, which is considered as an essential characteristic of true syphilis." (*Med.-Chir. Trans.* vol. viii. p. 422.) The constitutional symptoms also yielded without the aid of mercury; and frequently primary sores, corresponding to what had been called the true chancre, with indurated base, were cured in this manner, yet were followed by no secondary symptoms. We are also informed that "several cases occurred of a cluster of ill-conditioned sores over the whole inner surface of the prepuce; and behind the corona glandis; and also of a circle of small irritable sores, situated on the thickened and contracted ring at the extreme margin of the prepuce. These occasionally produce buboes." None of the sores of this description met with by Mr. Rose were followed by any constitutional affection. (Vol. cit. p. 370.) He bears testimony to the ill effects of mercury and stimulants in cases of phagedenic ulcers, and confirms a not uncommon opinion, that they are seldom followed by secondary symptoms; which opinion should be qualified with the condition mentioned by Mr. Guthrie (*Med.-Chir. Trans.* vol. viii. p. 565), that no mercury be given. Lastly, as I have already stated, Mr. Rose observed that most of the cases of papular eruptions followed ulcers which were not very deep, and healed without much difficulty. (P. 399.)



Although the fact of the *possibility* of curing every kind of ulcer on the genitals without mercury has been fully confirmed by the statements of Mr. Guthrie (*Med.-Chir. Trans.* vol. viii. p. 558 and 576), Dr. J. Thomson (*Edin. Med. and Surg. Journ.* for January, 1818), Dr. Hennen (*Op. cit.* Nos. 54 and 55; and *Principles of Military Surgery*, 2nd ed.), Mr. Bacot (*On Syphilis*, p. 26, &c.), and, although it is of great importance in relation to the removal of erroneous doctrine concerning the diagnosis; yet the *expediency* of the non-mercurial practice must evidently be determined by other considerations, the principal of which are the comparative quickness of the cures effected with and without mercury; the comparative severity and frequency of secondary symptoms; and the generally acknowledged fact that a syphilitic primary sore is not indicated with any degree of certainty by its mere external character, or, indeed, any other criterion hitherto discovered.

Respecting the comparative quickness of the cures of chancres, or reputed chancres, without the aid of mercury, much disagreement prevails in the different reports, even those collected by the same individuals, whose statements must therefore be deemed perfectly impartial, though inconclusive. (See *Hennen's Military Surgery*, 2nd ed. p. 536, &c.) Some of Mr. Rose's best marked cases of chancre, that is to say, such as were distinguished by the indurated base and circumference, healed in a very short time. But even respecting these or any other kind of chancre, no regularity on this point can be found. Mr. Guthrie observes, if the "ulcers were not without any marked appearance, and did not amend in the first fortnight, or three weeks, they generally remained for five or seven weeks longer; and the only difference in this respect between them and the raised ulcer of the prepuce was, that this often remained for a longer period, and that ulcers possessing the true character of chancre required, in general, a still longer period for their cure, that is, from six, eight, to ten, and, in one case, even twenty-six weeks, healing up and ulcerating again on a hardened base. Those that required the greatest length of time, had nothing particular in their appearance that would lead us to distinguish them from others of the same kind, which were healed in a shorter time." (*Med.-Chir. Trans.* vol. viii. p. 558.) The same writer afterwards expresses his belief, that almost all the protracted cases would have been cured in one-half, or even one-third of the time, if a moderate course of mercury had been resorted to.

In relation to the question before us, one of the most important documents which I have met with is an official circular, signed by Sir James M'Grigor and Sir Wm. Franklin, from which it appears, that in 1,940 cases of primary venereal ulcerations on the penis, *cured without mercury*, between December 1816 and December 1818, (including not only the more simple sores, but also a regular proportion of those with the most marked characters of syphilitic chancre), the average period taken up by the treatment, when bubo did not exist, was 21 days; with bubo 45 days. (See *Hennen's Military Surgery*, 2nd ed. p. 545.) And it further appears, that during the period above specified, 2,827 chancres, a more considerable proportion of which were probably Hunterian

chancres, were treated with mercury, and that the average period required for the cure when there was no bubo, was 33 days; with bubo, 50. As far, therefore, as a judgment can be formed from this official estimate, and no calculation is ever likely to be furnished on a larger or more impartial scale, the evidence tends to prove that primary sores may generally be cured rather sooner without than with the administration of mercury. But as practitioners are not obliged to restrict themselves either to the mercurial or non-mercurial practice, I am of opinion that the total rejection of mercury is by no means justified by any facts yet before the profession, concerning the time requisite for the cure on either plan; because, as it is universally admitted that *some* cases are very tedious, unless mercury be given, neither reason nor experience will sanction the exclusive adoption of only one mode of practice, whether the backwardness to heal exist or not. On the contrary, so far as the consideration of time has weight, prudence and common sense teach us to diversify the treatment according to circumstances. But it may be inquired, since the backward disposition of a sore to heal cannot be known at first by its mere appearance, should the treatment begin with mercury or not? Now, although late writers dwell very much on the impossibility of judging of the nature of a sore by its look alone, one fact is certain, that some ulcers on the penis have a clean appearance from their very commencement; some cases are simple excoriations; and others, though ill-conditioned, are so small that a fair chance offers itself of destroying every part of the disease with caustic. In all such cases I should never commence with mercury. With respect to phagedenic and sloughing chancres, repeated experience has convinced me that they are cases, in the first stage of which, at all events, mercury should always be avoided; and I believe with Mr. Guthrie, that when this is strictly done secondary symptoms are rare. One sore of this kind was long ago pointed out by Mr. Pearson as not requiring mercury, and the attention of surgeons has been of late particularly directed to it by Mr. Bacot. "It is characterised by a great derangement of the general health, by a high state of inflammation of the part, by great local pain, and proceeds rapidly to the destruction of the parts. The situation of this sore is most commonly in the angle between the prepuce and glans penis; and those of a full habit of body, the young and the vigorous, are most liable to its attack. The most prompt and vigorous antiphlogistic means are necessary to arrest the progress of this sore; and the blood taken away in these cases presents the usual inflammatory appearances, frequently in a very high degree. The exhibition of mercury in this species of sore is highly mischievous, and productive of the worst consequences; nor does it often happen that secondary symptoms succeed," &c. (*On Syphilis*, p. 57.)

With respect to chancres with a hardened base and margin, it certainly appears that many of them healed tolerably fast without mercury; but a proportion of them was tedious when that medicine was not employed. (See three cases recorded in the work last quoted.) It may be thought, however, that the official document, circulated by Sir James M'Grigor and Sir William Franklin, tends to prove that, at all events, these

sores heal sooner without than with mercury. But this conclusion seems hardly allowable, because, as these faithful and impartial reporters have sensibly remarked, the 2,827 sores treated with mercury may be fairly presumed to have partaken of the character of Hunter's chancre in a greater proportion than the 1,940 primary sores treated without mercury. (See *Henning's Military Surgery*, p. 545.) Consequently, though the sores treated with mercury seem, on the average, to have healed more slowly than others treated without it; yet it is to be taken into the account that a large number of the first cases were ulcers with a hardened base and margin, and that if they had not had the mercurial treatment extended to them, it is possible their complete cure might generally have been still more tedious. As the evidence now stands, therefore, I conceive it right to employ mercury, with moderation, for all sores on the penis having the characteristics of the Hunterian chancre and appearing after a suspicious connection. Yet I know, from cases which have been under me in University College Hospital, that the Hunterian chancre will often heal up quickly under the use of simple dressings.

A consideration, however, which ought to have greater influence than the slowness or quickness of the cure of primary sores with and without mercury, is the question whether, upon the average, secondary symptoms are more frequent after the non-mercurial practice than the other? On this most interesting point the reports vary, as, indeed, they do on almost every matter in the investigation, excepting the facts of the possibility of curing all forms of the venereal disease without mercury, the great rarity of any affection of the bones, and the general mildness of the secondary symptoms when that medicine is not employed. On all these points, the testimonies are strong and convincing. But, while Mr. Rose found secondary symptoms take place in one third of his cases treated without mercury (*Med.-Chir. Trans.* vol. viii. p. 422), the proportion in the York, and some other hospitals, was only about one-tenth. (Vol. cit. p. 559.) In the 1,940 cases of primary sores on the penis treated without mercury, in the army hospitals, between Dec. 1816 and Dec. 1818, there were only 96 instances of secondary symptoms of different sorts, or not more than 1-20th. But the proportion of cases of secondary symptoms in the cases of primary ulcers treated with mercury was still smaller, and this in an important degree, being only 51 out of 2,827 cases, or about 1-55th. Were it not necessary to make a considerable allowance for the probable circumstance of the Hunterian chancre prevailing most in the cases treated with mercury, a point admitted by Sir James M'Grigor and Dr. Franklin, we should here have a powerful and decisive evidence in favour of the general superiority of mercury for the prevention of secondary symptoms. Nor am I certain that the conclusion can be much weakened by the probability of the difference here alluded to, because from the evidence of late brought to light, respecting the nature of the class of diseases which go under the name of syphilis, we have no right to infer that what has been called the true, or Hunterian, chancre is more disposed than some other primary sores to occasion secondary symptoms. Indeed, Mr Guthrie declares, in the cases re-

ferred to in his paper, that when mercury was not used, these symptoms more frequently followed the raised ulcer of the prepuce than the true characteristic chancre of syphilis affecting the glans penis. (*Med.-Chir. Trans.* vol. viii. p. 577.) On the whole, as the reports now stand, and so far as I can judge from cases which I have seen myself, the secondary symptoms are more frequent when primary ulcers are promiscuously treated without mercury. But it by no means follows from this fact, that the way to have the smallest possible number of cases of secondary symptoms is to employ mercury in all instances of sores on the genitals. Until further data exist, I cannot venture to lay down other directions about the treatment of primary sores. It is with pleasure, however, that I subjoin the advice of other gentlemen, whose sentiments and talents deserve respect, though their opinions may not exactly agree with my own. "In every primary ulcer (says Dr. Hennen), I would give up the idea of using mercury at first, treating it as if it were a simple ulceration, by cleanliness, rest, and abstinence, and applying to it the most simple and mildest dressings. If the sore did not put on a healing appearance in a reasonable time, the extent of which must depend upon the circumstances of the patient, I should make use of more active dressings. But if, beyond all calculation, it remained open, I should certainly not sacrifice every consideration to a dislike of mercury, knowing how many persons have been seriously benefited by a judicious and mild administration of that remedy." (*On Military Surgery*, 2nd ed. p. 518.) When primary ulcers resist common means a certain time, Mr. Bacot would also have recourse to mercury. (*On Syphilis*, p. 69.) However, he does not approve of invariably postponing that remedy until the latter criterion, viz. the backwardness of the sore to be healed by other methods, is afforded.

Whenever the employment of mercury in this work is recommended, I am very far from wishing to be thought an advocate for *pushing* that medicine, as the phrase is. On the contrary, experience has fully convinced me that, in no forms of chancre, nor in any other stages of the venereal disease, is it proper to exhibit mercury in the unmerciful quantity, and for the prodigious length of time, which custom, ignorance, and prejudice used to sanction in former days. Violent salivations, at all events, ought to be for ever exploded.

In the year 1808, when I was an articulated student at St. Bartholomew's Hospital, most of the venereal patients in that establishment were seen with their ulcerated tongues hanging out of their mouths; the cheeks and gums ulcerated; their faces prodigiously swelled; and their saliva flowing out in streams. The wards being also not sufficiently ventilated, the stench was so great that they well deserved the appellation of *foul*. Yet, notwithstanding mercury was thus *pushed* (as the favourite expression was), it was then common to see many patients suffer the most dreadful of mutilations, in consequence of sloughing ulcers of the penis; many unfortunate individuals whose noses and palates were lost; and others who were afflicted with nodes, necroses, caries, and dreadful phagedenic sores.

Happily, at the present day, this attachment to violent salivations no longer prevails; simple



excoriations and common ulcers are more attentively discriminated; and even in what are reputed to be true syphilitic chancres, mercury is seldom given, except in very moderate doses, or such quantities as only gently affect the gums and salivary glands. The surgeon, now no longer blinded with the continual fear of the rapid and furious progress of syphilis when not duly resisted by mercury, avoids the very mode of practice which was itself the cause of all the aggravated forms of the disease. The consequence is, that very bad instances of the ravages of lues venerea are now hardly ever observed, except from the neglect and intemperance of patients themselves; and the few aggravated cases which are met with, even in hospitals, are generally in that state previously to their admission. Another benefit, also resulting from modern investigations, which prove that chancres, and all other varieties of the venereal disease, do not *absolutely* require mercury for their cure, is the knowledge of the safety with which the use of such medicine may be postponed, where the patient's present state of health will not well bear its exhibition. I know that the ignorance of this last fact formerly caused the death of many poor sufferers.

The greater present mildness of syphilitic diseases in England I ascribe chiefly to the more judicious treatment now adopted, and not to any change or modification in the nature of the disorder. There are others, however, who may think, as Dr. Fergusson does with regard to syphilis in Portugal, that the disease has exhausted a great deal of its virulence from long continuance amongst us. But, before we are altogether justified in drawing such a conclusion, we must forget all the bad practice which prevailed in former days; and which, in my opinion, is sufficient to account for the more severe forms in which syphilis then presented itself.

According to Mr. Hunter's ideas, the most simple method of treating a chancre is to extirpate it with caustic or the knife, whereby it is reduced to the state of a common sore, or wound, and heals up as such. However, he sanctions this practice only on the first appearance of the chancre, when the surrounding parts are not yet contaminated; for, he says, it is absolutely necessary to remove the whole of the diseased part, and this object is exceedingly difficult of accomplishment when the disease has spread beyond a certain size. Dr. Colles says:—"I have known a chancre completely cut out on the first or second day after its appearance, yet the occurrence of secondary symptoms was not prevented." (Op. cit. p. 77.) If this were a very common result, it would indeed not only be a reason for rejecting the plan, but also for doubting the statement, now sometimes advanced, that the poison is not absorbed in the early stage of a chancre, and not till the sore has begun to granulate. (See *Key*, in *Med.-Chir. Trans.*; and *Wallace, On Ven. Dis.*) When the chancre is situated on the glans penis, Mr. Hunter thought touching the sore with nitrate of silver preferable to cutting it away, because the hemorrhage from the cells of this part would be considerable after the use of the knife. If caustic be used, it should be pointed at the end, like a pencil, in order that it may only touch such parts as are really diseased; and its application should be repeated till the surface of the sore,

after the separation of the last sloughs, assumes a red and healthy appearance, when it will heal like any other sore made with caustic.

[Nitric acid will be found the surest escharotic for the purpose of destroying a chancre.]

When the caustic could not be conveniently employed, Mr. Hunter sometimes recommended the excision of chancres. When a chancre is destroyed almost immediately on its first appearance, Mr. Hunter believes that there is little danger of the constitution being infected, as it is reasonable to conclude that there has not been time for absorption to take place. However, on account of the impossibility of being certain on this point, he recommends mercury to be given, from motives of prudence; the quantity of which medicine, he says, should be proportioned to the duration and progress of the sore. When the chancre is large, Mr. Hunter deems mercury *absolutely necessary*; and he conceives that very little good then results from the extirpation.

Amongst later advocates for the application of caustic to chancres, Delpech was one of the most zealous; and the nitrate of mercury was what he commonly employed; but he abstained from the practice when much inflammation was present. (*Chir. Clinique*, t. i.)

When the disease is in the ulcerating stage, or when the process of granulation has only partially commenced, the late Mr. Wallace had no doubt of the utility of immediately applying the nitrate of silver, in such a manner as to destroy the diseased surface:—"I have treated, over and over again, primary syphilitic ulcers with this caustic, and others without it, in the same individual, at the same time, and under circumstances as nearly as possible similar in every respect; and the result has uniformly demonstrated the very great advantage of the former over the latter practice." He adds, "It will stop the process of ulceration; and, by preventing in a great measure the necessity of the state of granulation, it will lead directly to cicatrisation. It destroys a surface which seems to have a power of contaminating, for a limited period, continuous parts," &c. (See *Wallace, On Ven. Dis.* p. 93.) Should any portion of the ulcerated surface have entered on the stage of granulation, Mr. Wallace took care not to touch that portion with caustic. He adverts also to an interesting fact, which was communicated by M. Velpeau to the Acad. Royale de Méd., viz. the application of the nitrate of silver to the pustules of variola arrests their further progress—a fact demonstrating that the power of caustic to control the action of disease, caused by a morbid poison, is not limited to syphilis. (P. 93.)

In London, the excision of chancres is now rarely or never performed, though the late Mr. Wallace sanctions the practice "when the case presents itself during the first stage, and while the part is only in the state of circumscribed phlogosis;" he adds, "and for security against the constitutional symptoms, the patient should be treated constitutionally, as if he had *not applied* until the disease was more advanced." (*Wallace*, op. cit. p. 91.)

The attempt to destroy chancres with caustic, though occasionally made, is not resorted to with the view of superseding the employment of mercury. The applications to chancres, according to my judgment, should be adapted to the different condi-

tions of them, and be regulated very much by the same principles which are recognised in the treatment of ulcers generally. I cannot join, therefore, in restricting my preference either to simple dressings, astringent or stimulating lotions, or to nitrate of silver, or to other caustics. Dr. Colles, who prefers mild bland dressings, observes, with respect to various caustics and stimulating applications to chancres, that he has not seen that such cases were rendered thereby more manageable, or that the patient was secured from those untoward changes which too frequently occur in the chancre itself, before it is finally healed; nor were such cases less liable to secondary symptoms. (*Abr. Colles, On Ven. Dis. p. 77.*)

With respect to dressings for chancres, Mr. Hunter placed a good deal of confidence in those which contained mercury; but the same attachment to them does not now prevail which existed formerly. The established fact of mercury not being *absolutely* necessary in any way for the cure of different venereal sores must have had the effect of removing some prejudices even relating to local treatment. As common mercurial ointment is always more or less rancid, I have generally found it a bad dressing. In ordinary cases, I believe, the tepid water dressing, with a piece of oil silk over it, or astringent lotions, made with the sulphate of copper or zinc, acetate of lead, alum, &c. answer the best. Some chancres are indolent, and require stimulants, like the hydrargyri nitricooxydum blended with ointment, the unguentum hydrargyri nitratis more or less weakened, or the nitrate of silver, in solution or substance. Mr. Hunter, always partial to mercurial dressings, expresses his preference to a salve containing calomel, as being more active than common mercurial ointment. When chancres were stationary, Mr. Hunter found that they might often be cured by touching them slightly with nitrate of silver.

In some of these cases no cicatrisation seems possible, till the contaminated surface, or the new flesh which grows on that surface, has either been destroyed or altered. When sores are situated under the prepuce, where they are concealed by a phymosis, some emollient, or gently astringent lotion, or the black wash, should frequently be injected under the foreskin, so as to wash out any matter which might otherwise lodge and cause irritation.

Mr. Hunter believed that *mercury should be given in every case of chancre*, however slight, and even when it has been destroyed by caustic, or other means, on its very first appearance. *The remedy*, he says, *should be continued for some time after the chancre has healed, in order to hinder the venereal disposition from forming.* Here we find even Hunter himself falling into some inconsistencies; for, in other parts of his work, he seems to approve of the principle of giving mercury only when actual and visible disease exists, because it cannot cure the disposition to it even if it exists. Now, as the chancre is cured, no further absorption of the virus from it is possible, and whatever disposition to the disease can arise from absorption, must have already been formed, and, therefore, cannot be prevented; and though, according to Mr. Hunter's own theory, the virus has been long ago expelled from the system, together with some of the excretions, mercury is recommended with the view of protecting the constitution. How-

ever, if Mr. Hunter's explanations are not altogether satisfactory on this part of the subject, I believe the fault is in his theory; because, in cases where mercury is deemed advisable, general experience appears to sanction the practice of continuing its use for some time after the chancre is perfectly healed. Yet many exceptions to this rule present themselves; for, if a chancre is large, and long in healing, its syphilitic character is generally extinct a good while before cicatrisation is completed, and perseverance in mercury under these circumstances would be both an absurd and a dangerous practice.

Hence, in a great measure, the cause of the numerous instances of the *mercurial* disease, as Mr. Mathias has named it, and which, in former days, did far more mischief than syphilis itself. (See *An Inquiry into the History and Nature of the Disease produced by Mercury*, 3rd ed. 8vo. Lond. 1816.) This part of the subject is noticed by Mr. Hunter, who states that, in very large chancres it may not always be necessary to continue either the external or internal administration of mercury till the sore is healed; for the venereal action is just as soon destroyed in a large chancre as it is in a small one; since every part of the sore is equally affected by the medicine, and, of course, cured with equal expedition. But in regard to cicatrisation, circumstances are different, because a large sore is longer than a small one in becoming covered with skin. Hence, according to Mr. Hunter, a large chancre may be deprived of its venereal action long before it has healed; while, on the other hand, a small one may heal before the syphilitic affection has been destroyed. In the latter case he represents it as most prudent, both on account of the chancre and constitution, *to continue the employment of mercury a little while after the sore is healed.*

Whenever mercury is employed for the cure of chancre, the patient should first be prepared by one or two purges, quietude for a day or two, and a lowered diet. He should also avoid exposure to damp and cold, put on additional clothing, keep himself at home, and, if he wish to be cured speedily, observe the recumbent position. The following advice, I believe, agrees with what is generally said upon this subject by the highest authorities:—"In general, it will be prudent to continue the use of mercury, not only until all hardness be removed, but even for a few days longer. I think we may lay it down as a general rule, that the course of mercury even when it has been well conducted, and has agreed well with the patient, should be continued for not less than one month. I know that some cases have been perfectly cured in three weeks; but I have too frequently seen relapses follow these short courses of mercury, when employed for the cure of primary symptoms. I should wish a moderate pyalism to be kept up from the time the mercury comes to act on the system until it be finally discontinued." (*Abr. Colles, On Ven. Dis. p. 79.*)

As Mr. Hunter has explained, chancres, both in men and women, often acquire, during the treatment, new dispositions, which are of various kinds; some retarding the cure, and leaving the parts in an indolent thickened state, after the cure is accomplished. In other instances, a new disposition arises, which utterly prevents the parts



from healing, and often produces a much worse disease than that from which it originated. Such new dispositions may lead to the growth of tumors. They are more frequent in men than women, and generally occur only when the inflammation has been violent from some peculiarity of the parts or constitution. [Many of the cases here alluded to would in the present day be classed with tertiary symptoms, others with cancerous affections.]

Among the diseases in question, Mr. Hunter notices those continued, and often increased, inflammations, suppurations, and ulcerations, which become diffused through the whole prepuce, and also along the common skin of the penis, which becomes of a purple hue, attended with such a general thickening of the cellular membrane as makes the whole organ appear considerably enlarged. The ulceration on the inside of the prepuce will sometimes increase, and run between the skin and the body of the penis, and eat holes through different places, till the whole is reduced to a number of ragged sores. The glans often shares the same fate, till more or less of it is gone. Frequently, the urethra in this situation is wholly destroyed by ulceration, and the urine is discharged some way farther back. The ulceration, if unchecked, at length destroys all the parts. In this acute case, prompt relief is demanded; but often the proper mode of treatment cannot be at once determined, owing to our ignorance with respect to the exact nature of the peculiar cause of the disease. Mr. Hunter states that the decoction of sarsaparilla is often of service, when given in large quantities; and that the extract of hemlock and sea-bathing are sometimes capable of effecting a cure. According to my own experience the omission of mercury is here the most essential point.

Sometimes, after a chancre has healed, the cicatrix breaks out again, and puts on the appearances of the preceding sore. Occasionally, similar diseases break out in different places from that of the cicatrix. Mr. Hunter believes that they differ from a chancre in generally not spreading so fast nor so far; in not being so painful nor so much inflamed; in not having such hard bases as venereal sores have, and in not producing buboes. He is of opinion that they are not venereal, and he states that they are very apt to recur.

Another disposition, induced by the previous occurrence of chancres, is that to excrescences, or cutaneous tumors, called warts. These are frequently considered not simply as a consequence of the venereal poison, but as possessed of its specific disposition, and therefore, says Mr. Hunter, surgeons have recourse to mercury for the cure of them; and it is said that such treatment often removes them. This eminent practitioner never saw mercury produce this effect, although the medicine was given in sufficient quantity to cure recent chancres and a lues venerea in the same person. (See WART.)

When a bubo arises while the constitution is under the influence of a sufficient quantity of mercury to cure a chancre, which medicine has also been rubbed into the lower extremity, on the same side as the bubo, Mr. Hunter suspects that the swelling in the groin is not venereal, but is produced by the mercury. In such a case, he always preferred conveying mercury into the

system in some other manner. The foregoing criterion of the bubo not being venereal, I think would not be commonly admitted at the present day. Dr. Colles has observed that, in some cases, "mercury will most unexpectedly take a sudden and severe hold of the system, inducing profuse ptyalism within the first three or four days, and, as a consequence, the almost instantaneous healing of a chancre: such *healing of the chancre, however, is not a cure of the venereal disease*. For we shall find that a bubo will now make its appearance, perhaps at the very time that the chancre has thus suddenly healed: *this bubo will proceed with unusual rapidity to suppuration, if we do not at once desist from mercury*. I have not tried by experiment whether such bubo requires a further use of mercury. I can only say that I have always acted on the supposition of its being required; and as soon as the salivation has subsided, I resumed the use of mercury in such a manner as to affect the mouth again, but more slowly and more gently." (*Abr. Colles, On Ven. Dis.* p. 81.)

I have mentioned the tendency of a chancre on the frænum, or in the fossa between the corona glandis and the frænum, to perforate, and frequently to destroy, the latter. The usual plan, directly an aperture is thus formed, has been to divide the remainder of the part completely through, as recommended by Mr. Hunter. To this practice Mr. Wallace strongly objects:—"I affirm (says he) that, in nineteen cases out of twenty, if the patient applies before the ulcer has perforated the frænum, its perforation may be prevented by employing the caustic (nitrate of silver); and I still further affirm that, if such patient has not applied until after its perforation, we may, if we think it right, still save the remaining portion by cauterising, with the nitrate of silver, the sides of the opening." (*On Ven. Dis.* p. 95.) Dr. Colles differs, however, from Mr. Wallace, and insists upon the advantages of dividing the frænum as soon as it is perforated, and especially because the sore will not granulate till this has been done. (*Op. cit.* p. 94.)

Every surgeon of experience must have seen instances of chancre seated at the very orifice of the urethra, and become acquainted with the great difficulty of healing them; and with the fact that, after being healed, a constriction of the urethral orifice is apt to ensue. "In treating such a case (says Dr. Colles), we should use every effort to prevent the extension of the ulceration to the entire circle of the orifice; for unless it entirely encircle the orifice, contraction will not follow. This can with certainty be accomplished by touching the ulcer, as soon as it begins to extend, with the colourless muriate of antimony, or with nitric acid." Dr. Colles is confident that he has seen chancres seated altogether within the urethra: "*Such cases have been frequently mistaken for mild gonorrhœa*." I introduce this remark by Dr. Colles because it harmonises with that of M. Ricord and some other practitioners, and has an immediate relation to one or two of the most disputed points relating to venereal complaints, as already noticed.

Sometimes, after the venereal character of a primary sore has been removed, the prepuce continues thickened and elongated, so that the glans cannot be uncovered. In this case Mr. Hunter recommends trying the steam of warm water, hemlock fomentations, and cinnabar fumigations,

as frequently being of singular service. When the thickening and enlargement of the prepuce, however, cannot be removed, by these or other means, an operation will become necessary. (See PHYMOSIS.)

One important fact, alleged by M. Ricord to be fully established, not only by his own investigations, but by those of Dr. Fricke, of Hamburg; Professor Lallemand, of Montpellier; M. Ruef, of Strasburg; and M. Blandin, surgeon to the Hôtel-Dieu, is, that the number of secondary symptoms is not at all in relation to that of the primary symptoms developed at one and the same period. There will not (he asserts) be more constitutional symptoms after two, three, four, or five chancres, contracted at the same time, than after one. (Op. cit. p. 85.)

With respect to the treatment of chancres in women, since it is difficult to keep dressings on the parts, the sores are to be frequently washed with tepid water, or some astringent lotion. Mr. Hunter notices their occasional extension into the vagina, and even suggests the prudence, in such a case, of introducing lint into the passage to prevent its constriction and closure.

*Bubo*.—Mr. Hunter notices that what is now commonly understood by a bubo is a swelling taking place in the absorbing system, especially in the glands, and arising from the absorption of some poison or other irritating matter. When such swellings take place in the groin, they are called buboes, whether they proceed from absorption or not.

We are already aware that Mr. Hunter believed the matter of gonorrhœa to be capable of communicating the venereal disease. Hence he explains, in the following terms, the three ways in which he thought a bubo might arise in consequence of absorption. He observes that the first and most simple manner is when the matter, either of a gonorrhœa or chancre, has only been applied to some sound surface, without having produced any local effect on the part, but has been absorbed immediately after its application. Mr. Hunter affirms that he has seen instances of this kind, though he confesses that they are very rare; and that, in most cases, apparently of this nature, a small chancre may have existed. M. Ricord deems these *bubons d'emblée*, as they are termed by the French, very rare; and if his statement, that the venereal disease can never be produced by the matter taken from them, and that secondary symptoms never follow them, be correct, doubt, I think, must be entertained about the Hunterian account of their production. (Op. cit. p. 149.)

Mr. Wallace had frequently met with buboes, neither accompanied nor preceded by primary symptoms, but which had followed suspicious intercourse. He treated them as if they had been caused by the absorption of the venereal poison; and never had occasion to regret the practice. "On the other hand (says he), I have known buboes, which were not preceded by primary symptoms, to be followed by secondary symptoms, when mercury had not been used in their treatment." (Op. cit. p. 346.) This, we see, disagrees with the investigations of M. Ricord.

The second mode of absorption, or that taking place in a gonorrhœa, Mr. Hunter represents as more frequent. That secondary symptoms do occasionally follow gonorrhœa, is still by some admitted, though whether they differ essentially from

those which follow true chancres is a point not yet settled by the holders of this opinion. Delpech describes them as of the same nature (*Chir. Clinique*, t. i.); but his facility of belief in the multiplied effects of syphilis and gonorrhœa is almost unbounded. On a point of this kind, therefore, I should not attach much importance to his opinion. However, so far as Mr. Carmichael's experience goes, there is a difference, a part of which consists in the eruption being of the papular kind, as it is also after many instances of simple primary ulcers. (See *Obs. on the Symptoms, &c. of Venereal Diseases*, 8vo. Lond. 1818.) Most surgeons of the present day only admit the possibility of secondary symptoms when chancres are situated within the urethra, in cases supposed to be merely gonorrhœa; and this view, of course, leads to the recognition of secondary symptoms, not essentially different from those presenting themselves in consequence of chancres, in their more usual situations. (*Ph. Ricord*.)

The third mode is the absorption of matter from an ulcer. This mode is by far the most common, and it proves, with many other circumstances, that a sore, or ulcer, is the most favourable for absorption. Mr. Hunter believed that absorption was more apt to take place from sores on the prepuce, than those on the glans.

A fourth mode of absorption is from a wound; a case, which, according to Delpech, is almost constantly followed by an eruption on the face, soon extending all over the body, and very quickly followed by sore-throat, periostoses, and pains in the bones. In short, his idea is, that when the poison is absorbed from a wound, especially one that has not suppurated, its operation is peculiarly rapid and violent. (*Chir. Clinique*, t. i. p. 334.)

The matter of this poisonous sore is taken up by the absorbent vessels, and is conveyed by them into the circulation. In its passage through these vessels, it often affects them with the specific inflammation. The consequence is the formation of buboes, which are venereal inflammations, or abscesses of the lymphatic glands or vessels. The sores resulting from their being opened, or spontaneously bursting, are exactly similar to a chancre in their nature and effects, the only difference being in regard to size. As the lymphatic vessels and glands are irritated by the specific matter, before it has undergone any change in its passage, the inflammation produced, and the matter secreted, partake of the specific quality.

Whenever a bubo has arisen from any other cause than a chancre, if the swelling suppurate, and a person be inoculated with the matter, the experiment has no effect, whatever may be the period and the conditions in which the pus has been taken. (See *Ph. Ricord, Mal. Vén.* p. 140.) This author believes, however, that it does not necessarily follow that the matter must *always* be specific, when the bubo has been preceded by a chancre; for, in order that the pus be of this quality, the bubo must not be the result of simple inflammation, sympathetic or continuous, but of absorption.

In men, inflammation of the lymphatics, in consequence of chancres upon the glans or prepuce, generally appear like a cord, leading along the back of the penis from the sores. Sometimes they inflame, in consequence of the thickening and excoriation of the prepuce in gonorrhœa. The



indurated lymphatics often terminate insensibly near the root of the penis, or near the pubes; while, in other instances, they extend further to a lymphatic gland in the groin. Mr. Hunter believed that this affection of the absorbent vessels is truly venereal. The formation of a hard cord, he conceived, arose from a thickening of the coats of the absorbents, and from an extravasation of coagulable lymph on their inner surface. A cord of the above kind often suppurates, sometimes in more places than one, so as to form one, two, or three buboes, or small abscesses, in the body of the penis.

Inflammation much more frequently affects the absorbent glands than the vessels. The structure of the former parts appears to consist of the ramifications and reunion of the absorbent vessels. From this structure, observes Mr. Hunter, we may reasonably suppose that the fluid absorbed is in some measure detained in the glands, and thus has a greater opportunity of communicating the disease to them than to the distinct vessels.

Swellings of the absorbent glands may originate from other diseases, and should be carefully discriminated from those which arise from the venereal poison. With this view, Mr. Hunter advises us first to inquire into the cause, in order to ascertain whether there is any venereal complaint at some greater distance from the heart, such as chancres on the penis, or any preceding disease in this situation. He recommends us to inquire whether any mercurial ointment has been at all applied to the leg and thigh on the diseased side; for mercury, applied to those parts for the cure of a chancre, will sometimes cause glandular enlargements, which are occasionally mistaken for venereal buboes. This irritation of the inguinal glands by the mechanical action of mercurial ointment, has also been particularly noticed by Professor Assalini, who states, that he has had frequent opportunities of convincing himself of the fact. (See *Manuale di Chirurgia*, p. 67.) Mr. Hunter reminds us to observe whether there has been any preceding disease in the constitution, such as a cold, fever, &c. The quick or slow progress of the swelling is likewise to be marked, and the tumor must be distinguished from femoral hernia, lumbar abscesses, and aneurism of the crural artery. In particular cases, it would appear that some time elapses before venereal matter produces its effects on the absorbent glands after its absorption. Mr. Hunter notices that sometimes at least six days transpire first—a circumstance which can only be known by the chancres having healed six days before the bubo began to appear. However, as the last matter of a chancre is probably not venereal, he infers that, in cases of this kind, absorption must have taken place earlier than other considerations would lead one to suppose. In general, only the glands nearest to the seat of absorption are attacked. Thus, when the matter is taken up from the penis in men, the inguinal glands are affected; and when from the vulva in women, those glands swell which are situated between the labium and thigh and the round ligaments.

It was one of Mr. Hunter's opinions, that only one gland at a time is commonly affected by the absorption of venereal matter. If this statement be correct, the circumstance may be considered as a kind of criterion between venereal and other buboes. M. Ricord is also of opinion, that when

absorption takes place from a chancre, the matter is conveyed only to the superficial glands, and, for the most part, only to one at a time, although several glands, both superficial and deep, may be at the same time swollen; so that, according to this experienced surgeon, one gland may present all the characters of virulent bubo, while the neighbouring glands, in which the inflammation may also advance to suppuration, as well as the surrounding cellular tissue, may present only characters of simplicity and non-virulence. On this principle he accounts for the opposite and seemingly contradictory results of inoculations with the matter of buboes. (*Mal. Vén.* p. 140.)

According to Mr. Wallace's view, it is because the venereal poison is deprived of its power of irritating the lymphatic system, by passing through a lymphatic gland, that we generally find one gland only affected. "We are not, however, to suppose that a bubo cannot be syphilitic if more than one gland be diseased; for should the absorbents, which arise from the surface to which the poison has been applied, be so distributed as to pass in different directions, and, consequently, through the separate glands, a plurality of these bodies may be affected." (*On Ven. Dis.* p. 345.)

The second order of lymphatic vessels and glands are never affected; as, for instance, those along the iliac vessels or back. Mr. Hunter also observed, that when the disease was contracted by a sore, or cut upon the finger, the bubo occurred a little above the bend of the arm, by the side of the biceps muscle, and no swelling of this sort formed in the armpit. However, he had heard of a few cases in which a swelling in the axilla was also produced. Buboes in the armpit may occur, not only from a wound of the fingers or hand, but from ulcers on the nipple; and they may form in the neck, or under the jaw, when produced by absorption from ulcers on the lips. (See *Wallace*, l. cit. p. 344.)

When buboes arise from a venereal disease on the penis, they are situated in the glands of the groin: if from a gonorrhœa, either groin may be attacked; if from a chancre, the bubo most frequently takes place in the nearest groin.

The situation of the absorbent glands, however, is not always exactly the same, and the course of the lymphatics, therefore, is subject to some variety. Hence, Mr. Hunter has seen a venereal bubo, produced by a chancre on the penis, situated a considerable way down the thigh; he has also often seen buboes as high as the lower part of the belly, before Poupart's ligament, and sometimes near the pubes. At the present day, swellings of the femoral glands are rarely considered to be venereal.

The seat of absorption is more extensive in the female sex, and the course of some of the absorbents is also different. Hence, buboes in women may occur in three situations, two of which are totally different from those in men.

When chancres are situated forwards, near the meatus urinarius, nymphæ, clitoris, labia, or mons veneris, the absorbed matter is generally conveyed along one or both of the round ligaments; and the buboes are formed in those ligaments just before they enter the abdomen. Mr. Hunter suspected such buboes not to be glandular, but only inflamed absorbents.

When chancres are situated far back, near or on the perineum, the absorbed matter is carried

forward along the angle between the labium and the thigh, to the glands in the groin, and often, in this course, small buboes are formed in the absorbents, similar to those *abscesses* which occur on the penis in men.

Owing to the difficulty of being sure that women are quite free from infection, it is often more difficult to decide in them, than in men, whether a bubo is venereal or not. In men who have had no local complaint, the bubo can only be venereal when direct absorption from the surface of the skin has taken place, a circumstance of rare occurrence.

A bubo commonly begins with a sense of pain, which leads the patient to examine the part, where a small hard tumor is felt. This increases, like every other inflammation that has a tendency to suppuration, and, unless checked, pus forms, and ulceration follows, the matter commonly making its way to the skin very fast. Mr. Hunter remarked, however, that some cases were slow in their progress. This circumstance he imputed either to the inflammatory process being kept back by mercury, or other means, or to its being retarded by a scrofulous tendency. The inflammation, he says, is at first confined to the gland, which may be moved about in the cellular membrane; but, when the part has enlarged, or when the inflammation and suppuration are more advanced, the surrounding parts become more inflamed, and the tumor is more diffused. Some buboes become complicated with erysipelas, or œdema, by which they are rendered more diffused, and less disposed to suppurate. [Mr. Hunter does not appear to have been aware of the fact, now generally admitted, that buboes which follow or accompany indurated chancres do not, as a rule, suppurate, but remain indurated throughout the primary affection.]

Mr. Hunter allows, that to distinguish, with certainty, the true venereal bubo from other swellings of the glands in the groin, may be very difficult. He represents the true venereal bubo, in consequence of a chancre, as being most commonly confined to one gland. It generally preserves its specific distance till suppuration has taken place, and then becomes more diffused. It is rapid in its progress from inflammation to suppuration and ulceration. The suppuration is commonly large, considering the size of the gland, and that there is only one abscess. The pain is very acute, and the inflamed part of the skin is of a florid red colour. As I have stated, however, this description does not agree altogether with that of M. Ricord, who represents some venereal buboes as being combined with other abscesses not of a specific nature.

Mr. Hunter describes such buboes as arise without any visible cause, as being of two kinds. One sort inflame and suppurate briskly. These he always suspected to be venereal, although he allows there was no proof of it, and only a presumption deduced from the quick progress of the disease.

The second kind are generally preceded and attended with slight fever, or the common symptoms of a cold, and they are, for the most part, indolent and slow in their progress. If quicker than ordinary, they become more diffused than venereal buboes, and they are often not confined to one gland. When very slow, they give but little sensation; but when quicker, the sensation is more acute, though not so acute as in venereal

cases. They usually do not suppurate, and often become stationary. When they do suppurate, it is in a slow manner, and, frequently, in more glands than one, while the inflammation is more diffused, and not considerable, in relation to the swelling. The matter makes its way to the skin slowly, and the part affected is of a more purple colour. Sometimes the abscesses are very large, yet not painful.

In considering whether the swellings of the inguinal glands are or are not venereal, the first thing to be attended to is, whether or not there are any venereal complaints. If there are none, as Mr. Hunter observes, there is a strong presumptive proof that the swellings are not venereal. When the swelling is only in one gland, very slow in its progress, and gives but little or no pain, probably it is merely scrofulous. However, when the swelling is considerable, diffused, and attended with some inflammation and pain, the constitution is most probably affected with slight fever; the symptoms of which are lassitude, loss of appetite, want of sleep, small quick pulse, and an appearance of approaching hectic. Such swellings are long in getting well, and do not seem to be affected by mercury, even when promptly applied.

Mr. Hunter mentions his having seen the above affection of the groin, together with the constitutional indisposition, take place where there were chancres; and he was puzzled to determine whether the disease in the groin was sympathetic, from derangement of the constitution, or whether it arose from the absorption of matter. He had long suspected that there was a mixed case, and was at last certain that such a case might prevail. He had seen instances, in which the venereal matter, like a cold or fever, only irritated the glands to disease, producing in them scrofula, to which they were disposed.

In such cases, says Mr. Hunter, the swellings commonly arise slowly, give but little pain, and if mercury be given to destroy the venereal disposition, their progress is accelerated. Some suppurate while under this resolving course; and others, which probably had a venereal taint at first, become so indolent that mercury has no effect upon them, and, in the end, they either get well of themselves, or by non-mercurial means.

Another important point in Mr. Hunter's doctrine is, that buboes are local complaints.

When a bubo is judged to be venereal, and only in an inflamed state, an attempt is to be made to resolve the swelling. The propriety of the attempt, however, depends on the progress which the disease has made. If the bubo is very large, and suppuration near at hand, resolution is not likely to be effected. When suppuration has already taken place, the probability of any success attending the endeavour is still less, which now may only retard the suppuration, and protract the cure.

The resolution of these inflammations seemed to Mr. Hunter to depend *principally on mercury*, and almost absolutely on the quantity which can be made to pass through them. When suppuration has taken place, the cure also appeared to him to depend on the same circumstances. Hence, he recommended the mercury to be applied to such surfaces as allow the remedy, when absorbed, to pass through the diseased gland. In this manner, he conceived that the disease in the groin might



be subdued, and that the constitution would be less likely to be contaminated. At the same time, he admitted that the situation of many buboes is such as not to have much surface for absorption beyond them; for instance, the buboes on the body of the penis, arising from chancres on the glans or prepuce. This principle was much insisted upon by Delpech. (See *Chir. Clinique*, t. i. p. 301.)

Since venereal buboes are a consequence of chancres, or primary venereal sores; and since glandular swellings in the groin may take place from other kinds of sores, or local irritations, and even from various constitutional causes, while modern surgeons profess their incapacity always to pronounce the character either of a primary sore, or a bubo, by its first appearance and progress; it is evident that the same difficulties present themselves here as in cases of primary sores, respecting the principles by which the treatment should be guided. It is likewise to be remembered that buboes, when decidedly syphilitic, are not, as Mr. Hunter imagined, *absolutely incurable without mercury*. The firm confidence which Mr. Hunter, and Delpech subsequently, had in the doctrine that benefit was derived from the practice of rubbing mercury into surfaces, from which it would be conveyed directly to the diseased glands, so as both to resolve the swelling and preserve the constitution, is not now regarded as an unquestionable opinion. As Mr. Bacot has judiciously remarked, there is some inconsistency in Mr. Hunter's own statements upon this point; for, in one place, he affirms that mercury, applied to the legs and thighs for the cure of a chancre, will sometimes cause, instead of dispersing, a bubo. (P. 404.) And Mr. Bacot adds his own belief, that mercury as frequently promotes the suppuration of buboes as their dispersion. (*On Syphilis*, p. 74.) With respect to the practice of trying to make the mercury pass through the diseased glands, Mr. Hunter rather contradicts himself in another page, where he confesses his own doubts of its utility in suppurated buboes. However, he admits that mercury alone is not always capable of effecting the cure of such buboes as are deemed venereal; and when the inflammation rises very high, he approves of bleeding, purging, and fomentations. When the inflammation is erysipelatous, he has a high opinion of bark; and when it is scrofulous, he praises hemlock, and poultices made with seawater. He was also aware of the fact of emetics sometimes occasioning the absorption of the matter of buboes after it is distinctly formed.

If there is generally great difficulty in pronouncing at first as to the question whether a primary sore be syphilitic or not, the same difficulty must occur with respect to glandular swellings excited by it; and on this account, and from the encouraging circumstances that all buboes may be cured without mercury, and that the course of the venereal disease, unresisted by that mineral, is not so terrible and incurable as used to be supposed, some surgeons, instead of having immediate recourse to mercury, prefer a little delay, in order to see whether the swelling will subside or not under the use of common antiphlogistic means. Thus Dr. Hennen disapproves of using mercury immediately a bubo presents itself; and he states that the same principles which guide him in the primary ulcers would have the same, if not greater, force in the

case of buboes. "In their irritable state (says he) I consider mercury altogether inadmissible." (*On Military Surgery*, 2nd ed. p. 518.)

But, in order to exhibit the contradictory advice delivered by different writers on this point, I may contrast the practice of Mr. Wallace with that of Dr. Hennen. The primary syphilitic bubo, in its first stage, may, according to Mr. Wallace, be resolved, in *ninety-nine cases out of a hundred*, by mercury, assisted by rest, gentle laxatives, abstinence, and cooling lotions. Therefore, says he, as resolution should be our object, we are, without hesitation, to employ mercurial treatment in all such cases, provided there be no contra-indicating symptoms. In the second stage, or when the surrounding cellular tissue is involved, Mr. Wallace is an advocate for putting the patient rapidly under the action of mercury. When the bubo is more advanced, he admits that it is more difficult to bring about resolution; yet it seems to him that it may still often be accomplished by bringing the constitution, with the greatest possible rapidity, under the influence of mercury, which is joined, in full habits, with general blood-letting, large doses of tartrate of antimony, saturnine lotions, rest, and abstinence. Even when the bubo had suppurated, Mr. Wallace frequently demonstrated to his pupils the power of mercury to effect resolution. The following consideration guided him in selecting cases in which the attempt to resolve the bubo might be judiciously made:—"Should the process of suppuration have begun early; should the tumor be attended by considerable pain and heat, and should it exist in a plethoric or sanguineous habit; I despair (says he) entirely of causing the matter to be absorbed, or of resolving the bubo. But, on the other hand, should the process of suppuration have advanced more slowly, having been long in commencing; should the bubo be attended with comparatively little pain and heat, or inflammation; should the skin covering it be somewhat flaccid or wrinkled, with a strong propensity to desquamate; and should the habit of the patient be less full or plethoric; I do not despair of causing the resolution of the bubo, particularly if mercury has not been previously used." Here, also, Mr. Wallace enjoins the full and rapid action of mercury; the quantity of which is afterwards to be diminished, lest a very troublesome degree of salivation, or mercurial cachexia be produced; but a mild action of it is still to be kept up for some days. (See Wallace, *op. cit.* p. 356-359.)

When a bubo has already burst, Mr. Wallace lays it down as a general rule, that then mercury should not be employed until the stage of granulation has commenced; and "for the same reason as we refrain from its employment in the ulcerative stage of a primary ulcer. In fact, if it be used in this period, we run some risk of exciting an increase of the ulcerative process. But great advantage may be obtained from the application of the nitrate of silver to the whole ulcerating surface; for this valuable remedy has the power of stopping the ulcerating process of a bubo, as well as of the primary ulcer." (*Op. cit.* p. 364.)

Although the correctness of some of the principles by which Mr. Hunter regulated his practice in buboes must now be questionable, inasmuch as he calculates too much on the absolute necessity for mercury, and on the usefulness of making it

pass through the diseased glands, I conceive that some of his directions are yet too important to be excluded from this work. He says, the quantity of mercury necessary for the resolution of a bubo must be proportioned to the obstinacy of the complaint; but that *care must be taken not to extend the employment of the medicine so far as to produce certain effects on the constitution.* When the bubo is in a situation which admits of a large quantity of mercury being rubbed in, so as to pass through the swelling, and when the complaint readily yields to the use of half a drachm of mercurial ointment every night, the mouth not becoming sore, or, at most, only tender, Mr. Hunter thinks it sufficient to pursue this course, till the gland is reduced to its natural size. In this manner, he suspected that the constitution would probably be safe, provided the chancre which caused the bubo healed at the same time. When the mouth is not affected in six or eight days, and the gland does not readily resolve, then two scruples, or a drachm, may be applied every night; and if there should still be no amendment, even more must be rubbed in. In short (says he), if the reduction is obstinate, the mercury must be pushed as far as can be done *without a salivation*, or (as I suppose, he meant to say) *a violent salivation.*

When there is a bubo on each side, so much mercury cannot be made to pass through each, because the constitution will not in general bear this method. However, Mr. Hunter sanctions the plan of minding the soreness of the mouth less in this kind of case; though he adds, that *it is better to let the buboes proceed to suppuration than to load the system with too much mercury.*

When the situation of buboes will not allow an adequate quantity of absorbed mercury to pass through them, the frictions must be continued in order to affect the constitution; but according to Mr. Hunter, in this case more mercury will be requisite than when the remedy can be made to pass directly through the diseased gland—an assertion the correctness of which may now be doubted.

Many buboes remain, without either coming to resolution or suppuration; and notwithstanding every attempt to promote these changes, the glands remain very hard. Mr. Hunter conceives that these cases are either scrofulous at first, or become so, as soon as the venereal disposition has been subdued; and, therefore, he advises the use of hemlock, sea-water poultices, and sea-bathing.

When buboes are in a very chronic stationary state, the application of nitrate of silver, the tincture of iodine, or of blisters to the skin over them, is often attended with beneficial effects. When such tumors are extremely hard and indolent, it is more advantageous to let the patient have the benefit of the open air, exercise, and his accustomed mode of living, than to confine him in a hospital. (*Assolini, Manuale di Chirurgia*, p. 64. Milano, 1812.) Stimulating the skin with hydriodate of potash ointment, camphorated mercurial ointment, or antimonial ointment is also sometimes a good practice; and so is compression.

The suppuration of buboes frequently cannot be prevented by any known means. They are then to be treated, in some respects, like any other abscess. Before buboes were opened, Mr. Hunter conceived it advantageous to let the skin become as thin as possible, because a large opening would

then be unnecessary, and no measures requisite for keeping the skin from closing before the bottom of the sore had healed. These reasons do not generally seem to surgeons of the present day so valid as the arguments in favour of a more early opening.

There has been much dispute whether a bubo should be opened, or allowed to burst of itself, and whether the opening should be made with a cutting instrument or caustic. On this subject Mr. Hunter remarks that there is no peculiarity in a venereal abscess to make one practice more eligible than another. [It should be remembered that opening a bubo by means of caustic is not followed by the inoculation of the divided surfaces, as is the case when the knife is used.] The surgeon, he says, should be guided in some degree by the patient. Some patients are afraid of caustics, others of cutting instruments. But when the surgeon has the choice, Mr. Hunter expresses a preference to opening the bubo with a lancet, by which method no skin is lost. But when a bubo is very large—and there will be a great deal of loose skin after the discharge of the matter—he thinks that caustic may be better, as it will destroy some of the redundant skin, and occasion less inflammation than is caused by an incision.

After the bubo has been opened, surgeons usually poultice it, as long as the discharge and inflammation are considerable, and then they employ dressings, which must be of a quality adapted to circumstances; in the meanwhile, mercury is continued, both to make the bubo heal, and prevent the bad effects which might otherwise arise from the specific matter being absorbed.

The mercurial course is often to be pursued till the sore is no longer venereal. But, in general, since this point is difficult to ascertain, Mr. Hunter advises the continuance of mercury till the part has healed, and even somewhat longer, if the bubo has healed very quickly; for the constitution is apt to become contaminated. However, he did not approve of this long use of mercury in all cases; because buboes often assume, besides the venereal, other dispositions, which mercury cannot cure, and will even exasperate.

Sometimes the sores, when they are losing or are entirely deprived of the venereal disposition, become changed into ulcers of another kind, and, most probably, of various kinds. How far it is a disease arising from a venereal taint, and the effects of a mercurial course jointly, says Mr. Hunter, is not certain. He suspected, however, that the nature of the part, or constitution, had a principal share in the case; and, I believe, few surgeons of the present time entertain any doubt of the abuse of mercury having been a very frequent cause, independently of any other circumstance. (*See Mithius, On the Mercurial Disease*, 8th ed.)

Mr. Hunter observes, that such diseases make the cure of the venereal affection much more uncertain, because, when the sore becomes stationary, or the mercury begins to disagree, we are ready to suspect that the virus is gone; but this (he supposes) is not always the case. He had seen some buboes exceedingly painful and tender to almost everything that touched them, and the more mild the dressings were, the more painful the parts became.

In some instances, the skin alone becomes dis-



eased. The ulceration spreads to the surrounding integuments, while a new skin forms in the centre, and keeps pace with the ulceration, so that an irregular sore, which Mr. Hunter compares with a worm-eaten groove, is formed all round. It appears only to have the power of contaminating the parts, which have not yet been affected; and those which have, readily heal. According to the same author, when buboes become stationary, and are little inclined to spread, attended with a sinus or two, hemlock, joined with bark, is the medicine most frequently serviceable. It is to be used both externally and internally. Mr. Hunter also speaks favourably of sarsaparilla, sea-bathing, and sea-water poultices. In such cases, the efficacy of hydriodate of potash, the ioduret of mercury, and sarsaparilla in limewater, is recognised by numerous surgeons of the present time.

*Lues Venerea, or Constitutional Syphilis.*—Surgeons imply that a *lues venerea* has taken place when the venereal virus has been absorbed into the circulation. Mr. Hunter does not think the epithet *constitutional* strictly proper in its application to this form of the venereal disease. By *constitutional* disease, he observes, he should understand that in which every part of the body is acting in one way, as in fevers of all kinds; but the venereal poison seems to be only diffused through the circulating fluids, and, as it were, to force certain parts of the body to assume the venereal action, which action is perfectly local. To use Mr. Hunter's phrase, it takes place in different parts in a regular succession of susceptibilities. Only a few parts are acting at the same time; and a person may be constitutionally affected in this way, and yet almost every function be perfect.

The venereal poison is generally conveyed into the system from a chancre. It may also, according to Mr. Hunter's doctrine, be absorbed from a gonorrhœa, though, if confidence can be placed in M. Ricord's investigations, only where the discharge from the urethra, or vagina, &c., is either wholly or in part derived from chancres existing in, or upon, such parts. Whether there is a possibility of its getting into the circulation from the surface of the body, without any previous ulceration, is another point already considered. According to Hunter's doctrine, it may also be absorbed from common ulcers, *without necessarily rendering them venereal*; and it may be taken up from wounds, in which cases it generally first causes ulceration.

*Ulcers from Constitutional Syphilis.*—In consequence of the blood being contaminated with real venereal pus, it might be expected that the local effects, thus produced, would be similar in their nature to those producing them.

Before the time of Mr. Hunter, the matter secreted by sores which arise from a constitutional infection was always considered to be of a poisonous quality, like the matter of a chancre. At first, one would expect that this must actually be the case, because venereal matter is the cause; and mercury cures chancres, and also the ulcers proceeding from a *lues venerea*. Mr. Hunter remarks that when pus is absorbed from a chancre, it generally produces a bubo; but that a bubo is never occasioned by the absorption of matter from a venereal sore, arising from the virus diffused in the circulation. For instance, when there is a constitutional venereal ulcer in the throat, no

buboes occur in the glands of the neck; when there are syphilitic sores on the arms, or even suppurating nodes of the ulna, no swellings form in the glands of the armpit, although these complaints occur when fresh venereal matter is applied to the arm, hand, or fingers. No swelling is produced in the groin in consequence of nodes, or blotches on the legs and thighs. The correctness of the Hunterian doctrine of the impossibility of communicating the venereal disease by inoculations with the matter taken from any of its secondary or constitutional forms has been put to the test of experiment by M. Ricord, and the results, he says, conform to the truths established by Hunter. (*Mal. Vén.* p. 161.)

M. Ricord also subscribes to the doctrine adopted by Hunter, Jourdan, &c., that the disease cannot be communicated by inoculating with the blood of a syphilitic patient. "When once the matter is blended with the blood (says he) it is no longer inoculable." (P. 164.) And amongst other inferences, M. Ricord lays down the following one: that whenever a symptom, whatever may be its seat or apparent form, is still inoculable, it must of necessity be the product of direct contagion, and not the result of general infection from absorption established at another point. (P. 166.) [It is now well established, by the experiments of Wallace and others, that inoculation with the matter of secondary ulcers will be followed, in many cases, by distinct local manifestation of disease of a venereal character.]

Some very important experiments are related in Mr. Hunter's *Treatise on the Venereal Disease*, in order to prove that the matter from a gonorrhœa, or chancre, is capable of affecting a man locally who is already labouring under a *lues venerea*; and that the matter from secondary syphilitic sores has not the same power.

*Parts most susceptible of Lues Venerea, &c.*—Some parts of the body seem to be much less susceptible of *lues venerea* than others; indeed, Mr. Hunter observes that, so far as our knowledge extends, certain parts cannot be affected at all. The brain, heart, stomach, liver, kidneys, and several other viscera, have never been known to be attacked by syphilis. [Since Mr. Cooper's time pathologists have recognised that deposits of plastic lymph may take place in the viscera here mentioned as the result of syphilitic cachexia. See *Guy's Hospital Reports*, 3rd ser. vol. ix. p. 1.]

*The first order of parts*, or those which become affected in the early stage of *lues venerea* (*secondary syphilis*) are the skin, tonsils, throat, inside of the mouth, the iris, and sometimes the tongue.

*The second order of parts* (*tertiary syphilis*), or those affected at a later period, are the periosteum and bones, the fibrous textures about the joints, the testicle, the larynx, and the nose.

Mr. Hunter conceived that one great reason for the superficial parts of the body suffering from the effects of *lues venerea* sooner than the deep-seated ones, was that they were more exposed to external cold. He remarked that even the second order of parts (those affected in tertiary syphilis) do not all become diseased at the same time, nor everywhere at once. But, on the contrary, such as are nearest the external surface of the body are first diseased, as, for instance, the periosteum, bones of the head, the tibia, ulna, bones of the nose, &c. Neither does the disease affect these bones equally on all

sides; but first on that side which is next to the external surface. It was Mr. Hunter's belief, however, that the susceptibility of particular bones did not altogether depend upon their nearness to the skin, but upon this circumstance and their hardness together.

The foregoing account by no means agrees with the results of modern inquiries into the nature of the venereal disease; for unless mercury be given, it appears that the bones are very seldom affected by it. Thus, in the cases which were treated by Mr. Rose without mercury, he observes that "the constitutional symptoms were evidently not such as could be regarded as venereal, if we give credit to the commonly received ideas on the subject. Caries of the bones, and some of the least equivocal symptoms, did not occur. In no instance was there that uniform progress with unrelenting fury, from one order of symptoms and parts affected to another, which is considered as an essential characteristic of true syphilis." (*Med. Chir. Trans.* vol. viii. p. 423.) We learn also from Mr. Guthrie that the bones were not affected in any of the cases cured entirely without mercury in the York Hospital, though there were several other cases admitted "in which a few mercurial pills had been taken, and the mouth not affected, and in which the primary symptoms were followed by eruptions, both papular and scaly, by ulcers in the throat, by nodes, and, in one case, by inflammation of the periosteum covering the bones of the nose, and ulceration of the septum nasi. Mercury nevertheless was resorted to for its cure." (Vol. cit. p. 560.) The late Sir Patrick McGregor, however, informed me of one or two cases in which a node took place, though no mercury had been used.

[The editor has seen several cases of caries of bone, combined with other tertiary symptoms, where no mercury had been previously taken. In one instance a child was born with nodes, the mother having never taken mercury, although she laboured under caries of the palate, and a small communication existed between the mouth and nostrils, admitting a director to pass between the two cavities. Another similar case occurred of caries and fistulous communication between the mouth and nostrils in a lady whose husband was diseased. The lady had never taken mercury; after two or three abortions she again became pregnant, and, under a course of mercury, gave birth to a healthy child. In the following well-marked instance, the editor was consulted by Dr. Weber. A gentleman had suffered for years from nodes and severe pains in the tibiae and bones of the fore arm, without syphilis being suspected as the cause of the symptoms. When the nature of the complaint was explained to him, he recollected not only having had a small sore on the genitals, which healed without treatment, but also a rash which did not inconvenience him much, and disappeared in a month or six weeks, and for which he took no medicine, not thinking it of any consequence. A detailed account of this case, written by the patient himself, is in the possession of the editor.]

In the cases treated without mercury, under the superintendence of Dr. Hennen, this gentleman did not see "a single one in which the bones of the nose were affected; some cases of periostitis, and of pains and swellings of the bones of the cranium and extremities, were met with; but, except in two, he never remarked any nodes which

could be regarded as unequivocally syphilitic." One of these yielded to blisters and sarsaparilla; the other, after resisting guaiacum and sudorifics, was dispersed by mercury. (*On Military Surgery*, 2nd ed. p. 581.) Dr. Hennen's statement on this subject would have been more satisfactory had it comprised his opinion of the characters of an unequivocally syphilitic node. On the whole, it appears tolerably certain that mercury, especially when employed unmercifully, and even when employed in moderation, if the patient exposes himself to damp and cold, tends to promote the frequency of nodes, as a sequel of the venereal disease; though, as the long and abundant use of the same mineral does not cause the same consequence after other complaints, and venereal ulcers, treated altogether without mercury, rarely lead to nodes, it would seem as if these swellings were not unfrequently the product of the combined action of syphilis and mercury together. The infrequency of nodes in the strictly non-mercurial practice is one of the most important facts yet established in its favour, and it is curious to find, from some quotations made by Dr. Hennen, that it was well known in former days. Fallopius, in his 96th chap. *De Ossium Corruptione*, speaking of the loss of the bones of the nose and palate, says, "et sciat quod non in omni inveterato gallico hoc fit, sed tantum in illis, in quibus inunctio facta est cum hydrargyro." And Fernelius, in speaking of the injurious effects of mercury, observes, "recidiva raro similis est radici neque iisdem symptomatibus exercet, sed fere distillatione, arthritide, tophis, vel ossium carie." (*Aphrodisiacus*, vol. iii. p. 146.) And Palmarius, in considering the affection of the bones, as Dr. Hennen has noticed, uses the following remarkable words: "Sed hoc iis duntaxat contingit, qui olim a lue venerea hydrargyrosi vindicati putarentur, non qui decocto guaiacino et alexipharmacis curati fuissent." (*De Morb. Contagiosis*, cap. vii. lib. ii. p. 124. Parisiis, 1578.) Dr. Hennen expresses his own conviction, in which I entirely agree, that the carious affections of the bones, which are so common in persons treated by long mercurial courses, proceed not from the disease, but from the remedy rapidly and irregularly thrown in while periostitis exists; and he has not seen a single case of carious bone in the military hospitals since the non-mercurial treatment was adopted, except where mercury had formerly been used. (*On Military Surgery*, 2nd ed. pp. 505, 506.)

Nor will the results of modern experience and inquiries, made on a very extensive and impartial scale, allow us to consider the venereal disease as regularly and unavoidably leading to any secondary symptoms, even though no medicine at all be employed for their prevention. This is fully exemplified in the official reports of the army hospitals. The particulars of 5,000 cases, spoken of by Sir James McGrigor and Sir W. Franklin, lead to the opinion, "that the frequency or rarity of secondary symptoms would seem to depend on circumstances not yet sufficiently understood or explained, although the following fact would tend to the belief, either that the constitutions of the men or the mode of conducting the treatment without mercury, are the causes that possess the greatest influence in their production. In one regiment, four secondary cases out of twenty-four treated without mercury, supervened." In another



regiment, sixty-eight cases were treated without mercury, all bearing marks of the true venereal disease (twenty-eight of them having been especially selected for their decided characters of chancre), yet no secondary symptoms of any kind had taken place fifteen months after the treatment had ceased. The same document, founded on the above large number of cases, confirms another fact, that no peculiar secondary symptoms follow peculiar primary symptoms—a conclusion which is directly adverse to Mr. Carmichael's opinions.

According to Mr. Hunter, the time necessary for the appearance or production of the local effects, in parts most susceptible of the disease, after the virus has passed into the constitution, is generally about six weeks; but, in many cases, the period is much longer; while, in other instances it is shorter. Sometimes the local effects make their appearance as early as a fortnight after the possibility of absorption.

The effects on other parts of the body which are less susceptible of the venereal irritation, or slower in their action, says Mr. Hunter, are much later in making their appearance. And when the first and second order of parts are both contaminated (that is to say, in secondary and tertiary syphilis), the effects, generally, do not begin to appear in the latter till after a considerable time, and sometimes not till those affecting the former parts have been cured.

Mr. Hunter, however, refers to instances in which the periosteum, or bone, was affected before any of the first order of parts; but he was uncertain whether the skin or throat would afterwards have become diseased, as the disorder was not allowed to go on.

According to Delpech, the principal morbid effects produced on the bones by syphilis, are periostoses, exostoses, and necrosis. As for caries, which has been commonly set down as a consequence of the disease, he says that authors have generally mistaken necrosis for it; and that the pretended examples of caries of the bones of the nose and palate are, in fact, more or less extensive denudations and mortifications of the maxillary and turbinated bones, the septum nasi, &c. (*See Chir. Clin. t. i. p. 355.*)

*Venereal Eruptions.*—The whole tenor of various facts, specified in the foregoing columns, tends to prove that what is usually called the venereal disease is, if not several diseases, at all events one that is infinitely modified by constitution, climate, regimen, and mode of treatment. And hence, perhaps, and partly also from certain circumstances on which the investigations of M. Ricord have now thrown light, the chief source of all the perplexity and uncertainty, which have frequently raised doubts whether any disease corresponding to the former notions of syphilis really exists. Were any proof of the truth of this reflection needed, in addition to the many other proofs of it already premised, the subject of venereal eruptions would at once furnish it; for here no kind of regularity can be traced, either in the appearances on the skin abstractedly considered, or in the connection between certain kinds of primary ulcers and particular forms of cutaneous disease. Nay, as I have noticed in the preceding pages, sometimes, in consequence of a primary venereal sore, different kinds of eruptions form together, or successively on one individual; and, so far as one can judge

by the eye, exactly the same kind of chancre may produce very different eruptions in different persons, even though treated on precisely the same plan. These circumstances are truly confusing. In Mr. Rose's paper, however, there is a partial confirmation of one part of Mr. Carmichael's theory, viz. the frequency of papular eruptions after simple primary ulcers, or superficial sores, which readily heal. According to the latter gentleman, this form of eruption may also follow gonorrhœa, and is generally preceded by fever, and ends in desquamation.

There is as little certainty about the essential characters of syphilitic eruptions as about the test of every other symptom of the venereal disease. While Mr. Hunter describes the eruption as generally occurring over the whole body, Dr. Bateman states that syphilitic affections of the skin commonly make their first appearance on the face, where they are usually copious, and on the hands and wrists. (*Synopsis of Cutaneous Diseases*, p. 332, 3rd ed.) The colour, he says, is in general less vivid than that of ordinary eruptions, being of a brownish red of different shades; but that this is not universal; for some of the syphilitic ecchymata have a bright red base in the beginning. Exposure to cold accelerates their progress, and increases their extent; while, on the other hand, warmth retards and ameliorates them. (P. 333.) According to Hunter, the discolorations make the skin appear mottled, and many of the eruptions disappear, while others continue and increase with the disease.

In other cases, the eruption comes on in distinct blotches, which are often not observed till the scurf has begun to form. At other times, the eruption assumes the appearance of small distinct inflammations, containing matter, and resembling pimples, not being, however, so pyramidal, nor so red at the base. Mr. Hunter also observes that venereal blotches, on their first coming out, are often attended with inflammation, which gives them a degree of transparency, which is generally greater in the summer than the winter, especially if the patient be kept warm. In a little time, this inflammation disappears, and the cuticle peels off in the form of scurf. The latter occurrence often misleads the patient and the surgeon, who look upon this dying away of the inflammation as a decay of the disease, till a succession of scurfs undeceives them.

The parts affected assume a copper-colour, and begin to form dry, inelastic cuticle, called a scurf, or scale. This is thrown off, and new ones are formed, which spread to the breadth of a sixpence or shilling; but seldom more extensively, at least for a considerable time. In the meanwhile, every succeeding scale becomes thicker and thicker, till at last it becomes a common scab. Then the disposition to the formation of matter takes place in the cutis underneath, and a true ulcer is produced, which commonly spreads, although slowly. When the affected part of the skin is opposed by another portion of skin, which keeps it in some degree more moist, as between the nates, about the arms, between the scrotum and the thigh, in the angle between the two thighs, on the red part of the lip, or in the armpits, the eruptions, instead of being attended with scurfs and scabs, are accompanied with an elevation of the skin, which is swollen with extravasated lymph into a

white, soft, moist, flat surface, which discharges a white matter (*condylomata, mucous tubercle*).

A venereal eruption often attacks the part of the fingers on which the nail is formed (*syphilitic onychia*). Here the disease renders the surface red, which is seen shining through the nail; and, if allowed to continue, a separation of the nail takes place. When surfaces covered with hair are attacked, the hair falls off (*alopæcia*), and cannot be reproduced, so long as the disease lasts.

Dr. Bateman remarked how frequently cutaneous eruptions, the result of the venereal poison, are the source of embarrassment to the practitioner. They appeared to him to assume such a variety of forms that they bade defiance to any arrangement founded upon their external character; and, in fact, he sets them down as possessing no common or exclusive marks, by which their nature and origin are indicated. It seemed to him, that, perhaps, there is no order of cutaneous appearances, and scarcely any genus or species of the chronic eruptions, which these secondary symptoms of syphilis do not occasionally resemble. He admits, however, that in many cases there is a difference, which a practised eye will recognise, between the ordinary diseases of the skin and the syphilitic eruptions, to which the same generic appellation might be given. This, says he, is often observable in the shade of colour, in the situation occupied by the eruption, in the mode of its distribution, and in the general complexion of the patient. Hence, to a person conversant with those ordinary diseases, a degree of anomaly in these respects will immediately excite a suspicion, which will lead him to investigate the history of the progress of such an eruption and of its concomitant symptoms. (See *Synopsis of Cutaneous Diseases*, pp. 331, 332, 3rd ed.)

Dr. Hennen does not pretend to be able to discriminate true syphilitic eruptions from others; and hence, he generally approves of deferring the use of mercury at first, in order to see whether these cutaneous affections will yield to other means; which, by the bye, would, after all, be no test of their not being syphilitic: "but (says he) I should not very long postpone the employment of the mildest mercurial alteratives, aided by warm bathing and sudorifics." (*On Military Surgery*, 2nd ed. p. 518.)

By attending to the history of the case, and the concomitant symptoms, I should say that the practitioner will have less difficulty in arriving at a correct judgment than is sometimes represented. In Hunter's time, and until the period of Dr. Willan, we find venereal eruptions all jumbled together, under the general term of copper-coloured blotches. In Hunter's work, "we find (says Mr. Carmichael) no mention of papulæ, pustules, tubercles, rupia, psoriasis, or lepra; all these forms of eruption, indicative of different forms of disease, and often requiring different modes of treatment, are all classed under one general and undistinguishing term of copper-coloured scaly blotches." Mr. Carmichael argues, indeed, that a classification, grounded on the character of the eruption, is not only in accordance with nature, but the most practically useful for the following reasons:

1. When a practitioner meets with a patient affected with a papular eruption (*syphilitic lichen*), either in its early stage, when it presents itself in the form of pimples, with acuminated heads, containing matter; or in its advanced stage, when the

spots have desquamated, and present one of the appearances which Hunter calls copper-coloured blotches, he may be certain that he has only a disease of easy management to contend with, and that, under suitable treatment, he may assure his patient, with confidence, of a certain and speedy recovery.

2. If we meet with a pustular eruption, which terminates in superficial ulcers, and not in desquamation (*syphilitic ecthyma*), we may be certain that we have a much more formidable disease to manage.

3. If there is offered to our consideration a case of pustular eruption, mixed with tubercles, which terminate in deep ulcers, which spread into a phagedenic margin, and form those crusts termed rupia, we may be certain that we have the most unmanageable and destructive form of venereal disease to contend with. It is (says Mr. Carmichael) in this form of the disease that we meet with extensive ulceration, engaging the velum, uvula, tonsils, and back of the pharynx, where it lies upon the bodies of the vertebræ, ulceration of the nares, destruction of the bones of the nose, and also ulceration of the larynx, the usual precursor of laryngeal phthisis.

4. The scaly eruption (comprising *syphilitic psoriasis* and *lepra*) is a form of disease which is in general manageable; for, unlike the pustular and phagedenic forms of venereal disease, it yields with certainty and quickness to the influence of mercury. It may, however, as Mr. Carmichael adds, be accompanied by deep ulceration of the tonsils, and very obstinate nodes; but whether ulceration of the larynx and nares attends it is more than he is able to state, since he has never witnessed it. Mr. Carmichael believes that this form of disease, formerly denoted by the phrase "copper-coloured scaly blotches," is often confounded with other forms of venereal eruptions, because *papulæ and pustules, in their desquamating, declining stage, assume a scaly copper-coloured appearance*; and even rupia evinces the same tendency when the disease is on the decline. Mr. Carmichael states that it is the tendency of all venereal eruptions to become scaly, when the disease is gradually yielding to the powers of the constitution; and, says he, "when in this state, no matter in what form the eruption commenced, I never saw mercury do harm, but always observed the most decided and quick amendment to follow its adoption." (See *Dublin Journ. of Med. Science*, vol. xii. p. 28.)

[It should be remarked that in the description here given by Mr. Cooper of constitutional syphilis, and by the authors he quotes, no distinction is made between the secondary and tertiary symptoms of the venereal disease. In his remarks on the skin affections, and on those of the throat, nose, and tongue, it will be necessary to bear this in mind. With regard to the skin, the cases of rupia and the worst forms of syphilitic ecthyma; the cases of sloughing of the throat and of the soft palate; ozena of the nostrils, accompanied by caries and necrosis of the bones of the nose and of the hard palate; the deposits of plastic lymph under the skin (*subcutaneous tubercle*), in the muscles, and internal viscera, in the tongue producing hard nodules resembling cancer of that organ; the various affections of the fibrous tissues, whether it be of the periosteum, resulting in nodes, caries, and necrosis of bones, or the fibrous textures of the joints, the tunica albuginea of the testis, or the sclerotic coat of the eye, producing



disease of these several organs—should be all classified as tertiary affections, and be treated by iodide of potassium and sarsaparilla; while the other less severe affections may be grouped together as secondary, and require, as a general rule, the exhibition of mercury for their cure.]

*Venereal Disease of the Throat, Mouth, and Tongue.*—In the throat, tonsils, and inside of the mouth, it seems generally to make its appearance at once in the form of an ulcer, without much previous tumefaction.

A venereal ulcer in the throat was supposed by Mr. Hunter to be in general well-marked, though not in every instance distinguishable from an ulcer of a different nature. Several diseases of the throat, he remarks, do not produce ulceration on the surface. One is common inflammation of the tonsils. The inflamed place often suppurates in the centre, so as to form an abscess, which bursts by a small opening, but never looks like an ulcer that has begun superficially, like a true venereal sore. The case is always attended with too much inflammation, pain, and tumefaction of the parts to be venereal. Also, when it suppurates and bursts, it subsides directly, and it is generally attended with other inflammatory symptoms in the constitution.

Mr. Hunter describes the true venereal ulcer of the throat as *a fair loss of substance, part being dug out, as it were, from the body of the tonsil; it has a determinate edge, and is commonly very foul, having thick white matter like a slough adhering to it, and not admitting of being washed away.* According to one writer, the ulceration is attended with little pain at first, and excavates the part deeply, and often in a triangular form, as if the tonsil were split. It slowly acquires a smooth buffy surface. (*Welbank, in Med. Chir. Trans.* vol. xiii. p. 569.)

Here, however, as in most other supposed forms of syphilis, some test is wanting by which the case may be certainly distinguished from other diseases of the throat presenting similar appearances; for, as Mr. Rose remarked, “the excavated ulcer of the tonsils, as described by Mr. Hunter, is not, as Mr. Carmichael seems to think, a peculiar symptom of the presence of the syphilitic virus. I have repeatedly seen it, as well as the scaly blotch, in cases where mercury had been freely employed for the primary sores, and in which I considered the virus as eradicated; and both have disappeared under the use of sarsaparilla.” (*Med. Chir. Trans.* vol. viii. p. 421.) In a recent work, Mr. Carmichael himself acknowledges the justice of the preceding observation, and owns that, since the publication of his Essays, he has often noticed the excavated ulcer of the tonsils either attending the primary phagedenic ulcer, or the train of constitutional symptoms which arise from it. (*On the Symptoms, &c. of Venereal Diseases*, p. 17.) In affections of the throat, Dr. Hennen states, that he “would be more guarded than in any others in the employment of mercury, until all inflammatory disposition was removed.” Afterwards he has seen them yield, “as if by magic, so soon as the local effects of mercury, on the parts within the mouth, became obvious.” But when mercury was given earlier, he has seen a vast number of instances in which irremediable mischief was done. (*On Military Surgery*, 2nd ed. p. 518.)

According to Hunter, lues venerea sometimes

produces a thickening and hardening of the tongue, but frequently ulceration, as in other parts of the mouth. He describes venereal sores on the tongue as generally more painful than those on the skin, but less so than common sore-throats from inflamed tonsils. They oblige the patient to speak thick, as if his tongue were too large for his mouth, with a small degree of snuffing.

It is a remarkable fact that Mr. Hunter did not recognise any case of venereal inflammation of the eye; yet the frequency of syphilitic iritis is now a fact as well and as universally established as any in surgery. It may be enumerated also as in the early class of secondary symptoms, and as being very often accompanied with a papular eruption, periostitis, and pains and swellings of the fibrous textures about the joints. Its treatment has been considered in the article IRITIS.

Of the later class of secondary symptoms (*tertiary*), the periosteum, fasciæ, tendons, ligaments, and bones are the parts which Mr. Hunter enumerates, as liable to be affected in the second stage of lues venerea; to these should be added the testicle and the larynx. It is an observation of Mr. Hunter, that we cannot always know with certainty what parts may become affected in this stage of the disease. He has known the distemper produce a total deafness, sometimes followed by suppuration, and great pain in the ear and side of the head. I have already explained that it was one of his doctrines, that the second order of parts was generally deep-seated. When these become irritated by the poison, he observes that the progress of the disease is more gradual than in the first order of parts. It assumes very much the character of scrofulous swellings, or chronic rheumatism, only it affects the joints less frequently than the latter affection does. A swelling sometimes makes its appearance on a bone, when there has been no possible means of catching the infection for many months; and in consequence of the little pain experienced, the tumour may be of considerable size before it is noticed. Sometimes a great deal of pain is felt, but no swelling comes on till after a long while. According to Mr. Hunter, these remarks are also applicable to swellings of the tendons and fasciæ. As tumours of this kind only increase by slow degrees, they are not attended with symptoms of much inflammation. When they attack the periosteum, they seem like an enlargement of the bone itself, in consequence of being very firm, and closely connected with the latter part. In these advanced stages of the disease, the inflammation can hardly get beyond the adhesive kind, in which state it continues to become worse and worse, and when matter is formed it is not true pus. Some nodes, he says, both of the tendons and bones, last for years before they form any matter at all. These cases, he considered, as not being certainly venereal, though commonly considered as such. Mr. Hunter found it difficult to explain the reason why, when lues venerea attacks the bones, or the periosteum, the pain should sometimes be considerable, and sometimes but trivial. Venereal pains in the bones are described by him as being of a periodical kind, generally most severe in the night-time.

At the present day, when many cases, formerly supposed to be syphilitic, are treated without any mercury, and even those which are reputed to be

venereal are cured by much smaller doses of that medicine than were given in Mr. Hunter's time, or by means of the iodide of potassium and sarsaparilla, nodes have become much less frequent; and I have already, in a previous part of this article, expressed my decided belief in the justness of the opinion given by Fallopius and others, that a disposition to nodes is often occasioned in venereal patients by the abuse of mercury.

*Treatment of Secondary Symptoms.*—In Mr. Hunter's opinion, the first order of parts (*secondary syphilis*), or those most susceptible of being affected in lues venerea, is also the most easy of cure; while the second order of parts takes more time to be remedied.

In the class of complaints arising in the second stage of the lues venerea (*tertiary syphilis*), Mr. Hunter believed that it was unnecessary to continue the employment of mercury till all the swelling had disappeared; because such complaints cannot contaminate the system by absorption. Whatever may be decided concerning the superiority of mercury as a general remedy for many secondary symptoms, one thing appears already well made out, viz. that it should always be employed with moderation, lest it produce worse effects and more terrible diseases than those which it is designed to relieve; and here, indeed, the same ordinary rules and principles apply with reference to a mercurial course, or the mere alterative exhibition of mercury, which are applicable in other forms of syphilis. (See MERCURY.)

To the following ingenious reasoning on the operation of mercury, and the principles by which its administration should be regulated, surgeons of the present day will not give more credit than facts warrant, because some of Mr. Hunter's opinions are manifestly influenced by the supposition that mercury is *absolutely* necessary for the cure of the venereal disease.

In curing lues venerea, by which Mr. Hunter signified particularly the constitutional forms of it, mercury seemed to him to be capable of only two modes of action—one, on the poison; the other, on the constitution. If, says Mr. Hunter, mercury acted on the poison only, one might conceive it did so either by destroying its qualities, by decomposing it, or else by attracting it and carrying it out of the circulation. If mercury acted in the first of these ways, one would expect that the cure would depend on the quantity of the medicine taken into the system. If it acted in the second manner, one would infer that the progress of the cure would be proportionate to the quantity of evacuation. But, observes Mr. Hunter, if it act upon the principle of destroying the diseased action of the living parts, and of counteracting the venereal irritation, by producing one of a different kind, then neither quantity alone, nor evacuations, will avail much. He states that the quickness of the cure depends on quantity, joined with visible effects. However, it is added, that although the effects which mercury has upon the venereal disease are in some degree proportioned to the local effects of the medicine on some of the glands, or particular parts of the body, as the mouth, skin, kidneys, and intestines, yet such effects are not altogether proportioned to these other circumstances. When mercury disagrees with the constitution, so as to produce great irritability and hectic symptoms, this action of irritation, as Mr.

Hunter explains, is not a counter-irritation to the venereal disease.

It was also another Hunterian theory, that the effects of mercury on lues venerea are always in proportion to the quantity of the remedy exhibited in a given time, and the susceptibility of the constitution to the mercurial irritation. These circumstances seemed to Mr. Hunter to require the most minute attention. However, it appeared to him that mercury should not be exhibited too quickly; because, when the local effects are produced too quickly, they prevent a sufficient quantity of the remedy from being taken into the system to counteract the disease.

Mr. Hunter had seen cases in which mercury acted very readily locally, and yet the constitution was hardly affected by it, for the disease would not give way. He states that he has met with other cases in which the mere quantity of mercury did not answer, till it was given so quickly as to affect the constitution in such a manner as to produce local irritation, and, consequently, sensible evacuations. This, he observes, is a proof that the local effects of mercury are often the sign of its specific effects on the constitution at large, and it shows that the susceptibility of the diseased parts to be affected by the medicine is in proportion to its effects on the mouth. Its effects, he contends, are not to be imputed to evacuation, but to its irritation. Hence he inculcates that mercury should be given, if possible, in such a manner as to produce sensible effects upon some parts of the body, and in the largest quantity that can be given to produce these effects within certain bounds. Mr. Hunter also remarks that these sensible effects should be the means of determining how far the medicine may be pushed, so as to have the greatest effect on the disease without endangering the constitution. The practice must vary according to circumstances; and if the disease be in a violent degree, less regard must be had to the constitution, and mercury must be thrown into the system in larger quantities—a very dangerous precept, so far as I can judge from the results of many cases in which I have seen it acted upon.

When the disease is in the first order of parts (*secondary syphilis*), a smaller quantity of mercury appeared to Mr. Hunter necessary than when the second order of parts is affected (*tertiary syphilis*). For the purpose of curing the venereal disease, whether in the form of chancre, bubo, or lues venerea, Mr. Hunter was of opinion that probably the same quantity of mercury is necessary. He represents that one sore requires as much mercury as fifty sores in the same person, and a small sore as much as a large one. He thought that the only difference, if there is any, must depend upon the nature of the parts affected, that is, on their being naturally active or indolent. He conceived, however, that on the whole, recent venereal complaints are generally more difficult to cure than the symptoms of lues venerea, and that this may make a difference in regard to the quantity of mercury required.

Having now delivered these theories on the exhibition of mercury, as laid down by Mr. Hunter, I must not quit this subject without remarking that even this eminent surgeon appears, on the whole, too partial to the long use of mercury, and some-



times to the introduction of immoderate quantities of it into the system. In general, however, his observations tend to condemn all violent salivations. It is to be recollected that, in his day, nobody had a suspicion that truly syphilitic sores would in the end spontaneously heal; and he himself had no dependence upon any medicine, except mercury, for the cure of any form of true venereal disease. But modern experience proves that the disorder seldom now presents itself in shapes so bad and intractable as formerly; that it is even capable of spontaneously ceasing; and that we hardly ever see cases in which it is requisite to give mercury, except in moderate quantities. Indeed, such is the change that many surgeons suspect that the very nature of the disease must have undergone a material alteration, or modification. In England, in my opinion, everything is to be referred to the improved manner of employing mercury with a great deal of limitation and restriction; sometimes giving the preference to other means, and discarding it on account of its well-known pernicious effects on particular cases, as, for instance, those in which the disease is phagedenic, or the bones are attacked with necrosis. In other instances, where its use is preferred, many judicious surgeons give it only in moderate doses, and never push its exhibition till the constitution is so impaired that horrible forms of disease ensue, which are the compound effect of mercury and syphilis together.

I may say that mercury will generally expedite the cure of secondary symptoms; but that, in some states of the constitution, even when true syphilitic affections are present, or when ulcers, which were originally of this nature, have assumed the phagedenic or sloughing character, and are accompanied by considerable inflammation, or much derangement of the health, mercury will prove the worst medicine that can be employed.

When the eruption consists from the first of scaly copper-coloured blotches, presenting the characters of psoriasis or lepra, unattended with much febrile disturbance, but preceded by, or associated with, other venereal symptoms, the great majority of experienced surgeons prefer the use of mercury, so as to bring the constitution moderately under its influence; but not with the view of exciting profuse and violent salivation, or producing severe derangement of the health. If either of these states unexpectedly occur, mercury is to be immediately discontinued, and sarsaparilla, iodide of potassium, or such other medicines as circumstances dictate, prescribed.

Dr. Colles admits that one and the same treatment will not prove equally successful in all the various forms of syphilitic eruptions. The scaly eruption, the copper-coloured blotch, and the papular eruption seem to him to be those which yield most readily, and are most certainly and perfectly cured by the action of mercury, given in the ordinary doses. "But the pustular eruption, and especially when of larger size than ordinary, requires a very particular treatment. No fact can be more established than this—that if mercury be used too largely in cases of pustular eruption, the latter will quickly degenerate into venereal ecthyma, or rupia, or spreading venereal ulcers. This form of eruption is one of those venereal affections which, while it is materially aggravated by large doses of mercury, can be certainly and

safely cured by small doses. If we watch with care the progress of the pustular eruption, we must be struck with the strong disposition which it betrays of running into, or of being converted into, ulcers; sometimes the pustules, spreading widely, and still keeping superficial, form ulcers, covered with thin, soft, yellowish crusts; while, in other cases, each pustule, without enlarging much, forms a deep ulcer covered with a brown scab, which is depressed below the level of the skin. Now, in either of these cases, mercury, administered in very minute doses, and with extreme caution, will effect a cure, and that too in a very short time." (*On Ven. Dis.* p. 178.)

When the eruption is papular, and has been preceded by a great deal of fever, I have often known blood-letting employed with advantage in the beginning, followed up by the compound calomel pill and saline antimonial medicines. Mr. Carmichael entirely differs from Dr. Colles, with regard to the treatment of this eruption, for he completely disapproves of the use of mercury in the commencement; and he does not resort at that period even to small doses of it, which, however, he pronounces to be decidedly useful, as soon as the papular eruption begins to desquamate.

Mr. Carmichael abstains from the employment of mercury for eruptions of the pustular kind, unless the pustules change into scaly blotches, and he chiefly confides in sarsaparilla and guaiacum, with small doses of James's powder, or pulv. ipec. comp. In such cases the iodide of potassium, with sarsaparilla, cascarrilla, or other light tonic, is often very efficient. Sulphurous and nitro-muriatic baths are also frequently of service.

I was glad to meet with the following observations in the writings of a gentleman, whom Mr. Carmichael considers as too great a worshipper of the god Mercury. (See *Dublin Journ. of Med. Science*, No. xl.) "The scabs and ulcers of rupia appear to be very little under the influence of mercury. I have seen this medicine administered, in cases of this affection, to patients of pretty vigorous habits; and although it acted in a most kindly manner, and produced a full and healthy pyalism, yet it had not any effect in causing the scabs of rupia to dry up and fall off; nor did it induce in those ulcers which had been exposed by the previous removal of the crusts any disposition to heal; the only change induced by it on these was to convert them into ulcers, which, though florid, presented one uniform smooth surface, sunk below the level of the skin, and totally devoid of granulations, which proved very slow and difficult to heal. But the administration of mercury to patients afflicted with rupia is worse than useless in all instances where the patient is naturally delicate, or has been much reduced or lowered by previous disease; for in all such it proves almost invariably fatal by increasing the weakness, and generally by inducing an uncontrollable diarrhoea." (*Abr. Colles*, op. cit. p. 179.)

In University College Hospital, I have seen various examples of rupia yield to small doses (3 to 5 grs.) of the iodide of potassium given thrice a day, with sarsaparilla. In some instances, however, the cure required other means for its completion, as nitrous acid, the nitro-muriatic bath, the liquor arsenicalis, the sulphate of quinine, and a dose of comp. powder of ipecacuanha, every night at bed-time.

With respect to syphilitic disease of the throat, I have already noticed Mr. Hunter's description of what he considered as its appearance, viz. "a fair loss of substance, part being dug out, as it were, from the body of the tonsil, with undermined edges. This is commonly very foul, having white thick matter adhering to it like a slough, which cannot be washed away." Dr. Colles, and others, also regard this as the type of genuine venereal sore-throat; but, as he observes, "however strongly the characters of the ulcer may be marked, we must not rely solely on the present appearances; we should trace back the history of the existing disease, look to the interval which has elapsed, inquire into the premonitory symptoms, as also into the treatment employed for the cure of the primary disease. (Op. cit. p. 121.)

It is well ascertained that the genuine venereal ulcer of the throat will heal without mercury; and I have cured it, in many instances, merely with sarsaparilla and iodide of potassium, or nitric acid. Entertaining a firmer reliance, however, in the efficiency of mercury, the greater number of surgeons have recourse to it as the favourite remedy in the case before us. Here Dr. Colles deems it necessary, in general, to keep the system under the influence of mercury for eight or ten weeks; "and (says he) I would abstain from local applications to the ulcer, as the changes which the latter undergoes will, in various instances, assist us in discovering when mercury is beginning to disagree with the system. Besides, we must be guided in our opinion as to the proper duration of the mercurial course, by a reference to the period of the healing in the throat." (P. 122.) A venereal ulcer of the throat is sometimes so placed as to be concealed. The most common situation of such hidden sore is on the back of the pharynx, where it is prevented from being seen by the interposition of the velum pendulum palati. "We should therefore desire the patient to inspire as fully as he can; in attempting this, he raises the velum, and if we look into the pharynx, we shall then generally discover the lower part of an ulcer. This, of course, leads us to make a more full examination, and to effect this we must depress the tongue, and, with a curved probe, raise up the velum. The ulcer, which now becomes more fully exposed to view, is of a circular form, is sunk deep in the substance of the pharynx; the surface is rather foul, but not at all sloughy; and the surrounding inflammation extends a very short distance beyond the margin of the ulcer." Under these circumstances, Dr. Colles is an advocate for rubbing the entire surface of the ulcer with muriate of antimony, which is to be applied by means of a little lint, rolled pretty firmly on the eye-end of an aneurism-needle, and dipped in the liquid. (*Abr. Colles*, p. 124.) I have usually employed, for the same purpose, the diluted or undiluted nitrous acid, and sometimes strong solutions of creosote, and nitrate of silver.

Frequently a venereal ulcer of the throat is situated below the level of the base of the tongue, and, if not detected and treated properly, it may spread to the sides and top of the larynx, and cause mischief, too often ending fatally.

According to Dr. Colles, "the ulcer, low down in the back of the pharynx, generally presents a foul, and sometimes a sloughy, surface, seldom assuming the venereal characters described by Hunter;

and has this remarkable feature, that its lower edge is very deep, while the upper part of the ulcer is very superficial. A pretty constant symptom complained of by the patient is, that when he attempts to take any food, the morsel stops at a certain point, and can only be got down by his taking after it a sip of liquid." (Op. cit. p. 125.) Dr. Colles rubs this ulcer also with the muriate of antimony.

Another position, specified by Dr. Colles as one where an ulcer may be placed, is close to the insertion of the anterior palatine arch into the tongue; and the sore is detected in attempting to depress the tongue with a spatula. The ulcer is deep and foul, but not at all sloughy; and "whether it be seated on the dorsum, or near the edge of this fold, its exquisite sensibility should be immediately destroyed by touching the surface with a strong solution of nitrate of silver, or with muriate of antimony."

"In a few instances, the voice of the patient is rendered very nasal, and this, sometimes, even on the first appearance of the venereal sore throat and eruption; and yet, neither the situation, nor the condition of the ulcer visible in the fauces, will enable us to account for this symptom. In this form of the disease, we find that the patient not only suffers severe pain in any attempt to swallow, but he is also teased by frequent desire to draw down the mucus from the back of the nares; and this secretion, when coughed out, is often found slightly tinged with blood. A smart degree of fever is also generally present. The ulcer, in this case, is seated behind the velum, high up in the angle between the upper and back part of the pharynx, or at the junction of its occipital and vertebral portions." Dr. Colles recommends rubbing such ulcer with a solution of  $\mathfrak{zj}$ . of nitrate of silver in  $\mathfrak{ssj}$ . of water, by means of lint, wrapped round the end of a silver aneurism-needle; care being taken to pass one end of the lint through the eye, in order to prevent it from slipping off the needle.

When the ulcer is situated on the posterior surface of the velum (rather an uncommon case), Dr. Colles observes that we are informed of it, not only by an appearance of thickening, together with a flush of redness, on the anterior surface of the velum, which appearance corresponds to the seat of the ulcer, but by carrying behind the velum an aneurism-needle, wrapped round with lint, and rubbing it on the suspected point; when, if there be an ulcer, the lint, on being withdrawn, will be found covered with the discharge. Here, also, Dr. Colles deems the immediate application of liquid caustics to the ulcer indispensable.

Every surgeon of any experience must have repeatedly seen a condition of the mucous membrane of the back of the pharynx, in which it is covered with a thin crust of whitish or yellow hardened mucus. The nature of the case is readily ascertained by rubbing off the mucous crust with a probe wrapped round with lint, and then the membrane is seen perfectly free from ulceration. Like Dr. Colles, I have seen this affection sometimes continue for an extraordinary length of time, and this notwithstanding every variety of treatment. Dr. Colles has known some cases much relieved by gargling the throat with sea-water, and sometimes apparently cured by sea-bathing; but he has known both means very frequently fail. Patients who have venereal sore-throats, not only



suffer pain and difficulty in swallowing, and have a thickness of speech, but are sometimes annoyed with an almost incessant flow of saliva, which, falling back on the larynx when they lie down, interferes with respiration, and hinders sleep.

Another distressing symptom, adverted to by Dr. Colles, is the regurgitation of the patient's drink through the nose. "This alarms the patient excessively; we can, however, relieve his anxiety by assuring him that this will cease when the ulcers have healed." (*Colles*, op. cit. p. 129.)

It seems to this experienced surgeon that this kind of treatment has more influence in modifying the appearances of venereal sore-throats, than it has in those arising from scrofula, or other cachectic states of the constitution. At the same time, he admits that, if mercury be used injudiciously, and in a manner unsuited to the general health and condition of a patient, it will cause more mischief, and more strange changes in venereal ulcers of the throat, if the patient be of a highly scrofulous, or very delicate habit, than if he were of a vigorous and healthy constitution. Yet, as Mr. Carmichael has explained, we meet with a great variety of venereal sore-throats where not a grain of mercury has been used. (*See Dublin Journ. of Med. Science*, vol. xii. p. 39.) "In a case (says Dr. Colles) where a genuine syphilitic ulcer of the throat has been treated by an irregular, or excessive course of mercury, and has healed under this treatment, we shall often find the patient suffer a relapse of sore-throat. The new ulcer, whether it appear in the site of the former one, or whether it occupy some new position, will be found to differ most strikingly from the original ulcer. This appearance, which may be very frequently observed, is that of a superficial ulceration, of rather a whitish colour, with a good deal of surrounding redness, and some slight degree of swelling: in fact, it presents many of those characters which might lead some to call it an aphthous ulcer. If we watch the course of this ulcer, we shall frequently see that it creeps along from place to place; that, unless it be seized by phagedena, or sloughing, it appears to be rather indolent in its nature, and mild in its character. Thus it admits of being healed, or almost healed, by various topical means, assisted, perhaps, by some tonic, or alterative medicines." (*Id.* op. cit. p. 131.)

For many years I have relinquished the employment of mercury in all the phagedenic forms of syphilis; being convinced by experience that, in such cases, it is the most dangerous and pernicious of all medicines. I prefer in such cases sarsaparilla, with iodide of potassium, and a nightly dose of the muriate or acetate of morphia, or of the compound powder of ipecacuanha; and in some, bark and nitric acid; care being taken to apply to the phagedenic ulceration itself lint dipped in the same acid or a strong solution of nitrate of silver, creosote, or Labarraque's liquor of chloride of soda. The nitric acid, however, generally answers best. These cases of sloughing throat are particularly noticed by Dr. Colles. "On inspecting the fauces (he observes), we find the entire of the velum, and both tonsils, in a state of sloughy ulceration; and the back of the pharynx appears converted, as it were, into a soft pultaceous mass; in-leed, sometimes we see all parts of the throat covered with this soft slough. By rubbing these parts with lint, wrapped round the end of a

probe, we ascertain that this covering adheres tenaciously to the surface. The patient is scarcely able to swallow even a sip of the most bland fluid. By day, a constant flow of ropy saliva issues from his mouth, and he complains that, by night, he is not only deprived of sleep by the pain of his throat, but that he is prevented from lying down; for in that position he is in danger of being suffocated by the viscid saliva passing down his throat. His general health is completely broken up; he is emaciated to an extreme degree; his strength is quite prostrate, pulse extremely quick, and skin hot. In fact, he is in a very high state of fever, which is of the hectic type. When we inquire into the history of such a case, we learn that this unfortunate man had undergone repeated slight courses of mercury, or one or two very severe ones, for the cure of the venereal disease; that these for a time relieved the symptoms; but that, on desisting from the use of mercury, the disease of the throat had relapsed, and assumed the present appearances." Dr. Colles maintains, rather in opposition to general belief, that this is precisely one of those cases in which *very small* doses of mercury will be found of signal service. (*Op. cit.* p. 133.) With respect to the case brought forward to justify this advice, I join Mr. Carmichael in thinking that the amendment cannot be fairly attributed to merely rubbing in ten grains of mercurial ointment, for a few nights, while sarsaparilla, nitrous acid, and strong local remedies were also employed. (*See Dublin Journ. of Med. Science*, vol. xii. p. 40.) The ten grains of blue ointment, I calculate, were fortunately too small a quantity to do harm. I have never known of any case in which venereal ulceration of the throat occasioned death by producing hæmorrhage from the carotid arteries; but such occurrences are alluded to by Dr. Colles, who also gives an interesting case, in which a portion of the ring of the atlas exfoliated and was voided in a fit of coughing, the patient surviving this event five or six years. (*On Ven. Dis.* p. 139.)

When venereal ulceration of the throat is making alarming progress, and by sloughing, or by phagedena, threatens to destroy some important portions of the throat, or to extend to the larynx, Dr. Colles recommends, as the best means of arresting the ulceration, the application of the muriate of antimony, or other equally powerful liquid caustic: mercurial fumigations, he says, will not produce sensible effects in less than two or three days, and then are apt to excite profuse salivation. My experience will not allow me, however, to believe, with him, that such salivation is almost certain to arrest the further ravages of the ulceration; on the contrary, I have seen the disease mostly aggravated by it, and this sometimes in a fatal degree. Perhaps, however, Dr. Colles admits enough on this point when he states, that "all those cases, which have been profusely salivated by fumigations, and in which a relapse has occurred, requiring a fresh use of mercury, will be found very difficult of cure." (*Op. cit.* p. 140.)

Many ill-conditioned venereal ulcerations of the throat are benefited by fumigating the part itself with the red sulphuret of mercury, or the grey oxide, by means of a proper apparatus; but phagedenic ulceration, according to my experience, is more effectually checked by touching it with nitric acid than by any other local application.

*Ulcers of the Tongue.*—Dr. Colles acknowledges the difficulty of distinguishing a venereal from a cancerous ulcer of the tongue. Both, he says, are attended with considerable hardness, but the hardness around the cancerous sore appears to him to be more of the stony kind. If there be a slightly elevated narrow ring of considerable hardness, including an ulcer, with a surface so clean as at first view to resemble an ulcer which is about to granulate, Dr. Colles would declare it to be unequivocally cancerous. In all doubtful cases, he recommends giving the patient the chance of benefit from slight pyalism. (See TONGUE.) A venereal ulcer on the dorsum of the tongue, anterior to its base, is generally of a circular form, as large as a fourpenny piece, and has the characters of a secondary venereal ulcer of the skin. (*Colles*, op. cit. p. 159.)

According to my experience, by far the greater number of ulcers of the tongue in venereal patients are effects of immoderate salivations. Dr. Colles notices the superficial ulcerations of this organ sometimes met with after a course of mercury. They may be known by the history of the case; "for those ulcers, which are not venereal, will be found to make their appearance in twelve or eighteen days from the time the mercury has been laid aside—indeed before we can be assured that the action of this medicine on the mouth has entirely ceased." (P. 160.)

*Ulcers of the Nose.*—According to the observations of Dr. Colles, ulcers of the *alæ nasi* sometimes begin in the angle between the nose and cheek from a cluster of papular eruptions. Whenever such an ulcer shows a tendency to phagedæna, or sloughing, it should be treated with some active caustic. I believe all practical surgeons will agree with Dr. Colles, that the characters of a venereal ulcer in the nostril, distinguishing it from scrofulous *ozæna*, are unknown, unless it be said that the latter is often preceded by scrofulous sore-throat, which has terminated in the formation of tense silvery cicatrices. This gentleman does not regard as a venereal affection "those instances of ulceration of the nose in which we discover in the septum *nasi*, about a quarter of an inch from its anterior extremity, an opening through the septum" of a circular form, and having slightly ulcerated edges. It may remain for years precisely in the same state. The latter seems to be Dr. Colles's chief reason for not considering the case venereal. I agree with him, that we should not pronounce an *ozæna* to be venereal, unless we find it combined with some other decidedly syphilitic symptoms, and its history interwoven with other secondary effects of the disease. Lotions of creosote, chloride of soda, or of the nitrate of silver, and the exhibition of iodide of potassium and sarsaparilla, constitute generally the most successful practice for these affections of the septum *nasi*.

*Venereal Iritis.*—For a description of this affection, and the treatment of it, I refer to the article IRITIS.

*Tertiary Venereal Ulcers of the Skin* are well known generally to assume a circular shape, and to present a foul, tawny or yellow appearance. When such a sore begins to prepare for the healing process, it usually becomes clean first in the centre; "then granulations arise in that situation, and extend towards the circumference, where the skin forms a deep edge, between which and the granu-

lations is a ring of the same yellow ulceration as appeared when first the surface of the ulcer was uncovered. In proportion as the ulcer proceeds, the granulations encroach on this yellow ring, until at length they reach the edge of the ulcer. The central granulations, to a large extent, will have actually cicatrised before the entire surface of the ulcer is clean and healthy. These ulcers are also remarkable for the strong tendency which the central granulations have to assume a fungoid character; so that, unless particular care be taken to prevent it, they will leave when healed a very high and prominent cicatrix. The ulcers also often heal from one side only, so as to resemble a kidney-bean or horseshoe." (*Abr. Colles*, op. cit. p. 167.)

We meet with tertiary venereal ulcers of the skin very commonly in persons who have undergone repeated salivations; and then the question arises whether mercury should be resorted to again, or not. If the patient be in very reduced and deranged health, I should say, let mercury at all events be postponed, and try other means. I have cured hundreds of these ulcers with the iodide of potassium and sarsaparilla, aided by judicious local treatment; but, when the health has been improved by these or other remedies, then mild doses of mercury may be employed, if necessary, and will often be found to complete the cure with great facility; whereas, if they had been resorted to at first, they would have converted some of the sores into phagedenic diseases. When disease of the osseous system accompanies these ulcers, I should feel very reluctant to administer mercury at all.

In general, mild dressings answer best; but, in obstinate cases, creosote, nitrous acid, or nitrate of silver; lotions, fumigations, with the red sulphuret of mercury; a solution of the chloruret of soda, or of the extract of henbane or opium, may be tried.

A tertiary venereal ulcer sometimes forms on the edge of the eyelid, and extends down some way along the mucous surface of the part. In order to check the extension of such a sore with as little delay as possible, caustic should be freely applied.

Although I have advocated only the moderate use of mercury in the treatment of venereal ulcers, many practitioners aim at producing what is termed a full mercurial action. Dr. Colles asks, "Is it not generally the case that, about the seventh or eighth day, when mercury ordinarily begins to act sensibly on the system, that we see a change apparently for the worse in the condition of the ulcers? This continues for two or three days longer, viz. until the mercurial action comes to be fully established; and then we find a decided improvement take place in the ulcers. Let us not, therefore, determine upon laying aside the use of mercury in cases of venereal ulcers, until we have seen what effect this medicine shall have when it has come into full action." (Op. cit. p. 172.) I introduce this remark as affording a view not uncommonly entertained and acted upon; but which I have often seen lead to fatal results. I should say, let the maxim here inculcated be at all events the last for adoption, and only when other plans, less injurious to the health, fail in curing the ulcers.

*Nodes, and Venereal Affections of the Periosteum, Fasciæ, and Ligaments.*—The bones are amongst the parts which constitute the second order, or those



which are attacked by secondary syphilis later (*tertiary syphilis*) than the skin, throat, and iris. The bones nearest the surface are most liable to nodes, as the tibia, clavicle, cranium, sternum, and the superficial portion of the ulna. It is a remark made by Mr. Carmichael, that when the deeper parts are affected, the progress of the disease is more gradual than in the superficial. "Swellings of the testes, tendons, and fasciæ are in general very indolent, do not excite any pain, and have very much the character of scrofulous swellings." The true syphilitic node is described by the same author as a solid enlargement of the bone, and as not being at its commencement, nor for a considerable period afterwards, accompanied by any discoloration of the integuments. In most cases, it is a very indolent swelling, increasing by slow degrees, and exciting but little pain and inflammation, until an advanced stage. (*Carmichael, On Ven. Dis.* p. 318, 2nd ed.) Whatever pain is experienced is well known to be greater in the night than in the day. In some instances, Dr. Colles has observed the tumor to be for a few days soft and very painful; then it became firm, and, at the same time, almost totally free from pain. All nodes may in time proceed to suppuration; but this is a slow change, and only happens in nodes of long standing. Dr. Colles has seen it take place more frequently in nodes of the cranium than of other parts. True nodes are less frequently met with in individuals who have been treated entirely without mercury. So far as my experience goes, this fact, which is attested by several impartial and accurate observers, is founded upon truth, and is one of high importance in relation to the mercurial and non-mercurial practices.

The bones are subject, as Dr. Colles remarks, to some diseases which simulate venereal nodes; and one of them is simple periostitis. The distinguishing of one from the other he deems practicable only by a close attention to the history of the case, and to other accompanying symptoms. Many surgeons do not consider the swellings which occur near the heads of bones as true venereal nodes. A great proportion of them are certainly swellings of the fibrous textures and of strumous character—cases in which mercury generally does more harm than good. Dr. Colles does not adopt this view; for he observes, "the condition and seat of a node afford us some criterion by which we can judge whether it be easily curable or not, &c. The node in the centre, or in the hard part of a bone, will be more easily cured than one on the cancellated structure. The former node will bear, and it also requires, pretty active and full doses of mercury for its cure; while that on the cancellated structure will require mercury to be used in moderate doses, administered with much judgment." (*Op. cit.* p. 185.) In the treatment of venereal nodes, Dr. Colles looks to the operation of mercury for the final cure; but he observes, that until mercury acts upon the system, the part should be repeatedly blistered. Frequently, mercury and blisters remove the pain; but the swelling continues, and cannot be removed by these or any other means. With respect to the practice of making an early incision into a node, Dr. Colles objects to it, because it is sometimes followed by painful suppuration, and even by caries, necrosis, and tedious exfoliations.

Dr. Colles has no doubt that nodes are some-

times excited by the injudicious use of mercury, or by the irregularities of the patient. "I have known cases (says he) in which mercury having been largely and repeatedly employed for the cure of other symptoms, and the patient having been again subjected to a fresh course of mercury, has complained, even while his system was decidedly under the influence of this medicine, of a swelling and tenderness of one or more of the long bones. The tubercles of the tibia are frequently the seats of this affection; when thus attacked, they are not seen to become much enlarged, but are rather soft, and exquisitely tender to the touch; and not unfrequently the integuments covering them assume a reddish tint. Nodes, which form, from the above cause, on other parts of the long bones, are, from their commencement, very painful, and of different size in different individuals; but in all cases they are rather soft. The pain attendant on all these is more widely spread along the limb than in cases of purely syphilitic nodes. Of course, *patients under such circumstances are not fit subjects for the use of mercury.*" I was glad to find Dr. Colles giving his testimony on this important point. Temporary relief, he says, may be derived from blisters, and he recommends an endeavour to be made to repair the mischief caused in the constitution by the injudicious use of mercury. I was also particularly pleased to read his statement, that the swelling of the knee and elbow, met with in patients labouring under tertiary syphilis, is not truly venereal, and that it will often yield to blisters and sarsaparilla. "It is not benefited (he adds) by putting the patient immediately under a second course of mercury, although it is found to yield *pari passu* with the truly venereal symptoms to the powers of this medicine, when employed with judgment and under favourable circumstances." (*Op. cit.* p. 190.) For my own part, I do not remember a case in which it seemed to me that mercury ever acted usefully on these swellings of the knee and elbow in patients whose constitutions had already been subjected to one or more mercurial courses for other previous symptoms. I avoid mercury, apply blisters, give sarsaparilla and iodide of potassium, and a dose of the compound powder of ipecacuanha every night. The warm bath is also frequently of great service.

Venereal pains in the limbs are probably often seated in the cancellous texture of the bones, the ligaments, and the fibrous texture about the joints. The incorrectness of the opinion that nocturnal exacerbations are pathognomonic of them is noticed by Dr. Colles, the pain of gout and rheumatism being also worst at night.

*Syphilis in Infants.*—The venereal disease is sometimes communicated to the *fœtus in utero*, through the medium of the blood of the mother, or the placental intercourse between the two beings. The effects of the syphilitic poison, thus developed in the *fœtus*, or new-born infant, may be said, therefore, to be secondary ones, as they arise from the introduction of the poison into the constitution, such poison not having been applied directly to the parts affected. "Whether we inquire into the circumstances under which the diseased parent, or parents, can infect their offspring, or the form in which the disease affects the child, or the appearance and nature of those diseases which are communicated by the infant to the nurse, or of those communicated to its other attendants,

and the further propagation of the disease by the nurse to her husband, and, perhaps, to a large family of children,—I say, in investigating any one of these points, we must be struck with the fact that we find in each a striking deviation from those laws which regulate the venereal disease, as communicated by the adult to the adult. Indeed, this is so much the case that some authors have not hesitated to deny that these affections are venereal; while others, admitting the possibility of a venereal disease in infants, have yet made use of those very deviations from the regular laws of syphilis to prove that, in particular instances, the disease was not venereal, because it did not strictly square with the progress of syphilis in adults." (See *Colles*, op. cit. p. 262.)

Dr. Colles believed, with the late Mr. Hey, the present editor, and others, "that a newly-married man, who is himself free from every appearance of syphilis and every other disease, shall yet infect his wife in such a manner that secondary symptoms shall appear in her a few months after marriage, and these not preceded by any primary symptoms, or by any discharge whatever from the genitals." Perhaps there may not be anything extraordinary, nor any remarkable deviation of the disease from its usual course, in the fact of its being transmitted from the mother to the fœtus through the medium of the placental intercourse between them, in the form of secondary symptoms, because the maternal and fœtal systems may be regarded in some points of view as identified and blended together; yet some authors imagine that the child can only become infected by coming in contact, during parturition, with ulcers in the vagina of the mother. This doctrine, as Dr. Colles justly observes, is at once overthrown by the following facts:—1st. It has been ascertained that no such ulcers existed at the period of parturition. 2ndly. Many infants have the symptoms of the disease at the moment of birth. The latter consideration is, of course, the most important of the two; the existence of sores or discharges in women being a point sometimes left in doubt, notwithstanding an ordinary examination. Whether the infant is ever primarily infected—that is, whether, at the time of birth it contracts the disease—in consequence of the direct application of the virus of a chancre, which the mother may happen to have, is another consideration; but certainly this cannot be the common mode of infection. In some instances, the child comes to its full time, or nearly so; but is born in so weak a condition that it dies in a few hours, exhibiting a copper-coloured eruption about the anus and genitals, or even over the whole body. Another way in which the disease makes its appearance is the following:—The child is born, to all appearance, healthy and well-nourished, and continues to thrive for about a week or a fortnight. Then copper-coloured spots appear about the anus and genitals, or on the inside of the thighs, or about the groins, where they may degenerate into ulcers. The voice of the child is now observed to change, and the cry to be hoarse. Superficial ulcers next appear on the angles of the mouth, with cracks and fissures about the neighbouring skin, which sometimes bleed. The tongue, palate, and throat are also affected with white superficial aphthous ulcerations; the nose becomes obstructed; a sharp thin discharge flows from the nostrils, but sometimes dries into a scab,

which blocks up the nose, and impedes the freedom of respiration: hence there is a snuffling noise in the child's breathing. If the disease advance further, ulcers and fissures form in different folds of the skin; great emaciation ensues; the flesh is flabby; the edges of the eyelids red; the conjunctiva muco-purulent; and, unless proper treatment be adopted without delay, the little sufferer soon perishes.

It is occasionally suspected that an infant may contract the disease by sucking a nurse affected with secondary symptoms; but this is a disputed point, and Dr. Colles expresses a doubt whether the diseased nurse could infect the child, unless she had ulceration of the nipple. If the ulcer of this part were a secondary one, then one might infer, from the Hunterian doctrines, and the inoculations instituted by M. Ricord with the matter of such a sore, that it would not be capable of imparting the disease. [If the blood of the mother can affect the fœtus in utero, the milk secreted from that blood may and does, in the opinion of the editor, produce the same effect.]

The best method of treating syphilis in infants is to prescribe calomel in very small doses, or else the hydrargyrus cum cretâ in the quantity of one or two grains twice daily. The disease may be also cured by putting the mother under the influence of mercury.

Whether the infant can transmit the disease to others, as is so often asserted, is another interesting topic; because, if this be decided in the affirmative, it is contrary to the doctrine of Hunter, M. Ricord, and others, who maintain that no secondary symptoms can be the means of transmitting the disease to another individual. [This opinion has been proved to be erroneous by Wallace and other pathologists.]

With respect to the implication of the testicle in syphilis, I need add nothing to what is stated on the subject in the article *TESTICLE, DISEASES OF*. For other matter relating to the venereal disease, see *NITRIC ACID, GUAIACUM, MEZEREON, GONORRŒA, IRITIS, &c.*

Some years ago the nitric acid was introduced as a remedy for syphilis. To the position of its efficacy being as great in venereal cases as was first alleged, many surgeons have not acceded, though, as a sensible writer has observed, it has certainly been allowed, with some other medicines, to remain in a kind of copartnership with mercury, and admitted to be useful in venereal cases under certain circumstances. A great deal of this want of agreement with respect to the effects of remedies in syphilitic cases is now explained by the imperfection of the diagnosis, and the important fact that the disease may generally be cured in time without any medicines whatsoever, though this time is sometimes long. Dr. Scott, who first suggested the use of nitric acid, has attempted to account for its alleged occasional failures by observing that the acid which he employed was not pure nitric acid, but an impure acid containing an admixture of muriatic acid. He, therefore, some time ago recommended the use of a compound acid containing three parts of nitric acid and one of muriatic, which he administered internally, and also applied externally, largely diluted as a bath, until the gums were affected and pyalism produced; and he conceived every trial as quite inconclusive unless these constitutional effects occurred.



"The acid that I have used of late (says Dr. Scott) is the nitro-muriatic; and it is formed by mixing together equal parts of the nitric and muriatic acids. If these acids be in the state of concentration that they usually possess in the shops, and if the quantities be considerable, a great volume of gas is developed on their coming into contact, which taints every part of a house, is extremely hurtful to the lungs, and disagreeable to the smell. To avoid this inconvenience, I put a quantity of water, at least equal in bulk to both the acids, into a bottle, and I add the acids to it separately. This method does not only prevent the unpleasant odour, but it tends to retain the chlorine, on which its effects depend. It is well known that the nitro-muriatic acid acts very readily on the metals and earths; nothing, therefore, but glass, or extremely well-glazed vessels of porcelain, should be used to contain it. (*See Journ. of Science and the Arts*, vol. i. pp. 205-211; *Lond. Med. Repos.* vol. vii. p. 59; and *Med. Chir. Trans.* vol. viii. p. 173, *et seq.*)

The only important conclusion which I venture to draw from Dr. Scott's observations, is a confirmation of the fact of the generally curable nature of syphilitic diseases without the aid of mercury. And I further believe that, though the nitro-muriatic acid bath is sometimes useful, the surest way of bringing it into discredit is to represent it as applicable to all forms of syphilis, for which neither this remedy, nor even mercury itself, will ever suffice. The muriates of gold and platina have been much commended of late years; but after the facts detailed in this article—more especially the general curability of the venereal disease

without mercury, the frequently noxious influence of this mineral, so as to derange the health and impede the cure, and the marked benefit which often then follows its discontinuance and the substitution of other means for it—the alleged superiority of new remedies must be received with suspicion, and, in particular, the idea of their specific power over the venereal disease.

I have already said that the iodide of potassium, with sarsaparilla, is more employed than mercury in the treatment of tertiary venereal complaints, and that even in secondary symptoms, where the bones are implicated, and mercury has been already tried, the surgeon will generally act wisely who decides in favour of not resorting to it again.

[The foregoing pages comprise all that was known and accepted of the pathology and treatment of the venereal disease in Mr. Cooper's time. Throughout this able narrative he has of necessity frequently referred to the opinions of Mr. Carnichael, Mr. Wallace, and M. Ricord, in addition to those of Hunter and the army and other surgeons. It has appeared to the editor that a tabular view of the opinions of the three first of these original writers on the venereal disease, which have had so much influence in modifying the opinions of the Hunterian school, might with advantage be added here, as serving more completely to mark the distinction between the views entertained at the date of the last edition of this dictionary, and those which have since been introduced. After these tables the more modern views will be fully considered.]

## TABULAR VIEW OF MR. CARMICHAEL'S OPINIONS.

### PAPULAR VENEREAL DISEASE.

#### *Primary symptoms.*

1. The simple ulcer, without induration or raised edges.
2. Gonorrhœa virulenta.
3. Patchy excoriation of the glans or prepuce, attended with discharge.
4. Buboës.

#### *Secondary symptoms.*

1. Papular eruption preceded by fever, and ending in desquamation.
2. Erythematous inflammation of the fauces.
3. Swelling of the tonsils and glands of the neck.
4. Pains in the larger joints, resembling rheumatism.
5. Iritis.

### PUSTULAR VENEREAL DISEASE.

#### *Primary symptoms.*

1. The ulcer with elevated edges, without induration.
2. Buboës.

#### *Secondary symptoms.*

1. Pustular eruption preceded by fever, and terminating in ulcers covered with thin crusts, that heal from their margins; and when the disease is on the wane, the eruption desquamates into scaly red blotches.
2. Ulcers on the fauces, in general of a white aphthous appearance.
3. Pains in the joints.
4. Nodes.

### TUBERCULAR OR PHAGEDENIC VENEREAL DISEASE.

#### *Primary symptoms.*

1. The phagedenic ulcer.

#### *Secondary symptoms.*

1. Eruption of tubercles preceded by fever, and terminating in ulcers, often covered with conical crusts. The ulcers spread with a phagedenic margin and heal from their centre. When the disease is on the wane they sometimes desquamate into scaly red blotches.

*Primary symptoms.*

2. The sloughing ulcer.
3. Buboës.

*Secondary symptoms.*

2. Extensive ulceration of the back of the fauces, pharynx, and larynx.
3. Ulceration and caries of the bones of the nose.
4. Pains of the joints.
5. Nodes.

SCALY VENEREAL DISEASE.

*Primary symptoms.*

1. The Hunterian chancre or callous ulcer.
2. Buboës.

*Secondary symptoms.*

1. Eruption of scaly blotches presenting either the character of lepra or psoriasis, and unattended with any obvious degree of fever.
2. Excavated ulcers of the tonsils.
3. Pains in the joints, tibiae, cranium &c.
4. Nodes.

TABULAR VIEW OF DR. WALLACE'S OPINIONS.

PUSTULAR SYPHILIS, OR THAT ARISING FROM THE ORIGINAL POISON.

*Primary symptoms.*

1. An ulcer commencing ordinarily by a pustule which may be indurated, annular, phagedenic, raised or unattended by either of these characters.
2. Buboës.

*Secondary symptoms.*

1. Pustular eruption preceded by fever, which may scab or ulcerate.
2. Ulcers of the throat, palate, &c.
3. Pains.
4. Nodes.
5. Caries of the bones.

EXANTHEMATIC SYPHILIS, OR THAT ARISING FROM THE CONSTITUTIONAL POISON.

*Primary symptoms.*

1. Gonorrhœa—when the poison is applied to a mucous surface.
2. Superficial excoriation with discharge, when applied to a semi-mucous surface, as the glans, penis, or inner prepuce.
3. A thickened, red, desquamating state of the inoculated part when the poison has been applied to the true skin.
4. Superficial ulcers succeeding to the two latter states; these may be indurated, annular, phagedenic, raised or not.
5. Rhagades, if situated at folds or angles, as at the orifice of the prepuce or anus, the angles of the mouth or eye, and between the toes.
6. Buboës.

*Secondary symptoms.*

1. Mottled or measles eruption
2. Tubercular eruption which may desquamate, ulcerate, or encrust.
3. Vesicular or bullous eruption, which may scab or ulcerate.
4. Superficial white patches on the tonsils or other parts of the interior of the mouth.
5. Condylomata.
6. Pains.
7. Iritis.

TABULAR VIEW OF M. RICORD'S OPINIONS, FOUNDED ON HIS INOCULATIONS PERFORMED IN THE MALE WARDS OF THE VENEREAL HOSPITAL IN PARIS FROM 1831 TO 1837.

PRIMARY SYPHILIS.

Symptoms from which the matter produced the characteristic pustule.	Chancres at the period of ulceration or progression	of the penis . . . . .	347
		of the anus . . . . .	9
		concealed (larvés) . . . . .	21
		of the lips . . . . .	3
		of the throat . . . . .	1
	Primary pustules	in various positions . . . . .	8
		after connection differently situated from artificial inoculation seated on the inner part of the thigh. . . . .	59
		different situations . . . . .	18
	Poisonous abscesses or encysted chancres in Symptomatic abscesses or chancres in the course of a lymphatic Symptomatic bubo or chancre in a lymphatic gland	inoculated on the day of opening, or later . . . . .	11
		inoculated on the day of opening . . . . .	42
		on the following day, or later . . . . .	229

N.B.—Of these last, 214 had been inoculated without result on the day of opening.



M. RICORD'S OPINIONS, FOUNDED ON INOCULATIONS PERFORMED BY HIM  
IN THE FEMALE WARDS FROM 1831 to 1837.

PRIMARY SYPHILIS.

<i>Symptoms from which the matter produced the primary pustule.</i>	Chancres at the period of ulceration or of progression	of the vulva . . . . .	139
		of the vagina . . . . .	2
		of the neck of the uterus . . . . .	12
		concealed (larvés) . . . . .	6
		of the anus . . . . .	28
		of the lips . . . . .	4
		of the throat . . . . .	2
		in different situations . . . . .	6
	Primary pustules	after connection differently situated from artifi- ficial inoculation on the inside of the thigh	27
	Poisonous abscesses or encysted chancres in different situations		8
	Symptomatic buboes or chancres in a lym- phatic gland	inoculated on the day of opening	21
		on the following day, or later	46
		N.B.—Of these last, 20 had been inoculated without result on the day of opening.	

M. RICORD'S OPINIONS, FOUNDED ON INOCULATIONS PERFORMED BY HIM  
IN THE MALE AND FEMALE WARDS FROM 1831 to 1837.

PRIMARY SYMPTOMS.

<i>Symptoms from which the matter produced no result.</i>	Chancres at the period of reparation . . . . .	62
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SECONDARY SYPHILIS.

uced no result.

Condylomata (tubercles muqueux) in different situations . . . . .	221	
Secondary ecthyma or pustular eruption . . . . .	10	
Rupia . . . . .	9	
Ulcers following condylomata, ecthyma, rupia, or empetigo	of the nasal fossæ . . . . .	19
	of the lips . . . . .	14
	of the palate . . . . .	4
	of the throat . . . . .	81
	of the anus . . . . .	41

TERTIARY SYPHILIS.

<i>Symptoms from which the matter produced no result.</i>	Tubercles of the whole thickness of the skin ulcerated and in different situations . . . . .	21
	Tubercles under the skin which formed abscesses and ulcers in different situations . . . . .	11
	Suppurating nodes in different situations . . . . .	15
	Caries in different situations . . . . .	10

DISEASES NOT DEPENDANT ON THE SYPHILITIC POISON.

<i>Symptoms from which the matter produced no result.</i>	Buboes not preceded by a sore (bubons d'emblee)	.	.	.	.	.	39
	Buboes sympathetic	.	.	.	.	.	248
	Gonorrhœas, acute stage	{	of the glans and prepuce gonorrhœa preputialis (balanites)	.	.	.	82
			of the urethra	.	.	.	291
			of the vulva	.	.	.	31
			of the vagina	.	.	.	32
			of the uterus	.	.	.	27
			of the anus	.	.	.	36
			gonorrhœal ophthalmia	.	.	.	6
	Gonorrhœas, chronic stage, in different situations	.	.	.	.	112	
	Inflammations of epididymis terminating in abscesses	.	.	.	.	3	
	Vegetations, ulcerated or not, and in different situations	.	.	.	.	28	

*Modern Views.*—We now enter upon the consideration of the modern views entertained by British and foreign writers on the venereal disease since Mr. Cooper's time, and up to the present period, including some of the many disputed doctrines still under discussion.

In the first place, with respect to the primary syphilitic ulcer, its varieties, its causes, and its consequences, there is still the greatest possible difference of opinion, and it is to this portion of the subject that we propose now chiefly to direct attention.

M. Ricord, who, though incorrect in many of his conclusions, has, we believe, done more than any living authority to elucidate the subject of syphilis, endeavoured to show, at all events in his earlier teachings, that the production of a pustule by inoculation with the matter of a sore was a certain proof of the syphilitic nature of that sore; and conversely, that if the result of inoculation properly performed was negative, the original sore could not have been truly syphilitic. His experiments were performed on a large scale, they were witnessed by a large number of disciples and followers, who unhesitatingly adopted and zealously promulgated his doctrines, and they met with almost universal acceptance. It was, in fact, at that time difficult to imagine that anything could materially shake his conclusions.

But what is the prevailing opinion *now* with the modern school of French writers on syphilis? So far from holding to the doctrines originally taught by Ricord, they now tell us that the true syphilitic ulcer—that which infects the constitution—is *never* inoculable on the same individual, or on anyone who is, or who has been, the subject of constitutional syphilis. They affirm that there are two kinds of venereal ulcers, which represent two perfectly separate and distinct diseases: one the true chancre, *never auto-inoculable*, usually accompanied with induration, which *always* infects the system, but never occurs more than once in the same person; and the other, the unindurated, or soft sore, much the more common of the two, which is an entirely local disease, and *never* infects the system, which is *always* inoculable on any individual, whether previously the subject of syphilis or not, and which may be contracted any number of times. To the latter class of sores the name of chancroid is now often applied. The two sores are alleged to be perfectly distinct from each other, to have nothing in common, and to be capable only of reproducing their like.

This doctrine is so far antagonistic to that originally taught by Ricord, that a successful inoculation, instead of being a proof of syphilis, would now be held, by many authorities, to be conclusive that the sore from which the matter was obtained was *not* truly syphilitic—not infectious—that is, as regards the constitution.

The action of the two kinds of sore on the lymphatic system is also alleged to present certain marked points of contrast. Thus, the indurated sore is usually accompanied by an indolent painless enlargement of the neighbouring lymphatic glands, which very rarely suppurate; while the unindurated sore does not necessarily cause any affection of the lymphatic glands at all, but if it does, the action induced is of an inflammatory character, is very liable to end in suppuration, and the matter of the bubo is as readily inoculable as

that of the original sore. In well-marked cases these distinctions will, no doubt, be very commonly met with, but the exceptions are numerous. "Non-conformable" cases are constantly met with, and their diagnostic value has, in our opinion, been very much over-rated.

It was Bassereau, a pupil of Ricord, who in 1852 first brought prominently forward the theory of two syphilitic poisons. In a work, characterised by great ability and research, called *Traité des Affections de la Peau Symptomatiques de la Syphilis*, he refers to a number of cases which tend to show, by what he calls the "confrontation" of patients with the person from whom they have contracted their disease, that the indurated or infecting sore always produces an indurated or infecting sore; and that the unindurated, soft, or non-infecting sore, in like manner always produces its like, and never causes constitutional disease. On these grounds, he considered that the two kinds of sore represent two separate and distinct diseases.

At that time the inoculability of the indurated sore had not been called in question, but it had been observed, that when inoculated on the individual bearing it, it did not usually produce an indurated sore, but one with a soft base, exactly resembling the ordinary soft sore. Therefore, it was argued by M. Clerc, in opposition to Bassereau, that there was not necessarily a double virus, but that the soft sore was the product of the hard sore, when transferred to a person already affected with syphilis, and that it transmitted itself as a soft sore, having permanently lost its infecting property. Somewhat later, in 1857, M. Fournier, another pupil of Ricord's, who followed up the confrontation system of Bassereau, and who came to the same conclusion with him as to the distinctness of the two diseases, attempted to explain the fact, that the hard sore becomes a soft sore when inoculated on a syphilitic patient, by the theory, advocated latterly by Ricord, that a person cannot have an indurated sore, or *true syphilis*, twice, and that therefore, under these peculiar circumstances, the hard sore produces a soft one. But he urges, that if the matter from one of these soft sores be communicated to a healthy subject, a hard sore and subsequent constitutional infection will be the result. In those cases, then, the apparently soft sore is in truth a hard sore temporarily disguised.

Afterwards, however, M. Fournier, experimenting with inoculation, found considerable difficulty in inoculating the indurated sore on the individual bearing it, and only succeeded in doing so once in 99 attempts. M. Puche only succeeded twice in 100 inoculations, and other experiments with similar results might be quoted. Hence arose the idea that the indurated sore was *never* auto-inoculable, or indeed inoculable on anyone who was the subject of constitutional syphilis. These views of the duality of the virus, and of the non-inoculability of the indurated sore, have been ably advocated by MM. Diday and Rollet of Lyons and many others, and have met with considerable favour from the profession, not only in France and other parts of the Continent, but also in this country and in America.

There still remains, however, a very respectable phalanx of authorities, on whose side we do not hesitate to enrol ourselves, who are not disposed to accept these sweeping and positive distinctions, who find them frequently incompatible with what is



passing under their eyes in practice, who cannot help suspecting that theories have not always been made subservient to facts, but that facts have been sometimes moulded more or less to suit preconceived and tempting theories; and who, therefore, still hold to the older notion, that all these contagious ulcers have their origin from one and the same poison, modified probably by the different degrees of intensity of the contagious matter, by the individual constitutional peculiarities of the recipient, and by the character of the tissue on which the poison is implanted.

We, of course, admit, that the separation of venereal ulcers into two classes, the indurated or infecting, and the unindurated or non-infecting sore, is, within certain limits, of great practical value. We admit freely, that the indurated sore will, as a rule, be followed by constitutional infection; and that the unindurated sore will, as a rule, produce no such result. But both rules, the latter especially, have occasional exceptions, and we believe it to be impossible to predict *with certainty* of any given sore, however typical in appearance, that it will or will not be followed by secondary infection. There is no *certain* proof of the infecting nature of the sore, but the fact of infection itself.

Mr. Henry Lee has offered what is perhaps the most satisfactory explanation of the phenomena usually observed. His view, if we understand him rightly, is as follows. He thinks, that in the case of the hard sore, the *adhesive* inflammation is set up, lymph is effused round the base of the sore, the lymph is imbued with the infecting principle, and the blood circulating through the contaminated lymph conveys the poison into the system. On the other hand, if the local inflammation set up is of the suppurative or ulcerative kind, the contaminating material is thrown off from the surface, excreted, so to speak, either in the form of pus, or by disintegration of the tissue, and constitutional infection is avoided. Phagedenic or sloughing ulceration is, for the same reason, protective against secondary disease, especially if it sets in at an early period in the progress of the sore, and before the necessary absorption has taken place.

But why, on the supposition that only one poison exists, should it sometimes produce one kind of sore and sometimes another? There may be several reasons for this. Dr. Boeck attributes the fact to the greater intensity or irritating property of the poisonous matter in one case than in another. Where its virulence is great, he thinks it will induce a more violent local action, and the sore will suppurate rather than indurate. Individual inflammatory or non-inflammatory tendencies are also worthy of being taken into consideration. Again, the locality infected has certainly a great deal to do with it. For example, induration is rarely if ever seen on the glans penis, except, perhaps, at the urethral orifice, while its most frequent seat is on the prepuce, just behind the corona glandis. It is no uncommon thing to see the same sore affecting both these parts to be indurated on the prepuce and unindurated on the glans. In females also, good examples of the indurated sore are by no means frequently met with, and yet secondary syphilis occurs in them in as great a proportion of cases as in males.

Whether these reasons are or are not sufficient to account for the occurrence of two different characters of sore from the same contagious principle,

there can be no doubt that induration, when present, greatly favours constitutional infection, and this fact has led to the assertion that secondary disease is *certain* to follow it in all cases. This, however, like most positive statements on the subject of syphilis, requires qualification. We have ourselves met with several well-marked instances of indurated sores, in which there has been an immunity from further consequences for several years. These, however, were treated with mercury. Dr. Boeck states that he has met with cases of the same kind, for which no specific treatment was adopted, and yet no further disease appeared. Without mercury the probability of secondary disease after an indurated sore is certainly very great. With mercury the probability is, we believe, much diminished, but there is still considerable risk.

But there is the other question, a most important one, as to the *immunity* from secondary disease after the soft sore, which has been so positively asserted of late years. Of the erroneous nature of this view we entertain a very strong conviction. We are certain that sores which have never shown induration at any period of their progress, and which we have ourselves watched carefully throughout, have nevertheless been followed at the usual period by a well-marked secondary eruption. With the truth of this we have long been strongly impressed, and with the consequent necessity for a very guarded prognosis on the subject of secondary disease in such cases. Many young surgeons, more influenced by authoritative teaching than we are disposed to be, have been in the habit of assuring patients who presented themselves with a non-indurated sore that they need not apprehend any further consequences, till the signal falsification of their predictions on several occasions convinced them of the imprudence of such an opinion, and of the unreliable character of the doctrine. In the present day the falsity of this view has been verified so often, and by so many competent authorities, that we believe it will not be long before the old doctrine again meets with general acceptance. This fact, of the truth of which we are firmly convinced, of course operates in our mind in the strongest possible manner against the double virus theory, and in favour of the older view—that both kinds of sore are derived from one and the same source.

There is another point of distinction between the two kinds of sore, which is of great importance, but to which we have not yet alluded. We mean the period of incubation which is said to precede the appearance of the indurated sore. It is admitted, almost universally, that the *soft* sore commences to influence the tissues from the moment of its application, and that when inoculated, it gives rise to a pustule which is usually distinct enough at the end of forty-eight hours. But we are told that the hard sore presents a marked contrast to this, and that it does not cause any perceptible action upon the contaminated part till after a period of incubation varying from eight or nine days to three weeks or a month; that at the end of such period an induration will be met with at the infected point, and that the induration will be followed, not preceded, by abrasion or ulceration; that the appearance of the induration is, in fact, evidence of general contamination, and is the earliest of the secondary manifestations.

We admit that cases answering to this description are sometimes met with in practice, but we contend that this is not the only mode, or indeed the most frequent mode, in which the indurated sore is developed. From what is continually passing under our eyes, we find it impossible to doubt that the hard sore, like the soft sore, is in the majority of cases noticeable within a very short period after contagion. Often, like the soft sore, it is a small ulcer or pustule for the first two or three days, but after a short time, induration takes place around its base, the secretion from its surface diminishes, and instead of being purulent becomes scanty and serous in character, and a typical indurated sore is before us. This, it appears to us, is the regular and normal mode in which the indurated sore is produced. Or, instead of being pustular at first, it may be a mere abrasion, beneath which an effusion of lymph very shortly takes place.

What is the meaning, then, of those cases to which we have alluded, in which there is an incubation of several weeks between the application of the virus and the appearance of the local disease, a circumstance which some modern writers have alleged to be a constant characteristic of the indurated sore? From what has been observed of late years, they admit of satisfactory explanation on the supposition that they are examples of contagion from *secondary* syphilitic affections. It has been demonstrated beyond the possibility of doubt, that certain secondary affections, especially those producing secretions from their surface, such as mucous tubercles, are contagious when their secretion is applied to an abraded surface, or even when inoculated in the ordinary way. There is an amount of evidence in favour of this which is absolutely conclusive, both from cases in which the contagion has been conveyed artificially, as a matter of experiment, to healthy individuals, and a much larger number in which it has been conveyed in the natural way, and has been satisfactorily traced to its source. In these instances, with few, if any, exceptions, there has been no immediate local effect, but after a considerable interval an induration and abrasion have appeared at the infected spot, and have been followed by the usual train of secondary manifestations. There are therefore good grounds for attributing those cases in which we meet with a lengthened incubation to the effect of contagion from secondary syphilitic matter, a mode of communication which is probably much more common than is usually believed. We repeat, however, that we do not believe this to be the ordinary mode of development of the indurated sore, or that a period of incubation is its constant or even its most frequent characteristic.

We shall next refer to the difference of opinion which prevails on the inoculability of the matter from an indurated or infecting sore. Ricord, in his earlier experiments, does not appear to have remarked any material difference between the two kinds of sore in this respect. According to him, the production of the characteristic pustule by inoculation was a sure diagnostic sign, a true test of the nature of the disease. The earlier advocates of the duality theory also appear to have considered the inoculability of the hard sore on the person bearing it as an established fact; but inasmuch as, when thus inoculated, it was found to be a soft and not a hard sore which was usually

produced, and this circumstance was incompatible with the dominant idea of these gentlemen, that each kind of sore always produced its like, the incongruity was sought to be explained by the hypothesis that the hard sore became a soft sore in a syphilitic person, but would retain its infecting property and become a hard one again, if transferred to what our neighbours call a virgin subject. It would certainly be a very remarkable circumstance, to say the least of it, that the one disease if it have no more affinity with the other than it has with scarlatina or small-pox, should, under the circumstances alluded to, be in the habit of investing itself with precisely similar outward characteristics. But at a later period the same observers found that this ingenious explanation was unnecessary, because, meeting with difficulty in inoculating from an indurated sore, they jumped to the conclusion that the sore in question *never* is inoculable on the same person, or on anyone who has, or who at any time has had, true syphilis.

This view of the case is not altogether without foundation, for there is undoubtedly a difference in the degree of inoculability of the two kinds of sore. Inoculation with the matter of a soft sore will usually, though not always, succeed, let the person inoculated be the subject of syphilis or not. Inoculation with the matter from the hard sore will not unfrequently fail, unless certain precautions are taken, whether inoculated upon the individual bearing it, or upon another syphilitic subject. Whether it would succeed more readily on a subject free from syphilis, there is not sufficient evidence to show, and experiments to settle such a question are obviously unjustifiable.

Mr. Lee (See *Brit. & For. Med. Chir. Review*, 1856), was, we believe, one of the first to draw attention to the difficulty of inoculating from the indurated sore. He attributed the difference of the two sores in this respect to the difference in the character of their secretion; that from the soft sore consisting of well-developed pus, that from the hard sore being scanty and serous, the product of the adhesive, as contrasted with the suppurative inflammation, and usually destitute of pus globules. Mr. Lee afterwards showed that if the hard sore were artificially irritated, and so made to secrete true pus, it then became inoculable without much difficulty; but he states that the results of such inoculations were quite different in their course from those following ordinary inoculation from suppurating sores; that pustules were sometimes produced, but these shortly dried up, and the inflammation consequent upon the punctures soon declared itself to be of the adhesive character. (See *Brit. & For. Med. Chir. Review*, April, 1859.) Various experimenters have since confirmed Mr. Lee's statement that the indurated sore may be inoculated when artificially irritated and made to suppurate, but it has not been found that the sores so produced have had any of the characters of the indurated sore, as observed by Mr. Lee; they have, on the contrary, resembled as closely as possible the pustules produced by inoculating from the ordinary soft chancre.

It would appear, then, that properly developed pus is necessary for the successful inoculation of syphilis (at all events on a syphilitic patient); and this view is supported conversely by some experiments made by Rollet, who found that if the secretion from a soft sore was deprived of its pus



globules by filtration, the remaining liquor puris was uninoculable.

But, side by side with the positive assertions of the modern French school, that the indurated chancre is never inoculable, it is interesting to contrast the opinions of those who have practised syphilisation, and who therefore have had the largest experience in syphilitic inoculation. Sperino, in his original work, says that he always chooses the matter from indurated Hunterian chancres, and does not allude to any particular difficulty in inoculating from them. Dr. Boeck, who has been practising syphilisation on an extensive scale for the last fifteen years, finds that, if certain precautions are taken, it is only as an *exception* that the hard sore is non-inoculable in a syphilitic person. He prefers this kind of matter for purposes of syphilisation, and constantly uses it, finding it, as he says, more rapid in its curative action and less locally irritating. Dr. Boeck admits, however, that in proportion as the secretion from the sore is thin and serous, will be the probability of failure; he therefore recommends that a piece of dry lint should be left in contact with the sore for twenty-four hours, at the end of which time there will be found a thick and purulent secretion, from which a positive result can usually be obtained. In case of failure he re-inoculates daily, and by persevering in this way very rarely fails of success. His colleague and assistant, Dr. Bidentkap, relates fifteen cases of successful inoculation from indurated sores on the individuals bearing them. He says that he could bring forward a much larger number, but he restricts himself to these, because in all of them secondary disease had already appeared, and the truly infecting nature of the primary sore was therefore beyond all doubt. (See *Recherches sur la syphilis*, by W. Boeck, p. 65). Similar results have also recently been obtained in the Vienna Hospital by Dr. Pick. (See *Auspiß de Lehren von syphilitischen contagium* Wien 1866).

We are cognizant of six cases in which the matter from indurated sores was inoculated successfully. Three of these were inoculations from indurated sores on syphilitic patients; the other three were auto-inoculations. The first three occurred in the female Lock Hospital; one was inoculated by Dr. Boeck, one by Mr. Gascoyen, and one by Mr. J. Lane. In each the sore from which the matter was taken was carefully selected, and presented all the typical characters of an indurated sore. Previous to the inoculation supuration had been excited in them by the application of the Unguentum sabinæ. In all the inoculations were carried through a lengthened series. Of the three cases of auto-inoculation, two were male patients under the care of Mr. Walter Coulson at the Lock Hospital. In the first he did not obtain a positive result till after a daily inoculation for three weeks. In the second he succeeded on the fifth trial. The third case was inoculated by Mr. Berkeley Hill. In this case there was a well-marked indurated sore on the prepuce, from which Mr. Hill, after irritation with Ung. sabinæ, had obtained in the first attempt three well-developed pustules on the abdomen, and from these he inoculated successfully a second and a third time. In all these cases of inoculation from indurated sores the pustules have been large, and have produced ulcers varying in size from a fourpenny-piece to a shilling, but there has been

nothing in their appearance to distinguish them from inoculations made from non-indurated sores. There has been no more appearance of induration in the one than in the other; no noticeable difference in the duration of the ulcers, which averaged from three to four weeks; or in the appearance of the resulting cicatrices.

We are therefore confirmed in the opinion which we have always entertained, that there is no essential or generic difference between the two kinds of venereal sores, and no valid grounds for the assertion that they invariably produce their like.

But there are other proofs afforded by syphilisation of the unity of venereal disease. It has been found that after inoculations have been practised for a certain length of time, positive results will no longer be obtainable. A condition of resistance to, or immunity from, the contagion of syphilis, more or less absolute, will have been acquired. This immunity, it appears, is sooner reached when the indurated, than when the non-indurated matter is used, though it is attainable with one as certainly as with the other. But whichever matter has been employed, the patient, when immunity has been obtained, is proof against the effect of *both* kinds, or so nearly proof that no new matter of any kind can be inoculated through a series of more than two or three generations. This is surely very strong evidence that we are not dealing with two separate and distinct diseases. But in addition to this it is affirmed by Dr. Boeck and others, who have practised syphilisation on a large scale, that its curative effect is obtained equally with both kinds of matter. Of the curative effects of syphilisation we hesitate to express an opinion; but from our own observation we can testify to the reality of the immunity produced, and to its being obtainable whether the matter employed is derived from the hard or from the soft sore.

Attempts have recently been made to explain the cases in which the hard sore has been successfully inoculated on the bearer, or on another syphilitic patient. It has been said that the lancet may have been previously used for inoculating from soft sores, and may not have been sufficiently wiped. It is, no doubt, just conceivable that, in the hands of an extremely careless person, a lancet sufficiently contaminated with matter from a soft sore to produce a positive result *may* have been employed. But every one who has inoculated much must know that considerable care is necessary to insure success, even with soft matter, and that it is extremely unlikely that an inoculation should take after a lancet has been wiped, let the wiping have been done ever so carelessly. That such a thing *may* have occurred once or twice is certainly credible; that it should have occurred, not *exceptionally*, but in *all* the numerous cases in which the hard sore has now been inoculated by undeniably competent observers, is as certainly beyond the limits of ordinary belief. We consider, therefore, we are justified in affirming that the inoculability of the indurated sore on a syphilitic patient has been fully established.

But, if the inoculability of the indurated sore has been denied on insufficient grounds, on the other hand we believe that the inoculability of the soft sore has been much exaggerated. It has been affirmed positively that the soft sore is a purely

local disease, communicable to every person alike, whether previously syphilitic or not. From what we have seen we can state that this is certainly not always the case. Wherever there is any great depression of the vital powers, there seems to be great difficulty in obtaining a positive result from inoculation with syphilitic matter, whether obtained from hard or soft sores. We have witnessed two cases of severe tertiary syphilis, in which for a long time no inoculations could be made to succeed. Another patient, while undergoing syphilisation, suffered from an attack of jaundice, and, while she was jaundiced, no inoculations could be made to take, although they had taken freely before the jaundice commenced, and took again, with equal freedom, after the jaundice got well. Another patient in the Lock Hospital, with a severe secondary eruption, but who was in a very depressed condition, was inoculated over and over again without effect with matter from every variety of source. In this case, shortly after the treatment was commenced, an enlargement was noticed in the right hypochondriac region, which gradually increased, and in about three months caused her death. The tumor was supposed during life to be malignant, but a *post-mortem* examination showed an enormously enlarged liver, which was affected uniformly throughout with "waxy degeneration." This patient was inoculated on forty-three different occasions, and on two only was anything like a positive result obtained, and even then the pustules were small and abortive.

We are aware that those who support the view that there are two syphilitic poisons have a mode of explaining away all the anomalies and contradictions to which we have alluded. They do so by the hypothesis that there is another kind of sore, called the *mixed chancre*, which has been much talked of within the last few years. This mixed chancre is said to result from the accidental implantation of both poisons on the same spot. It partakes of the qualities of both kinds of sore, having the suppurating surface and ready inoculability of the one, with the induration and infecting property of the other. An individual bearing both kinds of sore may communicate at the same moment a double contagion to another person; or a hard sore may at any time during its progress be contaminated with matter from a soft sore, or *vice versa*, and a mixed chancre be the result.

This certainly will explain away difficulties in a very convenient manner. Thus, if we allege that an infecting sore may have all the characters of a soft sore at first, and afterwards become indurated, we are told that it is a *mixed chancre*, which has developed its soft moiety immediately after contagion, but to which the hard half has been superadded after the proper period of incubation. If we say that secondary symptoms sometimes follow the soft sore, this also was a *mixed chancre*, the induration of which was probably slight, and must have been overlooked. If we succeed in inoculating with the matter from an indurated sore, this again must have been a *mixed chancre*, or a positive result could never have been obtained, and we must, therefore, have been mistaken as to its real nature.

Now, we believe it has never been claimed for the mixed chancre that it is anything more than an unusual or exceptional occurrence. If, however,

we admit its existence, it becomes necessary to believe it to be exceedingly frequent, or it will not serve for an explanation of all the difficulties of which we have spoken. It must have been present in all those cases in which secondary disease follows the soft sore; in all those cases, by no means rare, in which the sore is soft at first, and becomes hard afterwards; and again, in all those cases, now very numerous, in which the hard sore has been successfully inoculated on a syphilitic person. It obliges us to suppose that Drs. Sperino, Boeck, Bidenkap, Melchoir Robert, Auspitz of Vienna, and others, who have inoculated successfully with matter from indurated sores, have *always* been mistaken as to their real nature, and that none of them know an indurated sore when they see one. But in this latter class of cases it is certain that such a mistake cannot *always* have been made; because it has happened, not once or twice, but over and over again, that when the secretion was thin and serous, as is often the case in indurated sores, the inoculations failed, whereas afterwards, when the *same* sores were made to produce pus, the inoculations succeeded. These cases, therefore, could not have been examples of the mixed chancre, or according to the views of the dualists, they would have been equally inoculable from the first.

It is easy enough to assert a proposition which, though it may have little or no foundation, may nevertheless be almost impossible to disprove; and this appears to me to be very much the case with the mixed chancre. We contend, therefore, that those who decline to admit the reality of this double-barrelled sore are not bound to prove its fallacy. The burden of proof is on the other side, and rests with those who have endeavoured to establish its existence.

But the evidence in its favour is of the slenderest possible character. It appears that in certain cases matter from a soft sore has been placed upon a hard sore, and the hard sore has then taken on a suppurative action, and has produced readily inoculable pus, whereas the matter which it originally secreted had been previously proved to be non-inoculable. This we can readily believe, and should have expected *a priori*. But the fact is of no value in proving the existence of the mixed chancre, or the truth of the duality theory, because it admits of a much more simple and intelligible explanation. It is clear enough that in these cases the indurated sore was irritated and made to suppurate by the more virulent quality of the new matter placed upon it, just as if it had been irritated with a blister or with savine ointment, and hence its increased inoculability. The converse experiment of inoculating a soft sore with matter from a hard sore has not, as far as we know, been attempted, though some few cases have been recorded with a view to show that this kind of mixture also may take place, and that a soft sore may alter its character in consequence of being contaminated with matter from a hard sore. Isolated examples are never worth much in the solution of a difficult question like this, but here—even if we admit the facts to be as stated—they are valueless as evidence in favour of the mixture; for there is another and a better explanation ready at hand, in the fact that a soft sore may, *of its own accord*, become indurated at any period of its progress.

When the reality of the mixed chancre is



established it will be legitimate to use it to explain *otherwise unexplainable* cases, but it is not legitimate to use cases, *otherwise easily explainable*, in support of the preconceived idea of the mixed chancre. There is, in our opinion, nothing at present to elevate it above the level of pure hypothesis. We do not hesitate to regard it as a myth which has had its origin solely in the necessity for a plausible explanation of the various anomalies of the double virus theory, without which necessity it is our belief it would never have been heard of.

In the foregoing remarks we have endeavoured to give expression to the opinion we have always entertained, that recent researches into the subject of syphilis have not always been advances in the right direction; that there has been of late, in the modern French school especially, too great a disposition to dogmatise, and to educe positive laws from a one-sided examination of facts; and that, consequently, many of the conclusions arrived at will not stand the test of impartial examination. Much may be learnt from what has been done, but there is a good deal also which will require to be unlearned; and the doctrines of twenty years ago are not yet so completely revolutionised as many modern authorities would lead us to believe.]

[*Modern Treatment*—The modern treatment of syphilis resolves itself into the management of the primary, the secondary, and the tertiary manifestations, of each of which it is necessary to speak separately.

*Primary Syphilitic Sores*.—In discussing the treatment of these, according to the practice of the present day, their division into two classes, the indurated and the unindurated, is very convenient, especially with reference to the propriety of adopting a mercurial treatment. The soft sores are more frequent than the hard in the proportion of five or six to one, while they are rarely (those who hold that there are two distinct poisons say never) followed by constitutional infection. If mercury, therefore, is given in all such cases, with the view of preventing this result, it will be given unnecessarily in the very great majority: and since it has not been found to exert any beneficial influence in promoting the healing of this kind of sore, surgeons are now pretty generally agreed that it is more prudent to withhold the remedy altogether in this class of affections.

When a sore of this character is seen in its early stage, say when of not more than four or five days' duration, destructive cauterization is without doubt the most effectual method. Strong nitric acid, and it should be the strongest procurable, is one of the best agents for this purpose. It should be freely applied both to the surface and edges of the sore, so as to completely destroy them. If this is effectually done, a healthy surface is left when the eschar separates, which rapidly heals, and all after consequences are averted. After the period mentioned, however, cauterisation is so often ineffectual, that the better plan seems to be to let the sore run its course.

The treatment should then consist of, above all, scrupulous cleanliness, the application of gently stimulating and cleansing applications to the ulcerating surface, and the avoidance of all extraneous irritation by over-exertion, friction with the clothing, or otherwise. Locally, there are no better applications than weak solutions of chlo-

rated soda, of carbolic acid, of sulphate of zinc, or the old-fashioned black wash of the strength ordered in the present Pharmacopœia, viz.—three grains of calomel to the ounce of lime water. A fresh application of lint dipped in one of these lotions should be made every five or six hours. Generally, the treatment must be regulated by the condition of the patient and the appearance of the sores; if these are inflamed, purgatives and salines will be useful; if they are slow in their progress, tonic medicines will often be required.

By means of this kind it is surprising within what narrow limits this form of disease may be confined, and to what extent more severe consequences may be averted. The good effects of perfect rest, regular diet, and scrupulous cleanliness, have been strikingly manifested in the London Female Lock Hospital in the women admitted under the Contagious Diseases Acts. Amongst these patients soft sores are of course common enough, but from the fact of their being secluded for treatment at an early period, the sores are for the most part singularly small and superficial, and very rapidly heal. Suppurating buboes are exceedingly rare, and anything like phagedena or sloughing still more so.

In considering the treatment of the indurated sore, the question of the propriety of administering mercury or not at once arises, and here opinions are divided. It is held by some to be useless as a preventive, that secondary affections are certain to appear sooner or later, and that the effect of mercury is only to retard and not to prevent them; that it is better therefore to wait and to treat the sore by local measures only. The majority, however, and ourselves among the number, believe that mercurial treatment materially hastens the absorption of the local induration, and the healing of the sore; while it also, in a considerable proportion of cases, prevents altogether the occurrence of future disease. It must be persevered with, not only until the sore has healed, but until all trace of induration has disappeared.

Sores, on which phagedena or sloughing supervenes, must be treated on the same principles as phagedena or sloughing generally. These conditions have no special connection with syphilis, and are merely accidents occurring in the course of that disease.

*Treatment of Secondary Syphilis*.—For the treatment of secondary syphilis, especially in its earlier stages, it is undoubtedly the opinion of the great majority of the profession that mercury is the remedy which exercises the most decided therapeutic influence over the disease. For more than two centuries, through evil report and good report, it has held and still maintains its position. Nevertheless, the anti-mercurialists have done great service in exploding the old idea that mercury was a specific remedy without which the disease must necessarily go on from bad to worse. There are few, nowadays, who maintain that mercury has any, so-called, specific influence, or that it does more than aid in the elimination of the noxious influence or poison which causes the outward manifestations. It is generally admitted that syphilis may run its course and terminate favourably without any mercurial treatment, but it seems equally certain that the remedy does exercise a beneficial influence both in the removal of existing symptoms, and in hastening the ultimate

restoration of the patient to health. Under proper management, if prescribed within certain limits, and at appropriate periods, it will effect this without any equivalent disadvantage.

It is in the earlier stage of secondary disease that mercury is especially indicated, but it is a question worth considering whether it should be given indiscriminately in all cases. Some of the French surgeons, especially Diday, are inclined to dispense with it in the milder cases, those, for instance, in which there is only a faint eruption of roseola, which they consider may safely be left to the unassisted operations of nature, while they resort to it in cases of well marked scaly or papular eruption with corresponding affections of the mucous membranes. In the slighter cases alluded to, it may be an open question, therefore, whether it is worth while to prescribe a mercurial course, at all events at the commencement; but in the severer examples, the course of the disease is greatly prolonged if it is left alone, and it is in them especially that the good effects of mercurial treatment are most manifest. The disappearance of existing symptoms is rapid under its use, which is the best evidence that the morbid influence is for the time, at any rate, much diminished. Relapses no doubt frequently occur under this as under every other plan of treatment, but they are as a rule slight and unimportant, and the final eradication of the syphilitic poison is in the end greatly accelerated. In many cases, where syphilis seems to exert an unusually injurious and depressing influence, mercury will be found to be the most efficient tonic that can be prescribed. Not only will the symptoms disappear, but the patient's appetite will improve and his weight increase under its use, and this often, although there may be indications of a strumous diathesis which might under other circumstances seem to contraindicate the use of the remedy.

There are three methods of administering mercury: by the mouth, by inunction, and by fumigation. Each has its appropriate uses, but as a general rule, we have a preference for the first, as being equally effectual and much more convenient. For internal use, there is the choice between blue pill, hydrarg. c. cretâ, the chloride, the iodide, the perchloride, and the biniodide. Blue pill or the hydrarg. c. cretâ are the least likely to derange the stomach, and are as effectual as any. The dose should not, to commence with, exceed three grains, with  $\frac{1}{4}$ th of a grain of opium, night and morning. Salivation is of course carefully to be guarded against, and the first indication of swelling and tenderness along the free border of the gums should be considered an indication for the diminution of the dose. In this way, all the good effects of the remedy are secured, without its depressing influence, and without any of the various evils which have been alleged to result from its use. The chloride or the iodide in doses of about a grain twice daily are preferred by some, but we have found them more irritating to the bowels, more depressing, and tending more rapidly to induce salivation. The perchloride and the biniodide have their appropriate uses; the former is especially valuable, but not in the early periods of the disease. It should be given in doses of  $\frac{1}{16}$ th or  $\frac{1}{12}$ th of a grain thrice daily, in combination with tonics. It is in cases of relapse, when mercury in other forms has already been

given, and particularly in affections of the mouth and throat, often so troublesome and persistent, and in palmar and plantar psoriasis, that these two remedies are especially applicable.

*Mercurial inunction* is a very efficient method, and is well adapted for hospital in-patients, who have nothing else to do and who are under regular supervision, but it is troublesome and dirty, and is often objected to by private patients who wish to conceal their disease. It may be reserved for those cases in which the internal administration produces griping or diarrhoea. Half a drachm of the strong mercurial ointment rubbed in on the skin of the thighs, abdomen, or axillæ, is an appropriate quantity.

*Mercurial fumigation* is another very effectual mode, and has again come into fashion of late through the advocacy in the first instance of Mr. Langston Parker in 1839, and afterwards of Mr. Henry Lee. Moist mercurial fumigation or the mercurial vapour bath is the plan now adopted. A spirit-lamp is so contrived as to surround the patient with a watery as well as a mercurial vapour. The lamp is placed under the chair on which he sits, and he is enclosed, chair and all, in a blanket or other covering, which should reach to the ground and be fixed closely round his throat, as it is not expedient that the vapour should be inhaled. The bath should be given at bed time, and he should remain in it for a quarter of an hour or twenty minutes. The bisulphuret, the oxide, or the chloride may be used; the latter has been specially recommended by Mr. Lee, and is perhaps the most convenient and effectual. From  $\mathfrak{ss}$ . to  $\mathfrak{sss}$ . of calomel each night is an appropriate dose, but care should be taken lest the mercurial action be carried further than is expedient, and salivation induced.

We have given a full and impartial trial both in the Lock Hospital and in private practice to each of the three methods of administering mercury, and have been unable to discover that, as a general rule, there is any material difference in the result. If fumigation has any special indication, it is in cases where there is a copious skin eruption, and where therefore it may be beneficial to give the patient the advantage of its local as well as its constitutional operation. We have found, however, that the repetition, for any length of time, of the mercurial vapour bath has had a depressing influence, and that patients more frequently complain of lassitude and debility under its use than under either of the other methods.

The preparations of iodine, in our opinion, have no therapeutic value, as a general rule, in primary syphilitic ulcerations, whether attended with induration or not. We believe them to be equally useless in the class of symptoms usually termed "secondary," at all events in their earlier stages, when mercury, under proper management, has so eminently beneficial an effect.

*Treatment of Tertiary Syphilis.*—The preparations of iodine have their special application in the treatment of the class of symptoms usually denominated "tertiary." These are skin affections tending to ulcerate—such as tubercle and rupia, destructive ulcerations of the throat and palate, affections of the periosteum and bones, gummatous tumours of the cellular and muscular tissues, and affections of similar character in internal organs; some forms of orchitis and also of iritis might be included in the list. In our opinion, nothing is more certain than



that, as a rule, mercury is injurious in this class of affections; they show themselves at a period when the direct influence of the syphilitic poison appears to have passed away, and to have left behind it a cachexia, which manifests itself in the destructive conditions above enumerated. These are essentially asthenic in their origin, and the remedies required are those which will repair the failure of nutrition and restore the debilitated powers. Good diet and stimulants, with pure air and other favourable hygienic influences, are essential; but, in addition to these, we have in the salts of iodine a remedy the value of which it is impossible to exaggerate. Amongst them the iodide of potassium holds deservedly the highest repute. Under its influence, rupial ulcerations heal in the most remarkable manner, periosteal swellings disappear, the gummatous tumours known as soft nodes are rapidly absorbed, and the strength and weight of the patient re-increased. It is true that he is not at once permanently cured; it is not to be expected that so serious a diathesis can be changed in a few weeks, although its outward manifestations have been removed and destructive action has been arrested. The symptoms will return again and again, and the remedy must be again and again resorted to, with the result, in the great majority of cases, of a cessation of all outward symptoms and the ultimate permanent restoration to health of the patient. It is a mistake to suppose that a recurrence of symptoms is an indication of the failure of the remedy; it is, on the contrary, a reason for its repetition; and even the appearance of fresh symptoms during its use should be regarded as an additional motive to persevere and to augment the quantity given.

The iodide of potassium should be commenced in doses of three grains, to be gradually increased to fifteen or twenty grains, thrice daily. It agrees best, and its efficiency is increased, when combined with carbonate of ammonia, and administered in a diluted condition. The decoction of sarsaparilla is an excellent vehicle, and is in itself useful as a tonic. The iodides of sodium and ammonium are inferior, in our opinion, to the iodide of potassium; but when the latter disagrees, and produces dryness of the throat, headache, and coryza, they may be substituted for it with advantage, as they are certainly not so liable to be attended with these unpleasant effects. We have not met with a case in which one or other of the iodides could not be borne, if the dose at the commencement was sufficiently reduced—and in some cases it is necessary to make it as small as half a grain—when carefully, and by slow degrees, toleration will be established. In all cases the gradual increase of dose is a point of great practical importance. It is by persisting in the same dose that the good effect is often missed, that disappointment ensues, and the remedy is discredited.

We are not prepared to offer any explanation of the mode in which iodide of potassium acts so beneficially in tertiary syphilis. It is known to be a diuretic, but it can hardly be on this that its influence depends. It is also known to act as a solvent for some metallic substances which may have become incorporated in the tissues, of lead for example, and, there is good reason to believe, of mercury. Hence its influence in causing salivation, as it not unfrequently does, when first given to those who have taken too large doses of mercurials.

In this way it may prove beneficial by getting rid of mercury which has been given in excess, or persevered in too long. But it is not only from their antagonism to mercury that the iodides are beneficial in tertiary syphilis, for their effects are equally manifest when no mercury at all has been given, and also in those cases in which the tertiary stage sets in, as it sometimes does, without having been preceded by the secondary. Whatever may be their mode of operation, they are found to be the most powerful of all stimulants and tonics for persons who labour under the cachexia of tertiary syphilis. The outward symptoms disappear under their use, the health improves, and in the end, in most cases, permanent recovery is the result. The fact that salivation is sometimes induced when the iodides are given at the end of a mercurial course, has, we believe, given rise to the idea that they stimulate and rouse up the mercurial influence, and hence has arisen the custom of prescribing them in secondary affections, after mercury has been discontinued. We do not agree with this practice, although we know it is a very common one. If mercury has been given at the proper time, and has not been given in excess, it is better to leave it to do its own work, than to complicate matters by following it with a remedy which is antagonistic to it in its action, and which is inappropriate to that particular stage of the disease.

From what has been said, it may be inferred that we are not in favour of the combination of mercury with the iodides in the treatment of syphilis, although the practice is frequently adopted. A very favourite method is to give the perchloride of mercury in combination with the iodide of potassium in secondary affections. The result is, of course, a solution of biniodide of mercury with iodide of potassium in excess. This appears to be "blowing hot and cold" at the same time, since the one remedy tends to neutralise the effect of the other; and, in most cases, where the one is necessary the other is injurious.

If there are any cases in which such a combination is desirable, it would appear to be those which are passing through the transition period between the secondary and tertiary stages, when the symptoms partake somewhat of the character of both periods—when, for instance, there are patches of scaly or papular eruption coincidentally with disease of periosteum and bone, with recurrent iritis, chronic enlargement of the testis, or gummatous swellings.]

[*Syphilis affecting Internal Organs.*—The injurious influence of constitutional syphilis on many of the internal organs have been of late brought under the notice of the profession by Dr. Wilks, in an able paper published in *Guy's Hospital Reports*, vol. ix., 1863. Dr. Wilks is not satisfied with the division of the venereal disease into primary, secondary, and tertiary states; he would recognise only two conditions of the disease,—constitutional syphilis, and syphilitic cachexia, or the sequelæ of syphilis. In constitutional syphilis he holds that there is always a tendency to the deposit of a fibro-plastic lymph, as exemplified in the indurated sore, in tubercular cutaneous eruptions, in nodes, in subcutaneous and submucous tubercles, in deposits in the tongue and other muscles. The deposits of fibro-plastic material occasionally met with in the *post-mortem* examinations of per-

sons who have led dissipated lives he would also place in the same category. In all such cases he considers mercury to be the most effectual remedy for the purpose of preventing further deposition, and for the promotion of the absorption of that already existing. The syphilitic cachexia, or sequelæ of syphilis, he looks upon as associated with destructive processes, such as extensive ulcerations or sloughing in soft structures, and caries or necrosis in bone. With regard to internal organs, he connects the lardaceous and waxy conditions occasionally found in the liver, spleen, kidney, lungs, and other organs, with the sequelæ of syphilis. In all these conditions he would consider mercury injurious, and would have recourse to iodide of potassium. We cannot subscribe to the opinion that the deposits of nodules of fibro-plastic material in the tongue and other muscles, or under the skin and mucous membrane, which last we have been in the habit of naming subcutaneous or submucous tubercle, should be classed with secondary or constitutional syphilis, and consequently treated by mercury. On the contrary, we are inclined to maintain that they are found associated rather with the so-called tertiary symptoms, and require the treatment appropriate to the sequelæ of syphilis. We have seen many fibro-plastic deposits, in the tongue and other muscles, and under the skin and mucous membrane, occurring in old-standing cases of venereal disease, but never in the early stages of constitutional syphilis, and have always found in these cases iodine a more effectual remedy than mercury. To the other views entertained by Dr. Wilks we are inclined to subscribe, with the reservation, in which he would probably agree with us, that fibro-plastic deposits will be occasionally met with as the result of inflammatory action from whatever cause. A few quotations from Dr. Wilks's essay will place his views more clearly before the reader. At page 4 he says:

"I would therefore insist, *in limine*, in reference to this subject, that the whole of the modern theories have been mainly in the direction of discovering a wider extent of influence for the venereal virus, and have not, as some have supposed, tended to the establishment of a syphilitic cause for various well-known internal diseases."

Referring to his own investigations, he says: "The modern doctrine simply maintains that the internal organs may be affected equally with the external; that not only the cranium, but the brain within it, or the nerves; not only the muscles of the limbs and tongue, but the heart; not only the pharynx, but the œsophagus; not only the larynx, but the trachea, bronchi, and lungs; also the liver, spleen, and other viscera."

"In syphilis there is a disposition to a low form of lymph or fibro-plastic material in nearly every tissue of the body, occasionally modified in character, to a slight extent, by the organ in which it occurs. Consequently in those who have died suffering from this disease, there is scarcely an organ but what may be found affected in this particular way. In solid organs, or in the interior of tissues, there is found a more or less circumscribed deposition of an albumino-fibrous material."

"That whilst the system is still contaminated by the syphilitic poison, there is this disposition to the deposit of lymph; and also the converse,

—that the discovery of such disposition existing must be regarded as evidence of the presence of the venereal virus."

"The character which the deposit assumes in a muscle may be taken as that which prevails more or less in all other organs. In the tongue, or in one of the muscles of a limb, a rounded hard lump may be felt through the integuments, and thus constitutes a tumor. It differs, however, from the ordinary class of tumors, known as new growths, since the latter proceed from a small point or centre, and continually grow on the surface, whereby they become circumscribed, and are constituted wholly of the new material which has been thrown out. This is the case in cancer and tubercle. In the syphilitic tumor, however, the exudation appears to have been, in the first place, of a soft and albuminous character, and, being poured out in large quantity, has infiltrated the tissue; consequently, when examined, the lymph and the original structure of the part are found incorporated. At a subsequent period, when this has become hard, if a portion be examined by the microscope, the muscular structure will still be found present in the apparently simple, hard, fibrous mass; and thus it is that if appropriate remedies be given at an early period, the tissue will be left in its integrity after the adventitious material has been absorbed. This is every-day experience as regards the tongue. In consequence, also, of the lymph being poured out, and not growing from a centre, the diseased mass is not so circumscribed as a new growth, and the lymph or fibre will be found radiating into the muscular tissue around."

"In the liver the same process occurs. In this organ the nodules are not seen, as a rule, until after some years of their existence. They are then hard, more or less circumscribed, but found shooting out their fibrous rays into the surrounding hepatic tissue. In this case, also, owing to the contraction which takes place, there is often left a remarkable cicatriform appearance on the surface. It is this exudation, or fibro-plastic material, and subsequent contraction, which peculiarises the disease. The deposit which is left in the liver and other organs has generally had a long existence there before it comes under our notice, and then, when submitted to examination by the microscope, is found to contain fibro-plastic elements, small nuclei, fatty granules, and some amorphous matter. By French and German writers the term 'gummy tumor' is used to designate these syphilitic deposits."

After stating that the sequelæ of syphilis are manifested in the lungs, liver, and other organs, not by deposits in nodules, but by a degeneration of the fatty, lardaceous, or waxy character, he goes on to say: "The subject, therefore, frames itself to my mind in this way: that the so-called secondary syphilis should be simply styled syphilis, and that the disease is known to exist so long as certain phenomena occur, these being exemplified more especially by the exudation of lymph in the various tissues of the body, thus showing that a morbid action is still in existence, and, according to some authors, a virus capable of being propagated in various direct and indirect manners. This virus may be exterminated by remedies, or may wear itself out, and the patient recover his health; but not infrequently, as a



consequence of the vitiation which the constitution has undergone (although the syphilitic poison may itself have disappeared) a morbid state of system may have been produced, tending sometimes to a fatty degeneration of the various structures of the body, but more especially to that change known as the lardaceous or waxy. This might, with more propriety be called the second stage, or, if preferred, the tertiary stage; but one to be distinguished from the preceding, inasmuch as the virus was then present, whilst in the latter it has departed, the changes in the tissues being attributable to the cachectic condition, and therefore not unlike what may arise under other circumstances. Such a division of the disease into syphilis and its sequelæ is one which I have long proposed to myself, finding it a simple one, and warranted by clinical experience as well as by pathological research."

The only material point in which we are unable to agree with Dr. Wilks has been already alluded to, viz., that the fibro-plastic deposits in the muscles, in the subcutaneous and submucous tissues, and in the viscera, which he classes with secondary symptoms, and in which he would recommend mercury for their cure. We, on the other hand, would group these gummatous deposits, together with the so-called lardaceous and waxy degenerations occasionally found in the viscera, as belonging to the tertiary syphilitic affections, or sequelæ of syphilis, and consequently hold that iodine and not mercury is the remedy which should be depended upon in the treatment of such cases. It would hardly be doing justice to Dr. Wilks's paper if we did not apprise the reader that his investigations are supported by numerous highly interesting and apposite cases occurring in his own public and private practice and in that of his predecessors at Guy's Hospital.]

[*The Diathetic Effects of Inherited Syphilis in After Life.*—This article would be incomplete did we not draw the attention of the reader to Mr. Hutchinson's extended researches on the subject of *inherited syphilis*, especially in reference to its effects on the constitution at periods remote from infancy. For many years Mr. Hutchinson has devoted his attention to this hitherto much-neglected branch of inquiry, and has from time to time published the result of his labours in the various medical periodicals. In the year 1863 a very elaborate and painstaking work emanated from him, embodying his previous views, and carrying them still further, entitled "A Clinical Memoir on certain Diseases of the Eye and Ear, consequent on Inherited Syphilis." The principal features of this valuable monograph are the unwearied industry displayed by him in the collection of cases bearing upon the points under consideration, and the perseverance and boldness with which he insists that certain morbid appearances affecting the teeth, the eyes, and the ears, hitherto overlooked or misinterpreted by the profession, should be considered the result of inherited syphilis. The influence of this diathesis on the permanent teeth, upon the cornea and other tunics of the eye, as well as upon the hearing, are successively discussed and illustrated by plates and numerous cases. With respect to the notching of the permanent teeth, it occurs in by far the greater number of the cases narrated, and is considered by Mr. Hutchinson as a patho-

gnomonic sign of inherited syphilis. "The ground-glass opacity of the cornea," hitherto attributed to struma, is treated of by him under the title of syphilitic keratitis; and this opinion of its origin from inherited syphilis is supported by no less than 102 cases recorded in detail, and afterwards carefully tabulated. The affections of the iris, the choroid coat, and the retina arising from the same cause, are likewise brought under notice, and their ophthalmoscopic characters detailed and represented in the plates and cases related in support of the conclusions arrived at.

But the scope and value of Mr. Hutchinson's researches will be more fairly estimated by a few quotations from his published memoir. In his preface he remarks: "The subject of inherited venereal taint in its casual relation to various diseases occurring in periods of life more or less advanced from those of infancy, has, for the last fourteen years, engaged my close attention." Further on in the same preface he observes "that *chronic interstitial keratitis* is essentially an heredito-syphilitic disease, and that dental peculiarities of a certain kind are, when cautiously examined, a reliable indication of inherited taint, are indeed the principal assertions met with in the following pages. That both should be received with incredulity by those who have not had large opportunities for examining the facts, is what ought not only to be expected, but strongly desired."

On the means of recognition of the subjects of heredito-syphilis, during the tertiary stage (pp. 204-5), he writes:—"By far the most reliable amongst the objective symptoms is the state of the permanent teeth, if the patient be of age to show them. Although the temporary teeth often, indeed usually, present some peculiarities in syphilitic children, of which a trained observer may avail himself, yet they show nothing which is pathognomonic, and nothing which I dare describe as worthy of general reliance. The central upper incisors of the second set are the test-teeth, and the surgeon not thoroughly conversant with the various and very common forms of dental malformation will avoid much risk of error if he restrict his attention to this pair. In syphilitic patients these teeth are usually short and narrow, with a broad vertical notch in the edges, and their corners rounded off. Horizontal notches or furrows are often seen, but they, as a rule, have nothing to do with syphilis. If the question be put, Are the teeth of the type described pathognomonic of hereditary taint? I answer unreservedly, that when well characterised I believe they are. I have met with many in which the type in question was so slightly marked that it served only to suggest suspicion and by no means to remove doubt, but I have never seen it well characterised without having reason to believe that the inference to which it pointed was well founded."

"Next in value to the malformation of the teeth are the state of the patient's skin, the formation of his nose, and the contour of his forehead. The skin is almost always thick, pasty, and opaque. It also often shows little pits and scars, the relics of a former eruption, and at the angles of the mouth are radiating linear scars running out into the cheeks. The bridge of the nose is almost always broader than usual, and low; often it is remarkably sunk and expanded. The forehead is

usually large and protuberant in the regions of the frontal eminences; often there is a well-marked broad depression a little above the eyebrows. The hair is usually dry and thin, and now and then (but only rarely) the nails are broken and splitting into layers. If the eyes have already suffered, a hazy state of the cornea and a peculiar leaden, lustreless condition of the irises, with or without synechia, may be expected. If, however, the eyes have not yet been attacked by syphilitic inflammation, they will present no deviation from the state of perfect health and brilliancy. The occurrence of well-characterised interstitial keratitis is now considered by several high authorities as pathognomonic of inherited taint. It is almost invariably coincident with the syphilitic type of teeth, and when these two conditions are found together in the same individual, I should certainly feel that the diagnosis was beyond doubt. As a general rule, however, it is only by the careful estimate of various physiognomical conditions and symptoms considered together, and mutually supporting each other, that the diagnosis of this diathesis can be established. I must especially beg of those who have not previously made the deformities of the teeth the subject of special study to be very careful in their inferences. Mistakes leading to painful and much-regretted consequences may ensue from too hasty reliance upon misinterpreted symptoms."

With respect to the symptoms of "chronic interstitial keratitis," resulting from inherited syphilis, in Chapter II., p. 28, the following description is given:—

"*Chronic interstitial keratitis* usually commences as a diffuse haziness near the centre of the cornea of one eye. There is at this stage no ulceration, and exceedingly slight evidence of the congestion of any tunic. The patient, however, almost always complains of some irritability of the eye, as well as of dim sight. If looked at carefully, the dots of haze are seen to be in the structure of the cornea itself, and not on either surface; they are also separate from each other like so many microscopic masses of fog. In the course of a few weeks, or it may be more rapidly, the whole cornea, excepting a band near its margin, has become densely opaque by the spreading and confluence of these interstitial opacities. Still, however, the greater density of certain parts—centres, as it were, of the disease—is clearly perceptible. Early in this stage the comparison to ground glass is appropriate. There is now almost always a zone of sclerotic congestion, and more or less intolerance of light, with pain around the orbit. After from one to two months, the other cornea is attacked, and goes through the same stages, but rather faster than the first. A period in which the patient is so far blind that there is but bare perception of light now often follows, after which the eye first affected begins to clear. In the course of a year or eighteen months a very surprising degree of improvement has probably taken place. In milder cases, and under suitable treatment, the duration may be much less than this, and the restoration to transparency complete; but in many instances patches of haze remain for years, if not for life. In the worst stage, the corneal surface looks slightly granular, and from the very beginning it has lost its polish, and does not reflect images with definite outlines. In certain cases after the ground-glass stage is

passed, a yet more severe one ensues, in which the whole structure of the cornea becomes pink or salmon-coloured from vascularity, and in these crescentic fringes of vessels are often noticed at its circumference. In the best recoveries the eye usually remains somewhat damaged as to vision, and often a degree of abnormal expansion of the cornea is apparent. Only in one or two cases have I ever observed ulcers of distinguishable size on the surface of the cornea, and I have scarcely ever seen pustules on any part of it."

"The duration of these cases (p. 127) is very unequal. I have seen the cornea cleared, and the attack over within two months, or even less, from the date of the commencement, but this is rare. More frequently from six to eight months are consumed before the cornea is restored to fair transparency. In many cases the duration is yet longer, and we have not a few patients attending at Moorfields in whom slow improvement is still taking place after the lapse of several years. I am persuaded that most of our systematic works understate the risk of permanent damage to the eye which attends this disease, and also give the average duration of its attacks as considerably shorter than they will be found to be in reality. It is necessary to keep careful notes of all cases if we would avoid erroneous conclusions on those points."

Chapter I. is devoted to the consideration of a subject which has been but little attended to by surgeons, viz., "Iritis in infants." Mr. Hutchinson relates and tabulates twenty-three cases of this affection, and appends the following aphorisms:—

"1. The subjects of infantile iritis are much more frequently of the female than of the male sex.

"2. The age of five months is the period of life, at or about which syphilitic infants are more liable to suffer from iritis.

"3. Syphilitic iritis in infants is often symmetrical, but quite as frequently not so.

"4. Iritis, as it occurs in infants, is seldom complicated, and is attended by few of the more severe symptoms which characterise the disease in the adult.

"5. Notwithstanding the ill-characterised phenomena of acute inflammation, the effusion of lymph is usually very free, and the danger of occlusion of the pupil great.

"6. Mercurial treatment is most signally efficacious in curing the disease, and if recent in procuring the complete absorption of the effused lymph.

"7. Mercurial treatment previously adopted does not prevent the occurrence of this form of iritis.

"8. The subjects of infantile iritis, though often puny and cachectic, are also often apparently in good condition.

"9. Infants suffering from iritis almost always show one or other of the well-recognised symptoms of hereditary taint.

"10. Most of those who suffer from syphilitic iritis are infants born within a short date of the primary disease in their parents."

Of the result to the organ in this disease, p. 19, he says:—"In seven cases (ten eyes) the cure may be said to have been complete, every trace of lymph having been removed; in two or three other cases it was complete, excepting that slender adhesions remained. In three cases (four eyes) the result is not known. In twelve cases one pupil was



permanently occluded by organised false membrane. In nearly the whole of the last cases, in which the effusion was never absorbed, the patients came under care only at a late period of the disease, after the lymph had become organised, and but very little chance of its removal remained. To Cases 7 and 13, I may point as interesting illustrations of the efficiency of mercurials in procuring the removal of lymph which already appeared to be vascular, and the absorption of which was by no means expected."

From Chapter VII., on Deafness in connection with Inherited Syphilis, p. 174, we select the following:—

"In some cases of deaf syphilitic patients, the history given is of otorrhœa, pain, &c., and other evidences of external inflammation; in others no such symptoms have been present.

"A form of deafness which occurs in these patients, and which, as far as what little observation I have made on the subject goes, appears to be peculiar to them, is one in which the function fails without any external disease. It is usually symmetrical. Not unfrequently its stages are rapidly passed through, and a patient who six months ago could hear almost perfectly, becomes—without otorrhœa, and without any marked degree of pain—utterly deaf."

Having detailed twenty-one cases of deafness, which he considers dependent on inherited syphilis, he makes the following general remarks on them (pp. 182-3):—

"It will be seen, that all of the cases in which the ears were inspected go to support the belief, that the deafness of syphilitic children is due either to disease of the nerve itself, or to some changes in non-accessible parts of the auditory apparatus. Its symmetry in all the cases would point to a central cause. In none were there found adequate changes in the membrana tympani, although in none was that membrane quite normal. In all the Eustachian tubes were pervious; my belief therefore is, that the deafness in these cases is due rather to disease of the nerves, or of their distribution in the labyrinth. The cases constitute the analogues of syphilitic retinitis, and of white atrophy of the optic nerves."

"With regard to the prognosis of heredito-syphilitic deafness. I believe this is very unfavourable. When the disease was progressive, I have rarely witnessed any permanent improvement or arrest. In most it has gone on to total loss of hearing, and this in several instances, in spite of the cautious use of specific remedies, almost from the beginning. From six months to a year would appear to be the usual time required for the completion of the process, and the entire abolition of the function."

But it is not possible by quotations to do justice to Mr. Hutchinson's labours in the interesting field of inquiry which he has so assiduously cultivated. A perusal of his memoir can alone enable the reader to reap the full advantages to be derived from it. We have only space to mention, that fourteen cases of "inflammation of choroid and retina," six cases of "so-called aquo capsulitis," three cases of "inflammation of the lens and vitreous," seven cases of "amaurosis with white atrophy," ten cases of "diseases of the ocular appendages," and eleven "miscellaneous cases," all attributed to inherited syphilitic cachexia, will be found narrated with great exactness in the work we refer to. In an

Appendix is added twenty-five cases of "syphilitic choroiditis, retinitis, &c.," resulting from acquired disease, with remarks on their treatment, pathology, and prognosis. Without giving in our adhesion to all Mr. Hutchinson's views, we think the profession may be well satisfied that the subject of the diathetic influence of inherited syphilis will be thoroughly investigated by him, and could not be in better hands. It will, however, require all his perseverance, zeal, and acknowledged talent to convince pathologists that inherited syphilis will account for all the cases of "ground-glass opacity of the cornea," or of "the vertically notched teeth." But we are prepared to admit, that to him must be accorded the merit of establishing the important fact, that the majority of these cases do owe their existence to this diathesis.

With respect to the "ground-glass opacity of the cornea," we may observe that struma, which was hitherto accredited with being the sole cause of this slow and destructive change in the cornea, may possibly still account for some of the cases of this disease, and that consequently the therapeutic means adopted to counteract the strumous diathesis may prove as successful as those administered for the cure of inherited syphilis. Bearing upon this point, Mr. Hutchinson himself states (p. 126):—

"Although, however, I have no doubt as to the superior efficacy of specifics, yet I would carefully guard my readers against expecting too much from their use. This form of keratitis runs but too often a very protracted course, in spite of the best contrived plan of treatment. Neither mercurials nor iodides will, as a rule, cut it short. If given to patients in fair general health, at a very early period of the attack, they will, I believe, prevent the effusion from being copious, and very much limit both the extent and duration of the disease. But if the surgeon expect from them such proof of specific efficacy as we often see displayed in the various forms of acquired (i.e. not hereditary) syphilis, he will be disappointed."

Again, with regard to the imperfection in the development of the teeth, in which the characteristic notches described by Mr. Hutchinson are found, it should be borne in mind, that in very many sufferers from inherited syphilis they are not present. Mr. Hutchinson would probably say, that in such cases there was little or not sufficient stomatitis during the period of growth of the permanent teeth to interfere with their normal development. But by admitting stomatitis to be the proximate cause of the malformation of the teeth, does he not acknowledge that stomatitis, from other causes during teething, may similarly interfere with their proper development? Be this as it may, on taking leave of this part of our subject, we feel bound to express our opinion that the profession are greatly indebted to Mr. Hutchinson for an advance in our knowledge of this branch of surgery.]

[*Syphylisation*.—Prior to the date of 1844, it was received by the profession as an established fact, that the syphilitic virus was peculiar to the human species, but at this date M. Auzias Turenne, being strongly influenced by the known facts that so many animal poisons could be transferred from animals to man, and from man to animals, and not satisfied with the authorities of Hunter, Ricord, and others, who, after frequent trials by inocula-

tion, had failed to produce any manifestation of the disease in animals, instituted a series of experiments in order to remove the doubts with which his mind was impressed; and, after frequent failures, and in spite of the most determined and influential opposition to his views, succeeded in completely reversing the hitherto received opinions on this important question. Thus was opened up a new field of observation, a new mode of investigation, which could not fail to advance our knowledge of the nature, habits, and character of the venereal poison, and to lead to a more thorough understanding of the numerous disputed points connected with the study of this very intricate subject. Earnest pathologists in Italy, in Norway, in France, and in this country, have not failed to turn to account the important facts promulgated by M. Auzias Turenne, and which have, in addition, led to the establishment of the interesting inference that the poison of syphilis may be so introduced into the system of animals and of man as to render it no longer capable of carrying on this disease; and that in this respect the poison of syphilis partakes of the well-known properties of the vaccine and variolous poisons. A difference in degree is noted, but a similar power can no longer be denied to the venereal virus. It is well known as regards vaccination, that a number of vesicles is more to be depended upon than a single one, to render the individual free from after attacks of small-pox or of vaccine poison. But with regard to the venereal virus, some hundreds of inoculations are required to produce a similar immunity to future attacks.

But to enter more into detail, in the year 1844, as above stated, M. Auzias Turenne succeeded in inoculating monkeys, cats, rabbits, dogs and horses with the syphilitic poison. He found it was necessary to select a part not accessible to the animal's tongue, and to take other precautions to ensure the contact of the virus with the living tissues. He generally inoculated the inside of the ear, by removing the cuticle with a curved pair of scissors; the poison was then applied in a moist state to the abraded surface. He soon ascertained that he could not only produce a chancre at will in these animals, but that he could transfer it from one animal to another, and again to the human species apparently in an unaltered state. He observed, however, that the chancre went through its stages of development and decline more rapidly in animals than in the human being, lasting in the former from ten to twelve days only, and healing spontaneously. But the most remarkable fact noticed by M. Turenne was, that an animal, after repeated inoculations, became less and less susceptible of the poison, and at last the inoculations failed altogether. The animal was said by M. Turenne to have gained immunity to the disease, and to have become syphilised or saturated with the poison. Admitting M. Turenne's facts, we should be inclined to give a different explanation of them; instead of saying, that the system had become saturated with the poison, we would rather say, that the system had lost the power of reproducing the poison. The next step was, to apply this information to the human subject, and to ascertain whether similar results could be obtained. M. Turenne applied for permission to prosecute his inquiries in the female Venereal Hospital of Paris, but without success. He had, however, no diffi-

culty in inducing patients in private practice to submit themselves to repeated inoculations, with the double hope of being cured of the disease, and of gaining an immunity to future attacks. His over zeal even induced him to propose syphilisation as a prophylactic as well as a curative measure. It was obviously of considerable importance to ascertain whether the poison became modified by passing through the system of animals, and whether its inoculation from them to man might be attended, as in vaccine, or in small pox, with any beneficial results.

In 1850, M. de Wetz, of Wurtzburg, inoculated himself from the ear of a monkey on four different occasions. Chancres of the usual degree of severity were produced. M. Robert also subjected himself to a similar experiment, and suffered most severely, proving in his own person that the poison had lost none of its virulence. He inoculated himself from a chancre on the ear of a cat on two different occasions, and transferred the poison again from himself to the same animal. M. Turenne, having performed his experiments on some hundreds of persons, boldly asserted that the system of any individual might be rendered by repeated inoculations insusceptible of the poison of syphilis; that all his existing symptoms would disappear, and lastly, that immunity from the disease would be secured. Struck by the statements of M. Turenne, Dr. Sperino, attached to the Venereal Hospital of Turin, determined to test their truth by direct experiments on the female patients under his charge. These experiments, conducted in a public hospital by a distinguished physician, under the observation of his colleagues and of the students in attendance on his practice, could not fail to have weight with the profession. He at first practised three or four inoculations at a time on the abdomen twice a week; subsequently he increased the number of the inoculations to ten, twelve, twenty, or more at a sitting, and diminished the intervals. This treatment was continued as long as any syphilitic symptoms remained, and as long as the inoculations produced any effect. In some cases the patients were under treatment for more than a year; in others only two or three months, the majority requiring from six to eight months before the inoculations proved abortive, or before the symptoms disappeared. Dr. Sperino observed as a rule that the first inoculations were more severe than the second; the second than the third, and that each succeeding set diminished in size and duration, until at last they produced no result. Matter from a fresh source would often take effect after the inoculation from the ulcers of the patient herself ceased to produce any result, but at last matter taken from any source would fail to create a poisonous sore, and the patient was now pronounced cured and insusceptible of further attack of the disease. He also remarked that, as long as the smallest ulcer could be produced, or any secretion obtained, the poison had lost none of its virulence, and was as powerful to affect another individual as if taken from the largest or first inoculated ulcers. He noticed that those who at the time of treatment had large or numerous sores, or where they had continued for a considerable length of time, a less number of inoculations were required to produce syphilisation. Dr. Sperino's first report, in 1851, to the Medico-Chirurgical Academy of Turin, contained a



detailed account of 52 cases treated by syphilisation. In 1853 he published a separate work on the subject, in which he gives full details of 96 cases. Of these 53 were affected with primary syphilis, 50 were cured, 2 failed, and in 1, other treatment was adopted. The remaining 43 laboured under constitutional affections; of these, 26 were treated by syphilisation alone; 25 of the 26 were cured; in the remaining 19, mercury or iodine was had recourse to. Of the primary cases in 2, secondary symptoms appeared, which gave way under the treatment by syphilisation. We have no hesitation in saying that Dr. Sperino's facts, if they stood alone, cannot be doubted, collected, as they were, with the most scrupulous care by a scientific, earnest, honourable and truthful man, under the observation of many opposed to the views they were calculated to establish. They do not, however, depend solely on Dr. Sperino's experiments; the same facts are proved by other distinguished investigators; by Dr. Boeck, of Christiania University; Dr. Danielsen, at Bergen; Dr. Gamberine, at Bologna; by Dr. Galligo, at Florence; by Carlsson and Sanborg, in Stockholm.

Dr. Boeck has published two works on the subject of syphilisation, one entitled *Clinical Observations on Syphilisation*, in 1854, the other as late as 1856, on *Syphilisation in Children*. At first Dr. Boeck inoculated in two places every six days, subsequently in as many as eight or ten places, at intervals of three days. He inoculated on the arms and thighs, preferring the former at first, as the chancres in this situation are smaller than on the thighs. Dr. Boeck's cases, 84 in number, confirmed completely the same facts as Dr. Sperino's viz. that each successive set of inoculations were, as a general rule, smaller than the preceding, till at last no effect was produced. He noticed that matter from a first source would be followed by more severe ulcers than a continuance of inoculation with the same virus, but that at last the poison from whatever source became apparently inert. In those cases in which mercury had been previously taken the average time and the number of inoculations required to produce syphilisation were greater than in cases in which no mercury had been used. In the former, 6 months 24 days, and 432 inoculations; in the latter, 6 months 2 days, and 322 inoculations. In the more inveterate cases (probably tertiary syphilis) the average duration of the treatment was 7 months 24 days, and the inoculations 570. It appeared to him also that relapses were frequent where mercury had been given previous to the treatment by inoculation, but that in 42 cases where no mercury had been taken no return of the disease showed itself in the three years that had elapsed. Dr. Boeck concluded from his investigations that:—

1st. In all cases, without exception, immunity from the venereal poison is obtained sooner or later by inoculation.

2nd. That the symptoms of syphilis present at the commencement of syphilisation disappear during the employment of this mode of treatment.

3rd. That the general health does not suffer in the least from syphilisation; on the contrary, if the patient has been in weak health before inoculation, he most materially improves in strength and appearance during the process.

Dr. Boeck is evidently not so sanguine as to the

curative effects of syphilisation in tertiary symptoms. He says the iodide of potassium acted most effectually after syphilisation in cases in which that medicine had previously failed. He makes this remarkable observation, that when the patient labours under syphilis and the effects of mercury combined, the syphilis will give way to inoculation, but the ill effects of mercury remain. Those, he says, will be readily cured by the iodide of potassium, thus admitting that certain symptoms, which he conceives depend upon the mercury and syphilis combined, such as bone affections and some others occurring in tertiary syphilis, require the iodide of potassium for their cure. Dr. Boeck does not approve of inoculation for the cure of primary symptoms, as many would escape the constitutional disease under the ordinary modes of treatment. In the tertiary symptoms, he observes, that the poison of syphilis and mercury have produced such a dyscrasis or cachexia that inoculating with the primary virus has no effect. It is, then, in the secondary stage alone of the disease that he would recommend syphilisation as a curative means. Before leaving Dr. Boeck, we may mention that he states in the towns of Norway, from the careful and regular inspection of the prostitutes and their being immediately subjected to treatment, that he was unable to procure inoculable matter from a native source for an entire year; that this occurred twice in six years, and that his experiments were carried on principally from chancres incurred in England and Germany.

Dr. Sperino's investigations have not, it appears to me, been properly appreciated in this country or by the profession generally here or elsewhere, and I regret to say that the opposition he has met with and the unfair criticism he has been subjected to, have determined him to leave to other lovers of science and truth, of whom he feels assured there are many in other countries with ample opportunities, who will pursue this subject to its legitimate extent, so as to derive from it all the benefit to humanity that it is capable of affording. After his numerous experiments and zealous investigations of this interesting subject, Dr. Sperino draws this moderate and cautious conclusion, viz. that for the present, that is, till more information be obtained, syphilisation should be limited to the treatment of constitutional syphilis, so long as we cannot be certain whether a person syphilised is protected from a fresh infection, at least for a few years. It appears to me, then, that we must confess our indebtedness to M. Auzias Turenne, to Dr. Sperino, and to Dr. Boeck for establishing, without doubt, that the power of the human system, as well as that of animals, to produce the syphilitic poison is limited, and that by repeated inoculations this power may be exhausted, and that consequently persons may be inoculated with impunity, as was long known to be the case with the small pox and vaccine virus. How long this state of immunity will remain is not yet satisfactorily determined, even with respect to the vaccine virus; it may be for seven or for ten years. With respect to the small-pox poison, it is considered to last for life, although exceptions occur; but as regards syphilis, time is required to determine this point. We confess we are inclined to think that the immunity will be found to be of very short duration. It may be interesting perhaps here to be reminded of Liebig's view of the action of

animal poisons which he represents as resembling fermentation in a saccharine solution.

On applying yeast to a saccharine solution, so long as any gluten remains, it is well known that yeast will be reproduced, but will cease to be formed when the gluten is exhausted. He supposes as regards those poisons that affect the system but once, that some unknown constituent of the blood or of the animal system, not essential to life, is as necessary for the formation or reproduction of the poison as the gluten is for the reproduction of yeast; that the reproduction ceases when this constituent is exhausted. As regards the yeast, we know that it is the gluten in the saccharine solution. As regards the animal poisons, as yet we know not what the agent is. But on applying this chemical theory to the action of the poison of syphilis, which may affect the system again and again, it would appear that the poison depends for its production upon some ingredient of the blood or tissues that is not easily exhausted, and which may possibly be continually reproduced; if so, it would be similar to fermentation in a saccharine solution to which gluten is being continually or from time to time added. In other words, there is in the human system, and in that of animals, something which is essential to the formation of the poison of syphilis. This something may be exhausted—that is distinctly proved; may it be reproduced? Is it something which is continually being formed? If so, the syphilitic virus will be again formed on the application of the proper stimulus, and the immunity will be temporary. Time alone will settle this important question. For ourselves, we have sufficient confidence in Dr. Sperino and Dr. Boeck to feel satisfied that they will watch the patients whom they have experimented on, and that they will as faithfully give the result, if the immunity prove to be temporary, as if it were permanent, although for the sake of humanity they may regret that result.

But with regard to the treatment of syphilis by syphilisation this stands quite upon a different basis. Both Dr. Sperino and Dr. Boeck would for the present limit it to secondary symptoms. The average treatment by syphilisation may be taken at six months as to time, and as to number of inoculations some 300 or 400; but there is some liability to return, according to Dr. Boeck, especially where mercury has been given. Dr. Boeck admits the necessity for the administration of iodine for tertiary symptoms; and also that complete immunity from the liability to contract fresh disease has not yet been proved.

We should not ourselves feel warranted in treating ordinary cases of secondary or tertiary syphilis by syphilisation, but the extraordinary cases, which refuse to yield to the usual modes of treatment continued for months and even years, appear to us to justify even treatment as severe as that of syphilisation, and we confess that we feel tempted to have recourse to it in such cases.

In order to bring our information on this interesting subject up to the present day, we will here add a few quotations from a valuable paper, entitled "Record of Cases treated in the Lock Hospital," by James R. Lane and by George G. Gascogen, published in vol. I. of the *Medico-Chirurgical Transactions*: read June 11, 1867:—

"The practice of syphilisation has evoked ex-

treme hostility in England, and it had never been thoroughly carried out until the present series of cases was commenced under the superintendence of Dr. Boeck himself.

"That gentleman, being on a professional visit to this country, most kindly acceded to the request of the committee then sitting to inquire into the treatment and prevention of venereal diseases in the Army and Navy, to state the result of his great experience; and he most generously, and at great personal sacrifice, offered to return to England for three months to initiate his system of treatment by syphilisation, provided he could obtain sufficient hospital accommodation for the purpose. At the request of the above committee, and at the suggestion of the authors of this paper, the governors of the Lock Hospital very liberally placed some beds at his disposal, and the practice was commenced in September, 1865, and continued under Dr. Boeck's supervision until the end of that year. After his departure from this country, the treatment of the cases begun by him was concluded by the authors, and some others have since been undertaken by them and carried through.

"The method pursued by Dr. Boeck is as follows:—At the commencement three punctures are made on each side of the chest, and matter is inserted, derived either from a person who has a primary syphilitic ulcer, or from the artificial sores of a patient who is undergoing syphilisation.

"After an interval of three days, if the punctures have developed pustules, three other inoculations are made from them in the same region of the body, and this process is repeated as long as pustules are produced; the inoculations being made at intervals of three days and the matter being always taken from the last formed pustules. When, at length, these are not inoculable, fresh matter is employed, and the above process is repeated, until a positive result can no longer be obtained on the trunk. The same practice is then commenced on the arms, and continued there until the punctures fail, when a similar process is pursued on the thighs until no more pustules result, and a condition of immunity more or less perfect is arrived at. In the ordinary run of cases this occurs in from three to four months."

"Although Dr. Boeck considers that the two varieties of chancre are produced by the same virus, and that the result produced by their inoculation is essentially the same, he prefers the matter from an indurated sore for the purpose of syphilisation, as he has found that patients pass through the treatment and attain immunity more rapidly and satisfactorily when this is used than when the secretion of a soft sore is inoculated. We have stated in each case the nature of the symptoms for which the treatment was undertaken; the progress of the inoculations; the effect of the treatment upon the symptoms; and the final result.

"The inoculations practised on each patient were recorded by means of a diagram, three of which, illustrating cases 2, 8, and 9, are printed to show the method adopted; in addition to these a written diary of the patients was kept."

The first only of the 27 cases treated by syphilisation is here given in detail, and a table of the whole number added:—

"CASE 1.—Female, C. J.—, æt. 18; admitted August 17, 1865; discharged February 20, 1866.



"*Symptoms.*—Incipient mucous tubercles on labia; squamous eruption on head, face, and trunk, with roseola on limbs, of five weeks' duration; multiple glandular enlargement in both groins. No previous treatment.

"*Syphilisation.*—September 5.—After two failures with matter from hard sores, the inoculations were commenced successfully with matter obtained from multiple soft sores in a male out-patient (same as in Cases 2 and 3). From these the inoculations were continued through seventeen successive generations on each side of the chest till October 23, when the pustules became too small and imperfect to reinoculate from.

"October 26.—Inoculations were made on the arms with matter originating in an indurated sore from a patient undergoing syphilisation, which was sent from Norway by Dr. Bidentkap, and it went through five generations. After this, matter was employed on the arms and thighs (chiefly from soft sores), and in one instance eleven generations were produced on the thighs, but for the

most part they terminated at the second or third.

"After December 27 only very imperfect pustules were developed, and these never contained reinoculable matter. Immunity, therefore, may be said to have been attained in three months and twenty-two days.

"*Progress.*—There was no improvement in the symptoms during the first two months of the treatment, but rather the contrary—fresh spots of eruption appeared, and the mucous tubercles on the labia increased in size. During the third month an amendment was apparent, and by the time the inoculations would no longer take the eruption had disappeared, as well as the mucous tubercles.

"*Result.*—Left the hospital February 20, 1866—five months and fifteen days from the commencement of the treatment—and has not since been heard of. 281 inoculations were made; 157 of these were positive, 124 negative. The longest series of pustules obtained from the same matter was seventeen (soft)."

Table showing the duration of the treatment in each case and the number of inoculations made.

Number of cases treated	Duration of treatment from first inoculation till immunity was obtained, or until the inoculations were discontinued		Stay in hospital from date of first inoculation		Number of inoculations made		
	Months	Days	Months	Days	Positive	Negative	Total
Case 1	3	22	5	15	157	124	281
2	3	8	5	13	155	121	276
3	3	14	5	—	157	122	279
4	3	6	9	5	181	78	259
5	8	7	10	8	296	126	422
6	3	23	3	23	154	106	260
7	3	17	4	6	160	105	265
8	2	3	2	28	168	94	262
9	3	20	4	18	170	94	264
10	4	—	4	4	127	117	244
11	1	15	4	5	82	184	266
12	5	5	5	24	196	89	285
13	5	10	6	13	164	123	287
14	2	27	3	21	66	107	173
15	4	4	6	11	131	131	262
16	5	27	5	17	116	40	156
17	4	27	10	—	122	15	137
18	4	—	6	15	103	27	130
19	3	3	3	3	74	28	102
20	6	13	6	13	178	174	352
21	3	25	3	25	93	40	133
22	4	10	4	10	173	106	279
23	4	—	4	—	92	181	273
24	5	—	6	—	127	164	291
25	5	14	5	18	195	144	339
26	3	19	4	8	22	226	248
27	7	20	8	9	254	214	468
	116	19	149	12	3913	3080	6993
Average	4	9	5	16	145	114	259

The conclusions drawn by Mr. J. Lane and Mr. Gascoven from the 27 cases under their treatment, and initiated by Dr. Boeck, are here given in their own words—

"The remarks suggested by the cases above narrated may be divided into those relating to the value and effect of syphilisation as a method of treatment, and those having reference to the various pathological questions illustrated by the inoculations and their progress.

"From the practical aspect of the question, the point to be first considered is the length of time occupied by the treatment. In those cases in which mercury had not been previously given, the inoculations occupied periods varying from six weeks to eight months and seven days. In the mercurial cases from three months and nineteen days to seven months and twenty days. The average in the first class was four months and three days; in the second class, five months and four days; and in the whole number of cases, four months and nine days.

"This, however, does not represent the entire period during which the patients remained in the hospital, as the healing of the later inoculations required time, and was, in some of the cases, much protracted. Their stay in hospital averaged in the non-mercurial cases, five months and fifteen days; in the mercurial cases, five months and nineteen days; and in the whole number, five months and sixteen days. The period is calculated from the date at which the inoculations were commenced.

"The average duration of the sores produced by inoculation was about three weeks. The size of the ulcers varied in different individuals; their average diameter may be stated at about half an inch. They were as a rule smaller and, in every respect, milder when made on the trunk of the body than when made on the upper extremities; milder again on the upper extremities than on the lower. There was a general tendency towards diminution in size, and the sores progressed more rapidly as the treatment was proceeded with, till at length it was extremely difficult, and often impossible, to obtain any result from inoculation. When the susceptibility of one region of the body was exhausted (the trunk, for example), the inoculations would take freely on the arms, and when the arms had been subjected to a like process with a like result, they would still take freely on the thighs, till a period was reached when it was next to impossible to obtain pustules at all on any part of the body, or, if obtainable, they were small and abortive, and the matter from them was not reinoculable.

"The healing of the sores was in several of the cases delayed considerably beyond the average period mentioned, and this was observed to be the case more frequently on the lower extremities than elsewhere. The sores did not exhibit any great tendency to spread, the larger ones rarely exceeding the size of a shilling. Occasionally, however, where the punctures had been made too close together, larger sores were produced by two or more becoming confluent.

"It is a very remarkable circumstance that in no case was there any perceptible affection of the neighbouring lymphatic glands resulting from the inoculations.

"The pain occasioned by the inoculated sores

was in some cases severe, in others it appeared to be trifling. It was in almost every instance cheerfully submitted to. It was found to admit of alleviation to a great extent by careful dressing, so as to protect the sores from irritation and friction; simple ointment was applied for this purpose.

"The inoculations did not appear in any case to exercise a prejudicial influence on the health of the patients. On the contrary, most of them improved in appearance, and seemed to gain strength while the inoculations were going on. This, however, may have been partly owing to enforced regularity in diet and habits, and to improved hygienic influences. The pustules and their resulting ulcers were better developed in those patients who were in robust health than in those who were weakly and out of health. The number of inoculations required, before the process was completed, varied greatly. The smallest number of pustules in any case was sixty-six (Case 14), the largest number was 296 (Case 5).

"The patients are, of course, permanently marked by the cicatrices. The appearance of these is very similar to those occasioned by vaccination.

"We will now refer to the results obtained. First—in those cases which were uncomplicated by any previous mercurial treatment, twenty-two in number.

"In sixteen of these the treatment was persevered with until an immunity, more or less complete, had been arrived at, and by the time this was effected the syphilitic manifestations had disappeared. In these cases, therefore, the process may be considered to have been carried to its legitimate termination. This result was obtained—

"In 1 case in . . .	1 month 15 days
1 " . . .	2 " 3 "
7 cases in from . . .	3 to 4 months
4 " . . .	4 to 5 "
2 " . . .	5 to 6 "
1 " . . .	7 to 8 "

"Of these sixteen cases, six (Cases 1, 3, 6, 10, 17, 18) have not been heard of since their discharge from the hospital, but ten have remained under observation up to the present time (April 1867), or to within a very recent date. Of these ten, eight (Cases 2, 5, 7, 8, 13, 14, 15, 16) have been inmates of the Lock Asylum; all of them have remained in perfect health and have had no recurrence of their disease. Of the remaining two, one (Case 11) returned to the hospital with a slight relapse, in the form of mucous tubercles on the genitals, which, however, soon disappeared under simple local treatment; the other (Case 9) has recently applied with swelling and superficial ulceration of the labium, but, as these rapidly subsided, and she presented no other syphilitic symptoms, we are disposed to think it was not connected with her former disease.

"In the remaining six cases the treatment was not persevered with to the end. Four of them, viz. the three males (Cases 20, 21, 22) and one of the females (Case 19), left the hospital by their own desire before it was properly completed. Of these four, we have subsequent information respecting one only (Case 22), who, after having been inoculated for four months, returned with a relapse of his cutaneous eruption soon after the practice was discontinued.



"In the two other cases, females, the treatment was given up before there was evidence of immunity, in consequence of sloughing having recurred in the cicatrices of former sores. One of these patients (Case 12) died from phagedena. The sloughing, however, did not originate in, nor was it propagated to, any of the inoculated sores; it was confined to the labium, groin, and abdomen.

"The other (Case 4) suffered in a similar way and to an alarming extent, but gradually recovered. In her, also, the sloughing was confined almost entirely to the genital organs, though one of the neighbouring inoculations was affected to a limited extent. This patient has recently presented herself at the hospital; she is now in sound health, and in a situation as laundry-maid. She has had no return of her venereal symptoms.

"It would not be fair, in our opinion, to attribute the untoward result of these two cases to the inoculation treatment. Both had been originally admitted with sloughing sores, after recovering from which syphilisation was adopted for their secondary disease. Nothing unfavourable occurred in one for three months, in the other for five months; but when immunity was nearly reached, sloughing commenced in the cicatrices of the old sores, and not in the inoculations. It would probably never have occurred but for the presence of several cases of phagedena in the wards at that particular time.

"Next—as to the result of the treatment in those cases comprising Class 2, in whom mercury had been previously given; they were five in number.

"Three of them (Cases 23, 24, 25) went through the process to its conclusion, in periods respectively of four months, five months, and five and a half months, and when discharged from the hospital were apparently free from disease. Of these three one (Case 24) has not since been heard of, the other two have returned with relapses. These were, however, mild in character; one of the patients speedily recovered under bichloride of mercury, the other got well without any specific treatment.

"The remaining two patients died. One (Case 26) from disease of the liver, supposed during life to be malignant, but found after death to be amyloid degeneration. She was inoculated persistently for more than three months with every kind of matter procurable, but with almost uniformly negative results. The cause of death in her case was therefore obviously quite unconnected with the treatment by inoculation. The other (Case 27) died from sloughing of the dura mater and exposure of the brain after the separation of a piece of necrosed bone, at a time when sloughing sores were prevalent in the wards. In our opinion the cause of her death also was in no way attributable to the inoculation treatment.

"The results obtained in these five cases, then, were very unsatisfactory, but they corroborate Dr. Boeck's experience that the previous administration of mercury interferes not only with the progress of the inoculations, but with their therapeutical action. Out of three who went through it to the end, as many as two were known to have suffered from return of the disease. In the fourth, the inoculations, having been almost uniformly negative, must be held to have gone for nothing one way or the other. In the fifth, it is by no means clear that the improvement which was at one time observed was due to the inoculations, rather than to the good

diet and to the iodide of potassium, which she was taking at the same time.

"With regard to the disappearance of the syphilitic symptoms while the treatment was going on, it was remarkable that in nearly all the cases no improvement took place for a considerable time—usually not until the second or third month—while in many of them the symptoms appeared to be aggravated, and fresh outbreaks of eruption were observed. Three patients were attacked with iritis (Cases 6, 15, and 18). In the two first the inflammation subsided under simple treatment with atropine and sedatives, and no injury to the eyes resulted. In the third the inflammation was more severe, and it was not considered safe to refrain from the use of mercury. This drug was accordingly administered in the usual way, and under its influence the iritis rapidly disappeared.

"As an auxiliary to the treatment by syphilisation, nitrate of silver was frequently used to the mucous tubercles on the genital organs, and to the similar patches on the mouth or tonsils, as without local treatment the inoculations appeared to exercise only a slight and tardy effect upon them.

"Having thus given a brief history of the cases treated, and a summary of the results obtained, the principal questions requiring an answer respecting syphilisation appear to us to be—

"Whether the process exercises any material or appreciable influence over the evolution and progress of the disease; or whether the favourable results may not more reasonably be attributed to lapse of time, the regular habits and regime of hospital life, and the natural tendency towards recovery which the disease exhibits in persons otherwise healthy?

"Whether—if it be admitted that syphilisation has a beneficial influence—that influence is of a specific character, such as Dr. Boeck has claimed for it; or may it rather be ascribed as it has been by others, solely to the depurative and excretory action of the ulcers?

"We do not pretend, from the limited number of cases which have been under our observation, to speak with authority on these difficult and important questions. Our object in this paper is rather to record facts than to express opinions; but we would, nevertheless, with much deference, submit to the Society the following conclusions as those at which we have ourselves arrived.

"We will commence by saying that we are disposed to reject the hypothesis that the results are, in any appreciable degree, owing to a depurative or excretory action of the pustules, analogous to what would be obtained by an equal amount of suppurative action artificially induced in any other way. Without denying that a discharge of pus from the cutaneous surface may have some effect in the elimination of a poison from the system, we think, if this explanation were correct, an amelioration in the symptoms would have been noticed at an earlier period of the treatment (as is the case, for instance, when mercury or iodide of potassium are given), whereas the rule has certainly been either that the syphilitic manifestations remained stationary for a considerable time, or that they exhibited decided aggravations. And the depurative hypothesis is further disproved by what is observed in the ulcerations which so often accompany the chronic and tertiary forms of the disease; the

suppuration from which has certainly anything but a curative action.

"There remains then the question—has syphilisation any specific effect over the disease, or is it devoid of all appreciable influence whatever? It will be obvious how great is the difficulty of eliminating the element of time and the natural tendency towards recovery in the consideration of such a question; it will not therefore be thought surprising if our conclusions regarding it are not precisely in accord.

"It is the impression of one of us (Mr. James Lane), from the observation of these cases, that syphilisation does exert some beneficial and specific influence over the progress of the disease, possibly in the way ascribed to it by Dr. Boeck. It has appeared to him that the treatment conducts patients through the disease more safely and rapidly than if they are left to themselves; that it leaves them with less liability to relapse, and that their relapses when they do occur are milder in character.

"Mr. Gascoyen, on the other hand, thinks that the natural tendency to recovery which an early and uncomplicated constitutional syphilis exhibits with the lapse of time, and under circumstances favourable to the general health—such as the dietary, rest, regular hours, &c., of a hospital afford—is sufficient to account for the subsidence of the secondary symptoms during syphilisation; and he is doubtful whether relapses are less frequent under this than under the ordinary methods of treatment. Neither does he admit any specific or other influence on the disease or the system from the continued inoculation of the virus. Were such the case, these fresh introductions of virulent matter would, in his opinion, either add to and intensify the existing disease, or else contaminate the blood until a general cachexia is produced, neither of which conditions is met with in practice, but the contrary. He, therefore, considers that no effect whatever is produced either upon the disease or the system by syphilisation.

"Differing, however, as we do, on the scientific aspect of the question, we are entirely in accord as to its practical bearings, and we are decidedly of opinion that syphilisation is not a treatment which can be recommended for adoption. We consider that, even if it could be admitted to possess all the advantages claimed for it by its advocates, its superiority over other modes of treatment, or in many instances over no treatment at all, would not sufficiently compensate for its tediousness, its painfulness, and the life-long marking which it entails upon the patient.

"If syphilisation could be relied upon, after other treatment had failed, to control the severer forms of the disease (especially in its tertiary stage), or to prevent its hereditary transmission, the benefit derived would, without doubt, more than counterbalance these disadvantages, but unfortunately these are precisely the cases in which it has admittedly the least influence.

"We will now refer to some points in the pathology of the disease which are illustrated by these experiments.

"The matter employed for inoculation in these cases was obtained sometimes from hard, sometimes from soft sores. Whenever it was practicable, matter from hard sores was used. Dr. Boeck prefers this kind of matter for the purpose

of syphilisation, having found it more rapid and effectual in its curative action, and less locally irritating; nevertheless, he does not believe there is any essential difference in the operation of the two kinds of matter.

"There has been a marked difference in the inoculability of the secretion from these two varieties of venereal ulcers. When matter from soft sores was used, pustules were readily obtained in the great majority of cases, *but not in all*. When matter from hard sores was employed, the same result was obtained, but with considerable difficulty, and the failures were more frequent. The difference in the inoculability of the two kinds of sores would appear to depend in a great measure on the different character of their secretion; that from the soft sore consisting of well-developed pus, whilst that from the hard sore is scanty and serous, and often altogether destitute of pus-globules. This difference was, we believe, first pointed out by Mr. Henry Lee (*British and Foreign Medico-Chirurgical Review*, October 1856, and April 1859), who also showed that if the hard sore were artificially irritated and made to secrete pus, it then became inoculable without much difficulty. This is in accordance with the experience of Dr. Boeck, who has observed that in proportion as the secretion is thin and serous, so will be the probability of failure. He therefore recommends that a piece of dry lint should be left in contact with the sore for twenty-four hours, at the end of which time there will commonly be found a thick purulent secretion; or this result may be more readily obtained by the artificial irritation of the sore with a stimulant, such as savine powder or savine ointment. From the matter thus formed a positive result can usually be produced by inoculation. In cases of failure he inoculates daily, and in this way rarely fails of success.

"The view that properly developed pus is necessary for the successful inoculation of syphilis (at all events, on a syphilitic patient) is supported, *conversely*, by the experiment of Rollet, who found that if the secretion from a soft sore were deprived of its pus-globules by filtration, the remaining liquor puris was not inoculable.

"Among the cases we have related will be found five examples of successful inoculation, made direct from typical indurated sores, carefully selected for the purpose, and as the possibility of inoculating a syphilitic patient from sores of this description has been denied of late years by many eminent authorities, we would direct special attention to these cases, as tending to elucidate a much controverted question.

"The first example was in Case 22, the male patient treated by Mr. Walter Coulson. This man had an indurated chancre on the prepuce and a secondary eruption. He was inoculated successfully from his own sore by Mr. Coulson, but it was not till after a daily inoculation for nearly three weeks that a positive result was obtained. From this a series of seven generations was produced, and the matter was used in the inoculation of several other patients.

"The next instance was in a female (Case 9), who was successfully inoculated from the primary sore of the above male patient, after it had been irritated for two days with savine ointment. Six punctures were made, and all six were followed by a positive result. The pustules were well de-



veloped, and were carried through a series of eleven generations.

"A third example of direct inoculation from an indurated sore occurred two months afterwards in the same female. The matter was taken from a carefully selected indurated sore in a male out-patient. The sore having been irritated for two days with Unguentum Sabinæ, three punctures were made, two of which failed, but one produced a well-developed pustule, which was inoculated through nine generations.

"A fourth will be met with in Case 7. The matter was taken from a well-marked indurated sore in a female out-patient, who afterwards had a secondary eruption. Six inoculations were made, and all were successful. They were carried through ten generations. The sore, which was quite recent, was also inoculated successfully on the patient herself.

"A fifth will be found in Case 16, who was inoculated from a female patient with a well-marked indurated sore on the labium. In this case six punctures were made, but only one proved successful. It was reinoculable through twelve generations. This would furnish a sixth instance of successful inoculation from an indurated sore. A seventh example, which occurred at the Lock Hospital in February 1866, may also be mentioned. The patient was a male, under Mr. W. Coulson, who succeeded, after four consecutive days' inoculations, in obtaining well-marked and reinoculable pustules. Both these are examples of auto-inoculation, and another is seen in Case 22.

"It appears, then, that there is greater difficulty in arriving at a positive result by inoculation with matter taken direct from a hard sore than with matter from a soft sore, but when pustules are obtained, they are as freely reinoculable in the one case as in the other. They may be carried with equal facility through a lengthened series on the same patient, and transferred with equal readiness to others. In all these cases of inoculation from indurated sores the pustules have been well developed, and have produced ulcers varying in size from a fourpenny piece to a shilling, but there has been nothing in their appearance to distinguish them from those made from non-indurated sores. There has been no more appearance of induration in the one than in the other; no noticeable difference in the duration of the ulcers (which averaged from three to four weeks), or in the appearance of the resulting cicatrices.

"The instances we have mentioned afford, in our opinion, convincing proof that the hard sore may be inoculated on the bearer, or on another syphilitic patient. It appears to us impossible to explain them away, either by the theory of the mixed chancre, or by the supposition that they are all owing to an accidental contamination of the lancet with matter from soft sores.

"But if the inoculability of the hard sore has been denied on insufficient grounds, these experiments go far to show that the inoculability of the soft sore has been much exaggerated.

"It has been taught of late years that the distinctive character of the soft sore is its constant communicability by inoculation to all persons alike, and at all times. and whether they are the subjects of syphilis or not. This, according to our observation, is certainly not the case; it would appear that, sometimes from no obvious cause, but

more often when there is great depression of the vital powers, the difficulty of obtaining a positive result by inoculating syphilitic matter is great, whether it be taken from hard or soft sores.

"In one patient (Case 27) with severe tertiary syphilis, only an occasional, and then a very imperfect, result was obtained for more than six weeks, though she was inoculated almost daily; but at length, as her health improved under the iodide of potassium and a liberal diet, pustules began to be developed. It was remarkable, also, in this case, that when the inoculations became successful, some of the earlier punctures, which had been apparently failures, came forward and produced pustules.

"Another patient (Case 26) who was in a very depressed condition, and who ultimately died from disease of the liver, was inoculated over and over again with every variety of matter without effect. She was inoculated on forty-one different occasions, and in three or four only was anything approaching to a positive result obtained, and the pustules were then small and abortive.

"In another female (Case 12), also in a very low condition, the inoculations at first failed, but succeeded afterwards and took freely, as her health improved.

"In a fourth instance (Case 13) there was a very remarkable temporary immunity during an attack of jaundice which lasted for about a month. In this patient, while she was jaundiced, no inoculations could be made to take, although they had done so freely before the affection commenced, and took again, with equal freedom, as soon as the jaundice got well.

"In some other cases (5, 11, 14) there were also frequent failures, although the patients were apparently in sound health. It appears to us, therefore, from these numerous examples, that there are conditions, both natural and acquired, under which a person is exempt, temporarily at any rate, from the action of the virus, even when obtained from a soft sore; and that some persons possess this immunity or power of resisting the effect of the poison much more than others.

"In two cases (17 and 18) a circumstance was observed which is worthy of attention. When these two patients had been inoculated for more than four months, and when they had arrived at such a degree of immunity that it was impossible to obtain satisfactory pustules with the matter at our disposal, they were inoculated by the house-surgeon with matter from a spreading phagedenic sore, four punctures being made in each patient. In both cases sloughing sores were produced at each puncture. In Case 17 they coalesced, and spread to an alarming extent. In Case 18 they were less severe, though each puncture produced a sloughing sore of an inch and a half in diameter. These inoculations did not, even in their early stage, present the ordinary aspect of a syphilitic inoculation, but rapidly gave evidence of a spreading phagedenic action. It would seem, therefore, from these cases, that phagedæna may be communicated as such, directly, by inoculation, and this even in cases where there is an evident indisposition to inoculation with ordinary syphilitic matter.

"The immunity from the action of the syphilitic virus obtained by repeated inoculation is another point of great interest. It appears to be beyond question that such matter cannot be inoculated

successfully *ad infinitum*, but that the susceptibility to its influence becomes gradually exhausted. At the commencement of the treatment the inoculations could, as a rule, be continued through a series of twelve or fifteen generations, without requiring the matter to be renewed, while the subsequent series became gradually shorter, until at length the result was altogether negative, or only small pustules were obtained, which could not again be inoculated. In many cases this immunity was tested repeatedly with matter from different sources. In some patients the immunity was less perfect, and with fresh matter two or three generations of pustules could be obtained, but these were small and imperfect, and rapidly healed, so that for all practical purposes the treatment came to an end. The longest series obtained in any case was thirty-eight (Case 5), and there were some between twenty and thirty. There were several exceptions to the rule that the first series was the longest, and the longest of all (thirty-eight) occurred towards the conclusion of the case.

"In testing the degree of immunity, it should be remembered that the development of a small pustule, after the inoculation of new matter, is not sufficient evidence against the presence of this condition, as any irritant introduced beneath the skin may have the same effect. The only true test of a genuine syphilitic inoculation is, that it shall produce matter which is again inoculable.

"It is also interesting to observe, that whether the matter employed was obtained from hard or from soft sores, the same degree of immunity was the result; and that the inoculation of matter from a hard sore would, in due course, cause insusceptibility to the action of that from a soft sore, and *vice versa*; and also when the patient had been treated partly with one matter and partly with the other, the immunity was equal against both."

[We will conclude by transcribing the greater part of the valuable Report of the Committee appointed by the Secretary of State for War and the Board of Admiralty to inquire into the *Pathology and Treatment of the Venereal Disease*, published in 1867. This Committee consisted of Mr. Skey (chairman), Mr. Cock, the late Dr. Kirkes (succeeded by Dr. Babington, also deceased), Mr. Quain, Mr. Spencer Smith (secretary), Dr. Wilks, Dr. T. Graham Balfour (appointed to represent the Army Medical Board), and Dr. Donnet (to represent the Naval Medical Board). The Committee examined upwards of sixty physicians and surgeons whose position and facilities of observation rendered their opinions desirable in reference to the pathology and treatment of the venereal disease. As many as 7,074 questions were put and answered during the investigation of the subject by the Committee. The report embodies the inferences drawn by the Committee from the collective opinions and ample information elicited from the various gentlemen who appeared as witnesses before them.

It will be seen by the preceding pages that we agree for the most part with the opinions expressed in the Report. In a few points, however, we have ventured to differ from both the pathology and treatment therein advocated.

"The *Syphilitic Sore* is seen under three forms: one characterised by induration throughout its entire course; one soft in its early stage and be-

coming subsequently indurated; and one soft throughout its whole course, but which, unlike the simple local sore, is followed by constitutional disease.

"This physical character of hardness in a sore is, as a rule, detectable by the touch, although it may vary in degree. It is, however, necessary to distinguish the occasional thickening formed around the base of a soft sore, the result of local treatment or accident, from the true induration of specific disease.

"The *Hard Sore* is marked by well-defined induration at its base. This induration, present *ab initio*, constitutes its characteristic feature. True syphilitic induration presents itself in three different forms: 1st, in that of a cup-shaped cavity or ulcer on an indurated base; 2nd, in that of a shallow abrasion or excoriation, commonly of an ash-grey or livid colour, also on an indurated base; and, 3rd, in that of a deposit of well-defined induration beneath unbroken skin. From the two former a serous ichor exudes; from the last there is no moisture, because there is no ulceration.

"The sore marked by specific induration, *ab initio*, is rarely met with; probably not in a greater proportion to other primary sores than one in fifteen, or more; but the proportion varies greatly at different times and in different localities.

"It is not frequently brought under the eye of the surgeon within fifteen or eighteen days, dating from the period of intercourse (*vide* 'Incubation,' Sect. 8). Often twenty-five days have elapsed before its appearance. It presents itself in one of the three forms already described. It may occupy the inner surface of the prepuce, the fossa, the glans, or the external integument. When seated on the glans it is supposed that the induration is imperfectly developed. This is only occasionally true: on the contrary, when the glans is the seat of the disease, the induration is often more than usually extensive.

"In persons affected with this form of sore, the constitution may become involved before the primary disease enters on the stage of ulceration, or even without ulceration occurring at all.

"Throughout its course the hard sore may be said to be almost dry, and neither the primary sore itself nor the glands produce pus, the secretion of which attends every other variety of venereal sore.

"The *Soft Sore*.—While the hard sore, as a rule, commences with induration, to which the destruction of surface succeeds, it is probable that soft sores commence as pustules or papules, which pass into ulceration.

"Some observers have stated that a sore marked by protracted ulceration is more liable to involve the constitution than a sore that has passed quickly through its stages.

"*Inguinal Glands*.—All primary venereal sores are liable to involve the inguinal glands; the soft frequently, the hard almost invariably. In the case of soft sores which involve the inguinal glands, such irritation occurs at a more or less remote date from the first appearance of the primary sore; in the case of the hard sores, the enlargement of these glands is almost concurrent with or quickly follows the first indication of hardness. In the case of soft sores, the inguinal glands appear to involve in their morbid action the surrounding tissues prior to suppuration, in addition to the glandular struc-



ture. In the case of hard sores, one or more glands are enlarged, and share the hardness of the accompanying sore, presenting to the touch well-defined globular-shaped tumours, which are not prone to suppuration.

*"Difficulty of Diagnosis in the early stages of Sores."*—The evidence is conclusive as to the impossibility of pronouncing with certainty upon the character of a sore on its first appearance, i.e. as to whether it will or will not be followed by constitutional symptoms; in other words, whether or not it be a syphilitic sore. Even though it remain soft throughout its course, it is not certain, although highly probable, that it will prove to be non-infecting, but it will sometimes remain soft for many days, and then, becoming indurated, be followed by constitutional symptoms. As a rule, however, the exceptions to which are rare, a soft sore, whether followed by suppurating bubo or not, is only a local disease, and does not infect the constitution; and an indurated sore, more especially if accompanied by indurated inguinal glands, does infect the constitution. It should never be forgotten that it is the virus which infects the system, and that the sore is a mere local lesion, and not a necessary antecedent to infection.

"However definite may be the laws that determine the history and progress of primary sores, a degree of obscurity always attaches to their future influence on the constitution, arising from the frequent apparent deviations from the laws which govern them. Certain it is that no amount of experience can protect us from occasional error in diagnosis. Hard sores do not necessarily contaminate the constitution, while, on the other hand, constitutional symptoms occasionally follow the presence of a sore which might have been regarded as a simple local sore by a practised observer. Too much caution, therefore, cannot be exercised in giving an opinion as to the future safety of the patient.

*"Constitutional Syphilis."*—The constitutional manifestations of syphilis follow the primary sore at an uncertain interval of time, ranging from four to ten weeks, the average term being about six weeks. Its first indication consists in a sense of chilliness, followed by heat of skin, accelerated pulse, general lassitude, and mental depression. These symptoms are accompanied by pains in the limbs, and especially in the joints, often of a severe rheumatic character. In the course of two days or more, the skin upon the chest, back, abdomen, and arms, occasionally in severe cases over the whole surface of the body, exhibits on examination some form of eruption, most commonly of an erythematous or roseolar character, of a pale pink colour. Such eruption terminates in copper-coloured patches.

"If the disease be severe, well-developed papules, vesicles, and pustules may appear over the back and head, intermingled with or following the rash. The pulse continues frequent. The throat exhibits a florid discoloration which involves the tonsils and the neighbouring parts of the soft palate. Of the condition of the throat the subject may remain for a time unconscious. This stage of the disease, which continues for some days stationary, may be preceded, accompanied, or succeeded by enlargement of the inguinal and posterior cervical glands. The latter, however, are not always affected. These indications are accompanied by impaired

health, and by loss of physical strength. A sense of general debility prevails, coupled with pallor of the skin, the blood being said to be deprived of a portion of its red corpuscles. The tonsils ulcerate and exhibit either an excavated ulcer, or a plain flat surface, of a soft red flabby aspect. The hair falls off (*alopecia*). On the side of the tongue at a yet later date, and generally on its under surface, are formed small white ulcers, three or four in number, of about the size of a split pea, which, on healing, leave a white and somewhat depressed cicatrix, while others appear on the soft palate and roof of the mouth, on the gums, or at the angle formed by the two jaws. Condylomata, soft mucous-like ulcerations of the angles of the mouth, nostrils, nates, and female genital organs, iritis, with its complications, and onychia, frequently occur. Such are the various symptoms that mark the progress of syphilis in the majority of cases, and which may be said to belong to the acute form of the disease.

"There is, however, another group of symptoms not preceded by febrile derangement, and more chronic in character. To this belong psoriasis, lepra, and tubercular eruptions, honeycomber ulcer of the palms of the hands, the excavated ulcer of the tonsils, and enlargement of the testicle. All these affections are in a remarkable degree almost destitute of pain.

"Although the evidence tends to the belief in the occasional development of any of these forms of eruption and other disease, in a given case, the Committee have sufficient ground for expressing their opinion that the dry and painless forms of eruption, viz. psoriasis, lepra, and tubercle, but especially the two former varieties, constitute the predominant symptoms following the indurated sore, and that the remainder more commonly follow the varieties of the soft or moist sore.

"There is a relation between the primary sore which is destitute of hardness in its early stage, and the moist forms of eruption as declared by Mr. Carmichael; but his views of the universality of the law which identifies the moist eruptions, such as pustules and rupia, with the soft sore, and the dry eruption of psoriasis and lepra with the indurated sore, are not borne out by the evidence produced before the Committee.

*"Syphilis in its ultimate form."*—While regarding syphilis as a constitutional disease, it must be remembered that it does not affect all persons alike, but attacks its victims with various degrees of virulence. In an ordinary case, or in one of medium severity, the disease will cease after the expiration of some months, when a certain set of phenomena have occurred. It does not, however, unfrequently happen that the syphilitic poison survives this period, and continues to exhibit its characteristic effects on other and deeper-seated tissues for an indefinite time. As the first mentioned form of the disease and its accompanying phenomena are styled secondary, so these later and ulterior effects are often named tertiary. These terms, however, are not scientifically correct, since the changes produced in the tissues are essentially of the same kind as are observed at the earlier stages of the disease, but differing only in their long continuance, and their spreading over a larger surface.

"The changes which occur in the inveterate forms of the more advanced stages of syphilis are

due to the deposition of a fibro-plastic material in the various tissues of the body. This product appears to be identical with that which in the so-called "secondary" stage is exuded in the bones, in the glands, on the iris, and indeed in the indurated chancre itself; but is now liable to be poured out in any structure where areolar tissue exists. There is not an organ of the body, therefore, which is not obnoxious to the influence of syphilitic disease.

"By the formation of distinct deposits, or by interstitial exudation, the different viscera may be so affected as to involve the life of the individual. The liver is more frequently the seat of the disease, and then affords, by the indelible cicatrices on its surface, an evidence of the nature of the malady from which the person may long have suffered. The brain and its membranes are also liable to be attacked by constitutional syphilis; giving rise to mania, epilepsy, paralysis, and many other serious and fatal diseases. The lungs too are frequently affected, although the cause is probably much overlooked, as the form of consumption, which is known so often to follow in the train of syphilis, has been regarded merely as tubercular, and a result of the debilitating effects of syphilitic disease.

"It is, therefore, highly important to recognise the immediate or direct effects of syphilis in the viscera, as a knowledge of their cause suggests the appropriate treatment.

"In addition to these characteristic and peculiar effects of syphilis, there is a tendency in those who have long been its victims to suffer from degeneration of the tissues of the body; and thus a very frequent cause of the mortality in long-standing syphilis is a universal fatty or lardaceous decay of the organs.

"A few words must be said on *hereditary syphilis*. A large number of cases of abortion and of still-births arise from the children being affected with the syphilitic taint; and even if the infant be born alive and apparently well, the existence of the taint may become manifest in a few weeks by the appearance of the characteristic rashes of lichen or roseola, accompanied by snuffles, ulceration of the mouth, condylomata, &c., and sometimes inflammation of the eye. At the end of about a twelvemonth these symptoms may disappear; it was, until quite recently, supposed that all traces of hereditary syphilis had then departed, but this is by no means invariably the case; the poison may be latent, and again exhibit its virulence during growing youth. Thus, children who have been the subjects of hereditary syphilis in infancy may not only exhibit the previous effects of disease, but may suffer from fresh outbreaks, in an active form, such as an acute ulceration of the throat and fresh formed nodes on the bones. The most remarkable affection which may occur at this period appears peculiar to the hereditary form of the disease—a cloudiness of both corneæ, due to an infiltration of lymph, which is technically known as *interstitial keratitis*. At the same time that these recent effects of the poisonous principle are seen, the changes that occur in infancy at once characterise the nature of the disease; thus, very often the whole body is puny, the forehead projects, the nose is flattened, the skin around the mouth is often puckered from old ulcerations, and lastly, and most important, a peculiar change takes place

in the teeth, the incisors being dwarfed in size, narrowed, rounded and notched.

"*Question of Incubation.*—The questions whether there be any fixed and definite period between the exposure to contagion and the appearance of the sore, and if so, whether that period be different in the case of the soft sore and that of the hard, have given rise to much difference of opinion. Upon the whole, the weight of evidence greatly preponderates in favour of the view that there is no definite period of incubation, either for the infecting or the non-infecting sore—assuming the term incubation to imply such a uniformity as exists in the period of incubation of other specific diseases, as measles, small-pox, &c. It is, nevertheless, a fact, that the soft sore which goes on to suppuration, does make its appearance at an earlier date than the hard sore, which does not suppurate, the average period in the former case being three or four, and in the latter twelve or fourteen days; but there is a great deviation from this average in individual cases. One witness, for example, spoke of fifty-six days, Q. 194; another, of three months, Q. 3304; another, of seven weeks, Q. 5339. Some witnesses have recognised no difference as to the period of their appearance after impure contact, but they are not borne out by general experience. It must not be forgotten, however, that, as a hard sore is characterised throughout its stages by the absence of pain or tenderness, it may have been in existence some days without exciting attention, and more especially when occurring in men among the lower class of society, where neither sensibility nor cleanliness abound. It is probable, if the progress of a sore could be watched from its commencement, and the first deviation from health of the surface affected be traced back, all sores would stand in closer proximity to their cause than they appear to do, and the generally adopted period of incubation be somewhat abridged. The statement of a patient with a well-developed hard sore, who dates its existence from a few days only prior to his visit, may reasonably be doubted, on the ground that being a painless disease his attention may not have been drawn to it. The soft sore, on the contrary, is painful, and cannot escape early observation. It is easier to detect a sore than a tubercle, or an excoriated induration.

"*Period at which the Constitution is involved.*—There is perhaps no question connected with the subject of syphilis more practically interesting than that which relates to the period at which the constitution becomes involved by the absorption of poison from a specific sore. The evidence obtained from the excision or destruction of a hard sore, even in its (so termed) early stage, is conclusive as to the early absorption of the poison into the circulation. It is in evidence that neither excision of the hard sore, nor its entire destruction by escharotics, can give immunity from constitutional disease. It is the opinion of a particular school, that the subject of a syphilitic sore is incapable of auto-inoculation, in other words, of receiving the poison of his own sore.

"*Inoculation.*—This doctrine, if sound, should strengthen the belief in the fact that the entire system is implicated, and even saturated, with the poison at an early period. But at what date or period is the constitution so involved? No positive answer can yet be given to this ques-



tion, because the really first stage rarely comes under cognisance. The experiment of excision of the induration on its first development is probably yet to be made; moreover, the disease in its first stage does not furnish secretion capable of testing the practicability of auto-inoculation. The information which the Committee have acquired upon the subject of inoculation is very unsatisfactory, and such as renders conclusive deductions therefrom impossible.

"It is possible that the poison of syphilis may be carried into the circulation from the moment of contact, in whatever manner that is effected; but it is more probable that time is required to this end.

"*Mode in which the poison is received into the system.*—Intimately connected with the foregoing subject is the question, How is the syphilitic virus introduced into the system by sexual intercourse? General opinion assigns it to the presence of a minute wound or lesion of the part through which the poison is admitted. This wound or lesion may be supposed to be either caused by the act of intercourse itself, or to have existed previously. There is another explanation of the phenomenon, viz., that the poison remains in contact with the folds, whether of the mucous membrane, or integument, and becomes soaked or infiltrated or absorbed through it. Mr. Hunter says,—'The irregular surface of the frenum, &c., allows the matter to lie undisturbed in chinks, by which means it has time to irritate and inflame the parts. But as this matter is easily rubbed off from prominent parts by everything that touches them, it is a reason why such parts so often escape this disease.' Hence the greater frequency of primary sores on the thinnest investing membrane. Hence multiple sores. Hence the duplication of sores by contiguity of opposing surfaces. Hence the occasional deposit of induration beneath unbroken integument. Nor can it be asserted that the primary lesion has ever with certainty been detected by the eye, excepting indeed in those cases of syphilitic contamination which occur to members of our profession from poisoned wounds of the hand. If this mode of the admission of syphilitic matter be deemed to be that which commonly prevails, it is still a most difficult question to determine how long such matter may remain in innocuous contact with the membrane beneath it. Until the precise time can be fixed which is required for the poison to come within the influence of the absorbent system of the body, by whatever process it gains entrance, whether by mechanical infiltration or by vital absorption, and the first indication of local disease on the affected surface can be detected, the question of incubation must be regarded as unanswered.

"The same apparent deviation from the laws that govern the constitutional manifestations of the syphilitic poison prevails as in the case of primary sores, and the exceptions to the ordinary phenomena of absorption, of exemption from recurrence of disease, of the period of incubation, of relapse, of liability or non-liability to contagion, are declared of frequent occurrence by all candid enquirers into the nature of syphilitic disease.

"*Unity or duality of virus.*—Among other questions of interest connected with the subjects of syphilis is that of the 'unity' or 'duality' of the poison. It has been stated under the head of the

'Varieties of Venereal Sores' (sect. 3) that they are divisible into two species. One of these, termed simple, is a purely local sore; the other involves the constitution. The terms 'unity' and 'duality' refer to the supposed identity, or otherwise, of the poison or virus producing them. In reference to this subject, the first question arises—can the poison which produces the 'local sore' be identical with that which produces the syphilitic sore? The term *syphilitic* cannot be applied to a sore which exhausts itself in its local actions, and does not become the parent or precursor of syphilitic disease. The local sore has nothing in common with the local products of syphilitic poison beyond its ulcerative action. It may be, and not unfrequently is, the morbid product of merely contagious secretions: while its characteristic form, progress, and duration, so dissimilar from the products of other forms of local disease or injury of the genital organs of a non-venereal origin, warrant its cause being attributed to the presence and operation of an irritant poison. Although comparatively innocuous at their source in the female, these secretions become a poison to the recipient, but not a syphilitic poison. Presuming the local sore, therefore, to belong to a different class of disease, if it be placed in juxtaposition with any of the varieties of the syphilitic sore, the Committee have no alternative but to express their belief in the non-identity of the two poisons. At the same time, the Committee are of opinion that all sores, whether hard or soft, affecting the constitution by the production of syphilitic disease, whatever eruptive form it may assume, are the products of the same character of poison.

"It is declared in evidence by twenty-nine experienced witnesses that sores, both soft and hard, may be followed by every variety of syphilitic eruption.

"In reference, therefore, to the question of 'unity' and 'duality' of the syphilitic poison, the Committee adopt the opinion of its unity and singleness. It is unphilosophical to resort to the assumption of the operation of two poisons in the same constitution at one and the same time, merely because a hard and a soft sore are found upon the same individual, or because a sore, half of which is seated upon the glans penis, and half upon the corona or prepuce, is soft in the one half and hard in the other. There is probably but *one* true syphilitic poison exerting its influence upon the soil in which it is implanted, producing various forms of true syphilitic sores, differing in different individuals, modified by health and by constitution, by locality, and probably by its ever-varying intensity.

"These views, though general, are not universal. Several of the witnesses stated their belief that all venereal sores may be produced by one poison only, and they refer the occasional absence of constitutional disease not to the absence of the syphilitic poison, but to the influence of collateral circumstances, viz., health, locality, and constitutional peculiarity.

"*One attack of Syphilis gives no future immunity.*—Of thirty-three witnesses who were asked for their experience as to whether one attack of true syphilis gives immunity to the individual from a repetition of the disease, twenty-three not only declared it to be their opinion that such was not the case, but several amongst them stated that they

had positively seen repeated attacks in the same person, which certainly were not relapses, whilst ten considered that an individual could be the subject of true syphilis only once.

*"Relapses ; period of safety for marriage."*—If it be granted that a relapse may occur after the adoption of any mode of treatment, and also when no treatment whatever has been employed, it follows that to no person who has been the subject of true syphilis can immunity from it be positively promised. Yet there may be, and there are degrees of probability with regard to future relapse, and the question therefore frequently arises as to the period at which a man may be warranted in marrying after all the symptoms of disease have disappeared. The answers to this question have been various ; a few witnesses even declared against the safety of marriage at any period ; a large majority concurred in recommending an interval of one year. The subject admits of division into safety as respects imparting the disease in its secondary stage to the other sex, directly through the medium of the secretions, and safety as respects imparting it indirectly, through the fœtus to the mother. Some witnesses do not admit the former liability, while the majority consider that secondary disease may be directly imparted through the medium of a moist secretion, as from a mucous tubercle, but all agree in the belief that a syphilitic father, though presenting no appearance of disease, may beget a syphilitic child, and that that child, through the medium of its blood, may impart the disease to its previously healthy mother.

*"Syphilis communicable in both stages."*—Evidence is conclusive to the effect that syphilis may be communicated by intercourse during either of its stages, local or constitutional.

*"Treatment of Primary Sores."*—The following remarks on the treatment of primary sores contain general views only, and may be the subject of occasional exception :—

*"The local and other varieties of Soft Sore."*—The simple or non-infecting sore (and indeed all sores unmarked by specific induration) should be treated almost entirely by local applications, having for their object to allay pain or inflammation, and protect the sore from injury. Treatment by mercury, as a rule, is not requisite, but exceptional cases occur in which minute or alternative doses tend to accelerate the cure. It is very doubtful whether mercury exercises any useful influence on the purely ulcerative action of primary sores. If resorted to at all as a curative agent, it should be administered only in the latter stages of the sore. There is no remarkable feature in the progress of the inguinal glands towards suppuration which demands comment. Their liability to suppurate, however, renders the destruction of the sore by escharotics desirable. Such treatment should only be resorted to in the earliest stage of the sore, and probably not later than two days from its first appearance. In other respects the most judicious treatment of all soft sores may be said to be negative and local ; the great rule of practice being to watch and observe ; nothing is lost by delay.

"A sore of a suspected character should be carefully watched, and the first indication of a palpable hardness noted, by the presence of which the probability of future constitutional disease is indicated. This occasional specific induration of the soft sore occurs usually at its final stage, or stage of cicatri-

sation, in which mercurial treatment is rarely adopted by men of experience. As the amount of induration is not usually great, and the sore is in process of cicatrisation, treatment by mercury should be reserved for the prospective constitutional disease, should it present itself hereafter : because the balance of evidence warrants the belief that at this stage of the disease mercurial action in the system cannot avert the occurrence of secondary or constitutional disease. Mercury will neither arrest the progress of glandular enlargement nor prevent suppuration. —(*Vide postea*, Treatment of Syphilis, Sect. 16.)

*"Treatment of the Indurated Sore by Mercury."*—In the treatment of the indurated sore, mercury is frequently resorted to, the object being to obtain the absorption of the indurated mass beneath it, in the belief that the induration constitutes the disease to be contended with.

"No treatment by mercury, whether moderately or freely administered for this purpose, can give exemption from the liability to constitutional disease. The service rendered by the mercury is, therefore, limited to its influence on the sore and the induration.

"The weight of evidence on this subject preponderates in favour of the advantage of mercurial treatment in postponing or modifying the severity of the constitutional disease. On the other hand, it is contended by a minority of authorities that mercurial treatment of the hard sore neither prolongs the interval of apparent health, nor modifies the severity of the future disease.

"The balance of these two opinions is rather favourable to treatment of the primary hard sore by mercury. The alternative to the employment of mercury consists in simple local treatment, the avoidance of local irritants, whether medical or mechanical, attention to cleanliness, and to the improvement of the general health.

"If treatment by mercury be selected, the agent should be administered more freely to a strong and vigorous person than to one of delicate habit ; and whatever the mode of exhibition, whether employed internally by the mouth, by inunction, or by means of vapour-baths, the first indication of its presence in the system should be accompanied by a reduction of the quantity employed, and the reduced dose maintained so long as an impression is made on the deposit, and the bodily health of the individual remains undisturbed. If administered in increased doses the constitution will suffer in proportion to their magnitude. There is no evidence more general and more conclusive than that which dictates the necessity for maintaining such controlling influence over the action of mercury. This principle should be persisted in until the induration is entirely removed by the absorbents.

"Unless marked by manifest induration *ab initio*, there is no warrant for the resort to mercurial treatment, in any form of primary sore, except as an alternative.

"It is both a salutary and a frequent practice, to support the health of persons under mercurial treatment, by the resort to such medicinal or dietetic agency as will promote strength, and antagonise the depressing influence of the mercury. Bark, iron, wine, good beer, are commonly resorted to, and especially is their protective influence required in the case of persons of impaired health, or of naturally weak constitutional powers.



*"Treatment of Primary Sores by Escharotics or by Excision.*—Treatment of primary sores, whether by excision or by escharotics, constitutes a prominent feature in the modern practice of surgery, and under favourable conditions may be resorted to with great advantage.

"The suppuration of the inguinal glands occasionally attending the local sore may be avoided provided the sore be destroyed in its first stage, while in its pustular form, or immediately subsequent to it. Probably the operation would be useless if undertaken after the third day. Whatever the escharotic agent selected, the destruction of the sore should be complete. As a rule, the treatment of sores by escharotics is preferable to that by excision. The operation by the knife is painful, and very uncertain in its consequences; and if ineffectually done, it leaves a large wound to assume the morbid actions of the disease, which has been only partially removed.

*"The Soft Sore.*—This principle regulates the treatment by escharotics of all soft sores, whether tending to infect the constitution or not. In the case of the soft infecting sore, it is obviously of great moment to destroy the local poison, and avert the train of constitutional symptoms which may possibly, nay, probably will follow. Should the destruction of this sore by caustic fail of its object, by reason of its imperfect application, or of the too advanced stage of the sore, it is not improbable that the consequences would be injurious, and that an earlier development of the poison in the system would result. The rule of practice, which limits the operation of destruction to the two or three days from the first development of the sore, must, therefore, be strictly adhered to. For the reasons before given, it is an operation which can rarely be resorted to with a prospect of success in the hospital class of patients.

*"The Hard Sore.*—The application of local agents for the purpose of destroying the hard sore is useless. The disease is generally detected by the presence of its induration, from the hour of the first development of which the constitution is probably involved, and no local application can arrest the progress of the disease, or render it less severe in its consequences. If the indurated mass be removed by the knife, a large wound is made, while the constitution is not necessarily protected from the occurrence of secondary disease.

*"Treatment of Syphilis (i.e., Constitutional disease).*—The opinion of the Committee is unanimous in favour of mercury as the most efficient agent yet known in the treatment of constitutional syphilis.

*"Mercury.*—Mercury cannot be deemed a specific in the ordinary acceptance of that term, and does not appear to exercise any direct influence on the poison of syphilis, but on the effects of the poison only.

"Opinions are divided as to its power, when administered in the primary affection, to postpone or to mitigate the severity of the symptoms of true syphilis; if mercury possessed the properties of an antidote to the poison of syphilis, it might with reason be employed at any stage before the constitutional symptoms appear. The non-resort to it during the interval between the healing of the sore and the appearance of constitutional symptoms proves that general opinion deems the action of mercury to be directed against the effects, and not against the poison. It is generally admitted that

treatment by the agency of mercury is not indispensable to recovery, and that in many cases the disease will die out spontaneously at a longer or shorter interval of time; and, again, it is a fact well worthy of remark, that syphilis, in both primary and constitutional forms, may make its appearance in an individual whilst under salivation by mercury.

"Still the advocates of mercurial treatment greatly preponderate amongst the witnesses, and, we believe, in the profession at large, and among them are included many who have tested the value of non-mercurial treatment, and who have returned to the use of the mineral after an impartial investigation into the relative value of each mode of treatment. (See *Observations on the Treatment of Syphilis*, by Thomas Rose, in *Medico-Chirurgical Transactions*, vol. viii., and Evidence, Q. 4105.)

"It is prominently in evidence, and is confirmed by the experience of the Committee, that treatment by mercury is rarely expedient in any form of constitutional disease (syphilis), accompanied by pustular and rupial eruptions, whether developed in the early stages of the disease, or reproduced at a later period. These forms of eruption are especially indicative of constitutional debility, and mercury, by its depressing influence on the health, tends to give force to the ulcerative action, and thus to neutralise the benefit resulting from tonic remedies. If there be any form of syphilis in which mercury is especially contra-indicated, they are the pustular and rupial forms of the disease.

*"Mode of testing the quantity of mercury required.*—There are two modes of gauging the quantity of mercury requisite in any given case: 1st, by its influence on the disease, and 2nd, by the evidence of its presence in the system. And it is well to retain this double test, because the presence of the mercury is not clearly indicated, either in the gums, in the breath, or in the increased frequency of the heart's action at the same interval in all persons. In some the fading eruption shows the presence of the remedy in the system before the gums are affected, in others after, and the period requisite for both also varies considerably in different constitutions, states of health, &c.

"When the gums and breath are thus affected, it may be inferred that the maximum quantity of mercury that can prove serviceable in the treatment has been reached, and as the indications of its presence in the system daily advance, while the dose administered is stationary, it is desirable to reduce the quantity, in order to render the indications stationary also, since a persistence in those early manifestations of its effects is all that is required.

*"Iodine.*—Another remedy extensively used in the treatment of constitutional symptoms is iodine in its various combinations. Iodide of potassium is, perhaps, the most efficient form for its administration. It is employed in doses of from 3 to 15 grains, and is often used in the dose of 10 or 12 grains with advantage. It is mostly combined with cinchona bark or sarsaparilla.

"Iodine in combination with mercury is frequently used, and testimony has been borne by many of the witnesses to the advantage arising from the combination.

*"Sarsaparilla.*—Modern experience does not confirm the confidence formerly placed in several supposed remedies of the vegetable kingdom employed in the treatment of syphilis. Among the

more prominent of these was sarsaparilla, which, notwithstanding the once almost boundless faith in its medicinal properties, does not at the present day command the confidence of the profession beyond its action as a mild, and occasionally a useful tonic. In this respect it possesses no especial virtues of its own, and is inferior to the various forms of bark. [In the opinion of the editor, sarsaparilla ranks next to iodide of potassium as a remedy in tertiary syphilis, and is of considerable efficacy.]

"*Muddur, &c.*—The same remark may be made of guaiacum, sassafras, and of the Indian root muddur, which at one time was largely employed by the natives of India as a supposed anti-syphilitic agent.

"Upon this important branch of their Instructions, the Committee are of opinion—

"1st. That until a more efficient remedy be discovered, the occasional employment of mercury cannot be dispensed with.

"2nd. That employed in moderation, and under judicious restrictions, it is to the large majority of constitutions harmless; and,

"3rd. That when employed in such larger quantities as will cause salivation, the excess is not only useless, but assumes the character of a poison.

"Their belief in the value of mercury as an anti-syphilitic agent is strengthened by observation of its remarkable influence in the hereditary syphilis of new-born children. The evidence of the witnesses testifies strongly to the value of mercurial treatment, by the adoption of which children in great numbers are annually restored to health. (See Evidence, Q. 4415 *et seq.*, 5583 *et seq.*, 5755 *et seq.*, 5817 *et seq.*, 5899 *et seq.*)

"*Treatment by Syphilisation.*—The opportunities hitherto afforded to the Committee for the investigation of the subject of syphilisation have been so limited that they have but few remarks to make upon it. It is in evidence that the practice of syphilisation has been adopted by some highly intelligent practitioners in Christiania, and is resorted to exclusively by one of the witnesses, in the treatment of syphilis in this country (*Vide* Q. 4642 *et seq.*) Although they have reason to believe it may prove serviceable in such chronic cases as have failed to yield to more ordinary treatment, they have no sufficient evidence of its curative properties to outweigh the obvious objections to its general employment; and even accepting the entire truth of the reports of its curative powers, the treatment is repugnant to the habits and feelings of the profession in this country, and, in the majority of cases, is slow of operation. The Committee acknowledge their obligations to Professor Boeck, of Christiania, who, earnest in the cause, not less of scientific medicine than of humanity, volunteered a lengthened residence in England for the express purpose of explaining his views, and initiating English surgeons into the practical detail of his mode of treatment. They desire to express their admiration of the active zeal and earnestness which Dr. Boeck devoted to this cause, and their regret that the opportunities of truly testing the value of this principle of treatment are so rare and so uncertain amongst the shifting population of a large metropolis; indeed, the Committee see no other means of attaining this object than through the active assistance of the medical officers of the army, who alone have the necessary opportunities

for a prolonged observation of the results of treatment.

"*Treatment of Infantile Syphilis without mercury.*—The remarkable success that has attended the treatment of infantile syphilis by the agency of mercury has been recorded in this Report. The Committee desire to call attention to the evidence given in reply to Questions 6246, *et seq.*, 6431 *et seq.*, and 6598 *et seq.*, on the subject of the non-mercurial treatment of syphilitic infants.

"The results of these experimental enquiries, so far as they have been carried, assuredly point to the conclusion that the syphilis of infants has no enemy to contend with more potent than a weak and anæmic state of the constitution, which disappears on the improvement of the general health. The disease for the most part, according to the evidence above referred to, attacks children ill-nourished and ill-tended, who consequently fail in vigour of circulation. These children are placed on a nourishing diet, and supplied with strengthening remedies, medical and dietetic, and the disease subsides; the cure is declared to be effected at a shorter date than that obtained through treatment by mercury.

"Such is the evidence before the Committee, founded, however, on a rather limited number of cases, but which, although numerically small, is sufficiently important to claim the attention of the profession, and to justify a renewed enquiry in a larger and more general field of observation.

"*Ptyalism.*—The fourth head of the Instructions given to the Committee refers to the best antidote to injurious mercurial action on the human system. The evidence shows that the use of mercury in the present day is so cautiously regulated as to render any reference to the subject in this Report almost unnecessary. The Committee, however, in respect to their instructions, suggest as remedies—the most abundant supply of fresh air, tonics combined with chlorate of potash, opium, and the moderate use of stimulants.

"*Phagedena.*—A Report on venereal disease would appear to demand some reference to an affection which is often associated with it, viz., phagedena. Although found in frequent alliance with venereal sores, the two diseases are distinct in their nature, and appear to have no necessary relation to each other. There is no evidence to show that a venereal sore becomes phagedenic because it is venereal. It is highly probable that any local sore on the genitals, occurring under circumstances favouring phagedenic action, would be equally liable with a venereal sore to become phagedenic. The two diseases become associated simply because the large majority of sores on the genital organs are of venereal origin.

"Phagedenic action is eminently destructive, whether it prevail in the form of rapid ulceration of the surface of a sore, or whether, in its more active form, it involve the tissues around in a process of rapid ulceration, or even of sloughing. The loss of living structure may be small or large, dependent on the greater or less activity of the phagedenic action that produces it. It extends with a rapidity far greater than that which characterises any form of venereal or non-venereal sore, and, under conditions most favourable to its extension, often rapidly destroys the whole glans, and the contiguous portion of the penis.

"Like venereal disease, phagedena may exist as



a local affection, or, where the local disease has been large and intractable, and the destruction of living tissue has been great, the constitution may become involved, and foul ulcers, of large size, characterised by a yet more destructive action than prevailed in the primary disease, may form on the surface of the body, on the head, face, trunk, and limbs, in large numbers. These ulcers extend with great rapidity until, reaching a certain magnitude, the active process of destruction appears to exhaust itself. The duration of this form of phagedena often extends over a period of eighteen months or two years, during which the ulcerative process ceases for a time, and is succeeded by that of imperfect granulation. But without any apparent cause these ulcers may again and again extend into wounds of formidable magnitude.

"In its active forms phagedena is eminently contagious, and is communicated from bed to bed in hospital wards, by means of sponges, dressings, &c., attacking any and every description of wound, or other solution of continuity.

"In the present state of knowledge respecting phagedena it is impossible to foretell whether or why any given sore should assume the phagedenic action, but it is known that every variety of sore may become the subject of it. Its presence betrays a defective condition of the health of those persons in whom it originates. Its ravages are most severe in crowded and ill-ventilated hospitals, and persons whose health has been undermined by the immoderate use of mercury are more especially liable to be affected by it.

"*Treatment of Phagedena.*—In nearly all forms of phagedena the morbid action will cease on the destruction of the affected part. The agent most generally resorted to is nitric acid, which, in the less active forms of the disease, may be reduced in strength by the addition of three, six, or eight proportions of water. In the severe and destructive examples, nothing short of the strong acid, or any other equally powerful escharotic will suffice to arrest it. The constitutional forms are extremely intractable. They defy the ingenuity of the surgeon, and set at nought every variety of remedy brought to bear on them. With a worn and debilitated frame, bark, iodine, mineral acids, wine and nutritious food, and the freshest accessible atmosphere are the principal remedies on which reliance must be placed."] "

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**VENESECTION (PHLEBOTOMY).** The mode of bleeding most frequently practised is that of opening a vein; and it may be done in the arm, ankle, jugular vein, frontal vein, veins under the tongue, on the back of the hand, &c. In whatever part, however, venesection is performed, it is always necessary to compress the vein, between the place where the puncture is made and the heart. Thus the return of blood through the vein is stopped, the vessel swells, becomes conspicuous, and, when opened, bleeds much more freely than would otherwise happen. Hence, according to the situation of the part of the body where the vein is to be opened, with regard to the heart, the bandage, or other means for making the necessary pressure, must be applied either above or below the puncture.

All the apparatus essential for blood-letting is a bandage or fillet, two or more small pieces of folded linen for compresses, a basin to receive the blood, and a little clean water and a towel. The bandage ought to be about a yard in length and about an inch broad, a common riband or garter being frequently employed. The compresses are made by doubling a bit of linen rag from one to two inches square. On the part of the surgeon, it is necessary to have a good lancet, of proper shape. He should never bleed with lancets with which he has been in the habit of opening any kind of abscesses, as very troublesome complaints have been the consequence of doing so. The shape of the instrument is also a matter of some importance. If its shoulders are too broad, it will not readily enter the vein, and when it does enter, it invariably makes a large opening, which is not always desirable. If the lancet be too spear-pointed, an incautious operator would often run the risk of transfixing the vein, and wounding the artery beneath it. More, however, certainly depends on the mode of introducing the lancet than on its shape.

In blood-letting, the patient may lie down, sit down, or stand up, each of which positions may be chosen according to circumstances. If the patient be likely to faint from the loss of a small quantity of blood, and such fainting can answer no surgical purpose, it is best to bleed him in the recumbent posture. But when the person is strong and vigorous, there is little occasion for this precaution, and a sitting posture is to be preferred, as the most convenient both for the surgeon and patient.



This, indeed, is the common position. In some cases, however, particularly those of strangulated hernia, it is frequently an object to produce fainting, in order that the bowels may be more easily reduced. In this circumstance, the patient may be bled in an erect posture, and the wound made large, as a sudden evacuation of blood is particularly apt to bring on the wished-for swoon. [Since the introduction of chloroform this practice has been relinquished.] For the same reason, if we wish to avoid making the patient faint, we should then make only a small puncture.

Every operator should be able to use the lancet with either hand, and thus bleed the patient in the right or left arm, as circumstances may render most eligible.

At the bend of the arm there are several veins in which a puncture may be made, viz. the basilic, cephalic, median basilic, and median cephalic. The median basilic vein, being usually the largest and most conspicuous, is that in which the operation is sometimes performed; but surgeons should never forget that it is under this vessel that the brachial artery runs, with the mere intervention of the aponeurosis sent off from the tendon of the biceps muscle. In very thin persons, indeed, the median basilic vein lies almost close to the artery, and nothing is then more easy than to transfix the first of these vessels and wound the last. Hence Richerand advises all beginners to prefer opening the median cephalic, or even the trunk of the cephalic itself, to puncturing the median basilic, which last is internally situated, and nearer the brachial artery. (*Nosogr. Chir.* t. iii. p. 38, ed. 2.) Dupuytren also objected to a puncture being made in the median basilic vein.

In fat subjects, the large veins at the bend of the arm are sometimes totally imperceptible, notwithstanding the fillet is tightly applied, the limb is put in warm water, and everything done to make those vessels as turgid as possible. In this circumstance, if the surgeon has not had much experience in the practice of venesection, he will do well to be content with opening one of the veins of the back of the hand, after putting the member for some time in warm water, and applying a ligature round the wrist. In children, a sufficient quantity of blood cannot always be obtained by venesection; and, in this event, the free application of leeches, and, occasionally, the puncture of the temporal artery, are the only effectual methods.

With respect to the choice of a vein in the arm, the most experienced operators give the preference to one which rolls least under the skin. Such a vessel, though sometimes less superficial than another, may commonly be opened with greater facility. The surgeon, however, is always to fix the vein as much as he can, by placing the thumb of his left hand a little below the place where he intends to introduce the lancet.

In bleeding in the arm, the fillet is to be tied round the limb, a little above the elbow, with sufficient tightness to intercept the passage of the blood through all the superficial veins; but never so as to stop the flow of blood through the arteries, which would tend to prevent the veins from rising at all. The veins being thus rendered turgid, the surgeon must choose the one which seems most conveniently situated for being opened, and large enough to furnish as much blood as it may be proper to take away.

Before applying the fillet round the arm, however, the operator should always feel where the pulsation of the artery is situated, and, if equally convenient, he should not open the vein immediately over this part. It is also prudent to examine where a pulsation is situated, on account of the occasional varieties in the distribution of the arteries of the arm. The ulnar artery is sometimes given off from the brachial very high up, and, in this case, it frequently proceeds superficially over the muscles which arise from the internal condyle, instead of diving under them in the ordinary manner.

The fillet having been put on the arm, the operator is to take the blade of the lancet, bent to a somewhat acute angle, between the thumb and forefinger, and, steadying his hand upon the other three fingers, he is to introduce the lancet, in an oblique direction, into the vessel till the blood rises up at the point of the instrument. Then bringing up the front edge in as straight a line as possible, the wound in the skin will be made of just the same size as that in the vein. The operator next takes away the thumb of his left hand, with which he steadied the vessel, and allows the blood to escape freely, till the desired quantity is obtained. The arm ought to be kept in the same position while the blood is escaping, lest the skin should slip over the orifice of the vein, keep the blood from getting out, and make it insinuate itself into the cellular tissue.

When the blood does not issue freely, most surgeons direct the patient to move his fingers, or turn something round and round in his hand. This puts the muscles of the arm into action, and the pressure which they then make on the veins makes the blood circulate more briskly through these vessels.

The proper quantity of blood being discharged, the fillet is to be untied. The flow of blood now generally ceases; though sometimes, when the orifice is large and the circulation vigorous, it still continues. In this circumstance, the operator may immediately stop the bleeding by placing the thumb of his left hand firmly on the vessel, a little below the puncture.

The blood is next to be all washed off the arm, the sides of the wound placed in contact, and a small compress of linen applied, and secured with the fillet, put round the elbow in the form of the figure 8, and regularly crossing just over the compress.

The patient should be advised not to move his arm much till the fillet is removed, which may be taken away in about twenty-four hours.

When the external jugular vein is to be opened, the surgeon generally makes the necessary pressure with his thumb. The orifice should be made in the direction of the fibres of the platysma myoides muscle: and the vein is not so apt to glide out of the way when the surgeon makes the puncture just where it lies over a part of the sterno-cleido-mastoideus muscle. The patient's head is now to be laid on one side, and properly supported; then the operator is to press upon the lower part of the vein with his thumb, so as to make the part above it swell, and the lancet is to be pushed at once into the vessel, with the cautions already stated.

There is commonly no difficulty in stopping the bleeding after the pressure is removed. Some practitioners divide the integuments with a scalpel,

before the vein itself is opened ; but this is quite unnecessary. In this country the fashion of opening the jugular vein has considerably declined. In fact, the operation is more troublesome, and less certain of succeeding, than venesection in the arm ; while the principle which recommended the practice to the old surgeons, namely, that of more effectually discharging in this manner blood from the sinuses of the brain, is erroneous ; for it is only the external jugular vein that can be safely opened, and this does not receive the blood from the interior of the head.

Now that the danger of air insinuating itself into the large veins of the neck is so generally known (see VEINS), it appears to me that the operation of bleeding in the external jugular vein is likely to become still less fashionable than it was, and that care should always be taken to keep up the pressure, until the compress has been securely fixed over the puncture.

[In young children and infants blood may be taken from the jugular vein when none can be obtained from the arm at the bend of the elbow.]

When blood is to be taken from the foot, the ligature is commonly applied a little above the ankle.

Blood-letting in the feet is executed on the same principle as in other parts ; but, as the blood from the veins in this situation generally does not flow with much celerity, it is customary to immerse the feet in warm water to promote the bleeding.

In orchitis, or acute inflammation of the testis, a beneficial discharge of blood may often be obtained from the veins of the scrotum. The recollection of this fact may be useful, particularly when leeches are not at hand, and the surgeon has no cupping instruments, by which the blood can be drawn from the loins.

#### ILL CONSEQUENCES SOMETIMES FOLLOWING BLEEDING IN THE ARM.

1. *Ecchymosis*.—The most common is the thrombus, or ecchymosis, a small tumour around the orifice, and occasioned by the blood insinuating itself into the adjoining cellular substance at the time when it is flowing out of the vessel. Changing the posture of the arm will frequently hinder the thrombus from increasing in size, so as to obstruct the evacuation of the blood. But, in some instances, the tumour suddenly becomes so large that it entirely interrupts the operation, and prevents it from being finished. In these cases, however, the most effectual method of preventing the tumour from becoming still larger is to remove the bandage. By allowing the bandage to remain, a very considerable swelling may be induced, and such as might be attended with great trouble. If more blood be required to be taken away, it ought to be drawn from another vein, and, what is still better, from a vein in the other arm. The best applications for promoting the absorption of these tumours are those containing spirit, vinegar, or the muriate of ammonia. Compresses wetted with any lotion of this sort may be advantageously put on the swelling, and confined there with a slack bandage.

2. *Inflammation of the Integuments and subjacent Cellular Tissue*.—Inflammation and suppuration of the cellular substance in which the vein lies are

occasionally met with. On the subsidence of this inflammation, the tube of the vein is free from induration. Sometimes the inflammation is rather indolent, producing a circumscribed and slowly suppurating tumour. Sometimes it is more diffused, and partakes of the erysipelatous nature. On other occasions it is phlegmonous.

When the lancet has been blunt, so as rather to have lacerated than cut the parts, when the constitution is irritable, and especially when care is not taken to unite the edges of the puncture, and the arm is allowed to move about, so as to make the two sides of the wound rub against each other, inflammation will most probably ensue. The treatment of this case consists in keeping the arm perfectly at rest in a sling, applying the saturnine lotion, and giving one or two mild saline purges. If suppuration take place, a small poultice is the best application.

3. *Absorbents inflamed*.—Sometimes, particularly when the arm is not kept properly quiet after bleeding, swellings make their appearance about the middle of the arm, over the large vessels, and on the forearm, about the mid-space between the elbow and wrist, in the integuments covering the flexor muscles. The swelling of the absorbent gland at the inner edge of the biceps is sometimes as large as an egg. Before such swellings take place, the wound in the vein often inflames, becomes painful, and suppurates, but without any perceptible induration of the venal tube, either at this time, or after the subsidence of the inflammation. Pain is felt shooting from the orifice in the vein, in lines up and down the arm, and upon pressing in the course of this pain, its degree is increased. On examining the arm attentively, indurated absorbents may be plainly felt, leading to the tumour just above the elbow at the side of the biceps muscle.

The pain and swelling often extend to the axilla, where the glands also sometimes enlarge. Cord-like substances, evidently absorbents, may sometimes be felt, not only leading from the puncture to the swelling in the middle of the arm, but also from this latter situation up to the axillary glands, and from the wound in the vein down to the enlarged glands at the mid-space between the elbow and wrist, over the flexor muscles of the hand.

The enlarged glands often proceed to suppuration, and the patient suffers febrile symptoms. It may be suspected that the foregoing consequences arise from the lancet being envenomed, and from the absorption of the virulent matter ; but the frequent descent of the disease to the inferior absorbents militates against this supposition.

When the absorbents become inflamed, they quickly communicate the affection to the surrounding cellular substance. These vessels, when indurated, appear like small cords, in some cases as large as one-eighth of an inch in diameter : this substance cannot be the slender sides of the vessels, suddenly increased in bulk, but an induration of the surrounding cellular substance.

The inflammation of the absorbents, in consequence of local injury, is deducible from two causes ; one, the absorption of irritating matter ; and the other, the effect of the mere irritation of the divided tube. When virulent matter is taken up by the absorbents, it is generally conveyed to the next absorbent gland, where its progress being retarded, its stimulating qualities give rise to in-



flammation, though frequently no evident disease of the vessel through which it has passed can be distinguished.

When inflammation of the absorbents happens, in consequence of irritation, the part of the vessel nearest the irritating cause generally suffers most, while the glands, being remotely situated, are not so much inflamed.

The treatment of the preceding case consists in keeping the arm perfectly quiet in a sling, dressing the puncture of the vein with any mild simple salve, covering the situation of the inflamed lymphatics with linen wet with the saturnine lotion, and giving calomel and saline purgative medicines.

When the glandular swellings suppurate, poultices should be applied; and if the matter does not soon spontaneously make its way outwards, the surgeon should open the abscess. (See *Abernethy's Essay on this subject.*)

4. *Inflammation of the Vein.*—When the wound does not unite, the vein itself may inflame. This affection will vary in its degree, extent, and progress. One degree of inflammation may only cause a slight thickening of the venous tube, and an adhesion of its sides. Abscesses, more or less extensive, may result from an inflammation of greater violence; and the matter may sometimes become blended with the circulating blood, and produce dangerous consequences, or the matter may be quite circumscribed, and make its way to the surface. If, however, the inflammation should fortunately produce an adhesion of the sides of the vein to each other at some little distance from the wounded part, this adhesion will form a boundary to the inflammation and prevent the entrance of pus into the circulation. The effect of the adhesive inflammation, in preventing the extension of inflammation along membranous surfaces, was originally explained by Mr. Hunter. In one case Mr. Hunter applied a compress to the inflamed vein above the wounded part, and he thought that he had thus succeeded in producing an adhesion, as the inflammation was prevented from spreading further. When the inflammation does not continue equally in both directions, but descends along the course of the vein, its extension in the other direction is probably prevented by the adhesion of the sides of the vein to each other. (See *Obs. on the Inflammation of the Internal Coats of Veins*, in *Trans. of a Soc. for the Improvement of Med. and Chir. Knowledge*, vol. i. p. 18, &c.) More information on this subject will be found under the head of VEINS.

Mr. Abernethy had seen only three cases in which an inflammation of the vein succeeded venesection. In neither of these did the vein suppurate. In one, about three inches of the venous tube inflamed, both above and below the puncture. The integuments over the vessel were very much swollen, red, and painful, and there was a good deal of fever, with a rapid pulse and furred tongue. The vein did not swell when compressed above the diseased part. In another instance, the inflammation of the vein did not extend towards the heart, but only downwards, in which direction it passed as far as the wrist.

The treatment is to lessen the inflammation of the vein by the same means which other inflammations require, and to keep the affection from spreading along the membranous lining of the vessel towards the heart, by placing a compress

over the vein, a little way above the puncture, so as to make the opposite sides of the vessel adhere together.

Mr. Abernethy conceives a case possible, in which the vein may even suppurate, and a total division of the vessel be proper, not merely to obviate the extension of the local disease, but to prevent the pus from becoming mixed with the circulating blood. Were such a proceeding deemed right, I think that Sir B. Brodie's method of cutting the vessel would be best. However, I have never heard of any case in which the practice has been adopted. As for the scheme of tying the vein above the diseased part of it, the severe effects frequently following this method must, as Mr. Dunn has reminded me, render it less eligible than an incision. In the case of an inflamed vein, Dr. Chapman states that nothing is so efficacious as blisters; a practice said to have been first suggested by Dr. Physick. (See *A fatal Case of Inflammation of the Vessel from Venesection*, in *Philadelphia Journ.* Feb. 1824.) Some time ago I was favoured by Mr. Howship with a view of the state of the parts in a case where a lady had died after an inflammation of the vein of the arm, brought on by venesection; the veins were considerably thickened, and in some places quite solid and impervious. (See the subject of *Phlebitis*, in the article VEINS.)

5. *Inflammation of the Fascia of the Forearm, or diffuse Inflammation of the Cellular Membrane.*—Sometimes, in consequence of the inflammation arising from the wound of the lancet in bleeding, the arm becomes very painful, and can hardly be moved. The puncture often remains unhealed, but without much inflammation of the surrounding integuments. The forearm and fingers cannot be extended without great pain. The integuments are sometimes affected with a kind of erysipelas; being not very painful when slightly touched, but when forcibly compressed, so as to affect the inferior parts, the patient suffers a good deal. The pain frequently extends towards the axilla and acromion, unaccompanied by much swelling. These symptoms are attended with considerable fever. After about a week, small superficial collections of matter take place in the neighbourhood of the elbow-joint.

Opening these superficial abscesses, however, is often inadequate to the complete discharge of the matter, which is sometimes originally formed beneath the fascia, in the course of the ulna; and its pointing at the upper part of the arm depends on the thinness of the fascia in this situation. The collection of pus descends under the lower part of the detached fascia, and a depending opening for its discharge becomes necessary. This being made, the patient soon gets well.

In these cases the vein is not inflamed; but sometimes the glands of the armpit and just above the elbow swell. The integuments are not much affected, and the patient complains of a tightness of the forearm. Matter does not always form, and the pliability of the arm after a good while gradually returns again.

Mr. Watson relates a case which was followed by a permanent contraction of the forearm. Mr. Abernethy was of opinion, that a similar contraction of the forearm, from a tense state of the fascia, may be relieved by detaching the fascia from the tendon of the biceps, to which it is naturally connected. Mr. Watson seems to have obtained

success in his first case by having made this detachment.

In the treatment of an inflammation of the fascia, or of an extensive quantity of the cellular membrane, in consequence of venesection, general means for the cure of inflammation should be employed. The limb should be kept quiet, and the inflamed part relaxed. As soon as the inflammation abates, the extension of the forearm and fingers ought to be attempted and daily performed, to obviate the contraction which might otherwise ensue.

Sir C. Bell objects to calling the affection an inflammation of the fascia, because he sees no proof of this part being inflamed; and he conceives that the symptoms proceed from the inflammation spreading in the cellular membrane and passing down among the muscles and under the fascia. On this point I believe him to be quite correct, and that the disorder partakes of the character of diffuse inflammation of the cellular membrane so well described by Dr. Duncan. (See *Edin. Med. Chir. Trans.* vol. i.) The fascia acts as a bandage, and from the swelling of the parts beneath it binds the arm, but is not itself inflamed and contracted. When necessary to divide the fascia, Sir Charles Bell thinks it would be better to begin an incision near the inner condyle of the humerus, and to continue it some inches down the arm, rather than perform the nice operation of cutting the fascia at the point where the expansion goes off from the round tendon of the biceps.

When the elbow-joint and forearm continue stiff after all inflammation is over, Sir C. Bell recommends frictions with camphorated mercurial ointment, &c., and the arm to be gradually brought into an extended state by placing a splint on the forepart of the limb. (*Operative Surgery*, vol. i. p. 65.)

6. *Ill Consequences of a Wounded Nerve.*—Mr. Pott used to mention two cases in which the patients suffered distracting pains, followed by convulsions and other symptoms, which could only be ascribed to nervous irritation, arising from a partial division of the nerve, and he recommended its total division as a probable remedy. Dr. Monro related similar cases, in which such treatment proved successful.

Hence it is highly necessary to know the characteristic symptoms of the case, particularly as all the foregoing cases would be exasperated by the treatment just now alluded to. It is to Mr. Abernethy that we are indebted for several valuable remarks elucidating this subject. He informs us that the two cutaneous nerves are those which are exposed to injury. Most frequently all their branches pass beneath the veins at the bend of the arm; but sometimes, although the chief rami go beneath these vessels, many small filaments are detached over them, which it is impossible to avoid wounding in phlebotomy.

Mr. Abernethy thinks the situation of the median nerve renders any injury of it very unlikely. If, however, a doubt should be entertained on this subject, an attention to symptoms will soon dispel it. When a nerve is irritated at any part between its origin and termination, a sensation is felt as if some injury were done to the parts which it supplies. If, therefore, the cutaneous nerves were injured, the integuments of the forearm would seem to suffer pain; if the median nerve, the

thumb and next two fingers would be painfully affected.

The extraordinary pain sometimes experienced in bleeding may denote that a cutaneous nerve is injured. The situation of the nervous branches is such, that they must often be partially wounded in the operation, though they probably unite again, in almost all cases, without any ill consequences. Yet, says Mr. Abernethy, it is possible that an inflammation of the nerve may accidentally ensue, which would be aggravated if the nerve were kept tense, after its partial division. The disorder, he thinks, arises from inflammation of the nerve in common with the other wounded parts. This gentleman supposes that an inflamed nerve would be very likely to communicate dreadful irritation to the sensorium, and that a cure would be likely to arise from intercepting its communication with that organ.

The general opinion is, that the nerve is only partially divided, and that a complete division would bring relief. Mr. Pott proposed enlarging the original orifice. It is possible, however, that the injured nerve may be under the vein, and if the nerve be inflamed, even a total division of it at the affected part would perhaps fail in relieving the general nervous irritation, which the disease has occasioned. To intercept the communication of the inflamed nerve with the sensorium, however, promises perfect relief. This object can only be accomplished by making a transverse incision above the orifice of the vein. The incision need not be large, for the injured nerve must lie within the limits of the original orifice, and it need only descend as low as the fascia of the forearm, above which all the filaments of the cutaneous nerves are situated. As the extent of the inflammation of the nerve is uncertain, Mr. Abernethy suggests even making a division of the cutaneous nerve still farther from the wound made in bleeding. Perhaps this surgeon dwells too much on inflammation of the nerve. I have seen neuralgic affections of the arm brought on by venesection, where the pain had endured for years. Surely inflammation was in such cases not concerned.

Examples are recorded in which not only extraordinary pain was occasioned by the prick of the lancet, but erysipelas, ending in gangrene of the whole limb, and the death of the patient. (*Richerand, Nosogr. Chir.* t. ii. p. 490, ed 2.) A case in which the greater part of the integuments of the arm had been destroyed by erysipelas thus produced, I once saw under the care of Mr. Vincent, in St. Bartholomew's Hospital.

In former times it was customary to refer many of the bad symptoms occasionally following venesection to a puncture of the tendon of the biceps; but this doctrine is now in a great measure renounced, the experiments of Haller having completely proved that tendons and aponeuroses are, comparatively speaking, parts endowed with little or no sensibility.

See *R. Butler's Essay concerning Blood-letting, &c.* 8vo. Lond. 1734. *M. Martin, Traité de la Phlébotomie et de l'Artériotomie*, 8vo. Paris, 1741. *Quesnay, Traité des Effets et de l'Usage de la Saignée*, 12mo. Paris. *G. Vieussens, De la Saignée, et de son Usage dans la Plupart des Maladies*, 8vo. Paris, 1815. *J. J. Walbaum, De Venesectione*. Gott. 1749. (*Haller, Disp. Chir.* t. v. p. 477.) *B. Bell's System of Surgery. Essay on the Ill Consequences sometimes following Venesection*, by *J. Abernethy*. *R. Carmichael, On Varix and Venous Inflammation*, in *Trans. of Assoc.*



Physicians, vol. ii. *Duncan*, On Diffuse Inflammation of the Cellular Membrane, in *Edin. Med. Chir. Trans.* vol. i. Medical Communications, vol. ii. *Richerand*, *Nosogr. Chir.* t. ii. p. 416, edit. 4. *J. Hodgson*, On the Diseases of Arteries and Veins, 8vo. Lond. 1815. *B. Travers*, in *Surgical Essays*, part i. 8vo. Lond. 1818. *Chapman*, in *Philadelphia Journ.* Feb. 1824. *Freteau*, *Sur l'Emploi des Emissions sanguines*, etc. 8vo. Paris, 1816.

[VESICO-UTERINE FISTULA. This condition will be treated of in the article on Vesico-Vaginal Fistula.]

[VESICO-VAGINAL FISTULA. Under this head will be noticed several varieties of urinary fistula in the female. Abnormal communications are met with between the urethra and vagina, *urethro-vaginal fistulæ*; between the bladder and vagina, *vesico-vaginal fistulæ*, which is the most common form; there are also *vesico utero-vaginal fistulæ*, which involve the upper part of the vagina and the lower part of the anterior lip of the cervix uteri, and are tolerably frequent; and *vesico-uterine fistulæ*, very rare, in which there is a communication between the base of the bladder and some part of the canal of the cervix uteri.

These several conditions are almost always the result of injury inflicted on the parts during parturition; either by laceration from the incautious use of instruments or otherwise; or by sloughing from long-continued pressure in cases of tedious labour. Exceptionally they have been known to result from the pressure of a large vesical calculus, or from abscess in the vesico-vaginal septum, or venereal ulceration perforating that part; but fistulæ from abscess, or from non-malignant forms of ulceration, are much more common between the vagina and rectum than between the vagina and bladder. Cancerous ulceration is another occasional cause, but cases of this class are obviously beyond the reach of curative surgical measures.

The condition of a female suffering from urinary fistula is most distressing. The urine flows away as fast as it is secreted; or if, in certain positions, a portion of it can be retained, any movement or change of posture will cause it to escape. Her clothing by day and her bed by night are constantly saturated, and the labia and thighs often severely excoriated. When the fistula is caused by laceration, the incontinence of urine is noticed immediately; but if it is the result of sloughing, there may be no escape for several days, until the separation of the slough takes place.

It is only within the last twenty years that any effectual methods of dealing with this class of affections have been adopted. Previous to this, notwithstanding the persevering efforts of Dieffenbach, Jobert and others, the failure of all operative procedure was so constant, that the bulk of the profession were content to regard vesico-vaginal fistulæ as practically incurable.

It is to the use of metallic sutures that the now very constant success of plastic operations for the cure of these affections must be ascribed, and to Dr. Marion Sims belongs the credit of bringing prominently before the profession, not only this important element of success, but of bringing to bear an amount of perseverance and mechanical ingenuity upon the details of these difficult operations, of which it is impossible to speak too highly. Dr. Sims, however, was not the first to employ metallic sutures for the cure of vesico-vaginal fistula. Mr. Gosset of London operated successfully,

in May 1834, with silver gilt wire, fastening the sutures by simply twisting their ends. His plan of operation, and his after treatment, was in all essential particulars the same as is now practised; and the following remarks made by him are remarkable from their coincidence with the result of subsequent experience, as to the advantages of metallic sutures. "The advantages of the gilt-wire suture are these. It excites but little irritation, and does not appear to induce ulceration with the same rapidity as silk, or any other material with which I am acquainted; indeed it has scarcely any effect of the kind, except when the parts brought together are put much on the stretch; you can therefore keep the edges of a wound together in close contact for an indefinite length of time, by which the chance of union is greatly increased." Mr. Gosset used the wire suture for various operations, such as removal of tumours, &c., but did not recommend it for general employment on account of the greater difficulty of applying it. He says, "it is in minute and delicate operations, such as hare-lip, staphyloraphé, and for the closure of fistulous openings, where success mainly depends upon a speedy union of parts, that the advantages of the gilt suture are most manifest." (See *Lancet*, Nov. 29, 1834, p. 345.)

Mr. Gosset's very instructive case, however, appears not to have attracted much attention in this country, and abroad was probably altogether unknown. Dr. Marion Sims, after repeated failures during four years with sutures of other materials, obtained his first success by using silver wire in 1849, and full details of his mode of operation were first published in the *American Journal of Medical Science* for January 1852.

In his early operations, when practising at Montgomery, Alabama, Dr. Sims used leaden cross-bars or clamps, on the principle of the quill suture. The cross-bars were perforated with holes through which the sutures, after having been inserted through the opposite sides of the fistula, were passed, and their ends were fastened by means of split or perforated shot. Further experience, however, at the women's hospital, New York, induced Dr. Sims to give up this and other complicated mechanical contrivances for fixing the sutures, and to trust to the wire alone, used as an interrupted suture, and fastened by simply twisting the ends, a method now adopted by the great majority of surgeons.

Dr. Bozeman, who had witnessed Dr. Sims' early operations, and who succeeded him in Montgomery, used a leaden plate or button perforated with holes along its centre, the holes being placed about one-third of an inch apart. The ends of the sutures were brought through the holes in the plate, and fastened by split or perforated shot. This was on the principle of the interrupted suture, with the addition of the button and shot, the button, when the sutures were fastened, being firmly pressed against the wound.

Dr. Bozeman's plan was adopted in this country by Mr. Baker Brown, who had already made trial of Dr. Sims' early method. Mr. Brown obtained signal success in his operations at St. Mary's Hospital, and afterwards at the London Surgical Home, and it was mainly through his writings and published cases, that the profession became aware of the ease with which most of

these unfortunate cases may be cured by practised and skilful surgical manipulation. Mr. Brown at one time substituted separate leaden clumps to fasten each suture for Dr. Bozeman's single plate or button; but latterly, following the example of Dr. Sims, he has discarded all complicated mechanical appliances, and has used the silver wire as a simple interrupted suture.

The late Sir James Simpson introduced other ingenious methods of fastening the sutures, but it is unnecessary to dwell upon them, as the simple twisting of their ends is now almost universally preferred. (See Marion Sims; *American Journ. of Med. Science*, Jan. 1852; and *Anniversary Discourse to the New York Academy of Medicine*, 1858; Baker Brown, on *Surg. Diseases of Women*, 2nd ed., 1861; J. Y. Simpson, *Med. Times and Gaz.*, Dec. 1858 and Jan. 1859.)

#### OPERATION.

*Position of the patient.*—In his earlier operations, Dr. Marion Sims placed the patient on her knees, with the nates elevated and the head and shoulders depressed. In this position the abdominal and pelvic viscera gravitate towards the epigastric region, and if the labia and nates are drawn upwards and outwards by an assistant, the air enters the vagina, stretching out that canal and affording an easy view of its interior. The inspection is further facilitated by a bent spatula, or rectangular speculum, to raise the perineum and recto-vaginal septum. Dr. Sims afterwards adopted the *semi-prone* position, the patient lying on her left side, with the thighs flexed at right angles with the pelvis, the right a little more than the left. The left arm is thrown behind and the chest rotated forwards, bringing the sternum closely in contact with the table. The patient being thus rolled over as much as possible on the front, and the labia being drawn aside the air enters and dilates the vagina in the same manner as above described. This position is much less irksome to the patient, while it admits also of the use of anæsthetics if desired, but Dr. Sims rarely resorts to them. Mr. Baker Brown adopted the lithotomy position, and his example has been generally followed in this country. It is in most respects more convenient both to the operator and the patient, and decidedly to be preferred when chloroform is administered, but it does not perhaps afford so complete a view of the parts, nor does the light fall so directly upon the vesico-vaginal septum. A good side-light is essential to the satisfactory performance of these operations, and the operating theatres of hospitals, which are usually lighted by a skylight, are not well adapted for the purpose. To remedy this inconvenience, the writer has recently, in St. Mary's Hospital, used the oxy-hydrogen lime-light on several occasions, and has found the operation thereby greatly facilitated. The lamp should be placed behind the operator's shoulder; it is fixed on an upright stem, and can be raised or depressed to any required level. It can also be directed at any angle. By means of it, a light equal to the brightest sunshine can be concentrated on the part. The best instrument to dilate the vagina and depress the perineum and recto-vaginal septum is the bent concave speculum, used by Sims and Bozeman, known as the "duck-bill" speculum.

*Denudation of the edges of the Fistula.*—A

good view of the fistula having been obtained, the next point in the operation is the denudation of its edges. When the aperture is high up, and not easily accessible, it may be necessary to draw the part downwards towards the outlet of the vulva, by means of a vulsellum or a hook inserted into the vesico-vaginal septum, and held by an assistant. With a narrow, sharp-pointed knife, the vaginal mucous membrane forming the edges of the fistula should be removed, the vesical mucous membrane which often projects through the aperture being carefully excluded. It is an important condition of success that as broad a cut surface as possible should be obtained, and this object is best effected by dissecting off the edges of the fistula obliquely, bevelling them off, that is, at the expense of the vaginal surface. The denudation must be everywhere complete, and if the whole circumference of the opening can be removed in one piece, this object will be the more effectually and certainly secured.

Mr. Hilliard has invented a forked instrument, which he calls a "fistula clamp," for transfixing and holding the edges of the opening, so that they can be pared off in one slice. (See *Med. Times and Gaz.*, Nov. 24, 1860.) Most surgeons, however, will probably prefer the simpler method with the knife and forceps. As in the operation for cleft palate, knives bent at different angles will often be found useful.

The direction which the line of union shall take must be determined by the shape of the fistulous opening; whether it be longitudinal, transverse, or oblique, there seems to be little difference in the probability of union taking place.

*Insertion of the Sutures.*—The sutures have now to be inserted. At first a long needle, set in a handle, with an eye near the point, was armed with a silk ligature and passed through the opposite lips of the fistula; the loop of silk being drawn through with the forceps, the needle was withdrawn, and the silk was then tied to the metal suture, which latter was then drawn through and substituted for it. Another method was a short curved needle, passed with the aid of a *porte-aiguille*, which was an improvement on the first mentioned plan, inasmuch as the needle could be drawn through carrying the suture with it; but both have been superseded by the tubular needle of Mr. Startin. This, with the addition of a clever mechanical contrivance, devised we believe by the late Mr. Price, for conducting the wire onwards till it projects through the end of the tube close to the needle's point, leaves little to be desired. The needle should be entered on one side at about one-third of an inch from the cut edge, and be brought out close to, *but carefully excluding*, the vesical mucous membrane; it is then carried onwards through corresponding points on the opposite side, when the wire, having been protruded through the end of the tubular needle, is seized with the forceps and the needle is withdrawn, leaving the suture in its place. The distance between the sutures should be about a fourth (it should certainly not exceed a third) of an inch. When a sufficient number have been inserted, they are secured by twisting their ends together, and are then cut off short. The adjustment of the edges and fastening the sutures is often a matter of considerable difficulty, especially if the fistula is deeply seated. Mr. Hilliard has contrived an ingenious in-



strument for this purpose (see *Med. Times and Gaz.*, Nov. 24, 1860), and another of simpler construction was used by Sir James Simpson (see *Med. Times and Gazette*, vol. i., 1859). In tightening and twisting the wires great care is required, on the one hand that the surfaces may be brought into sufficiently close apposition, and on the other hand that the wires may not be drawn so tight as to cause the edges to be inverted.

*After Treatment.*—The operation is now completed; no dressing of any kind is required, but the vagina may be gently and carefully syringed twice daily with warm water. A short silver catheter, with a double curve like an italic S, which from its form will, as Dr. Sims calls it, be “self-retaining,” must be introduced into the bladder; its free end having attached to it an india-rubber tube long enough to reach a vessel placed under the patient’s bed, into which the urine is thus drained away as fast as it is formed. The catheter must be worn for eight or ten days, but it should be removed and cleaned once a day. Opium should be given in sufficient doses to allay the restlessness of the patient, and to prevent the action of the bowels, which should be kept confined for about a week. All meddling with the fistula or manipulation of any kind should be carefully avoided, as likely to interfere with the union of the parts, which should not be examined till nine or ten days have elapsed. At the end of that time, and after the rectum has been evacuated, the duck-bill speculum may be introduced, and if the union is firm the sutures may be removed, but if there is any doubt on the point, they may be left for three or four days longer with advantage.

By careful attention to the foregoing rules success may be confidently looked for in all cases in which the margins of the fistula are in a healthy and pliant condition, and the patient in fair health. The unpromising cases are those in which there has been loss of substance from sloughing, leaving widely gaping openings, with margins rigid from cicatricial contraction. The writer has operated on fifteen cases, of which ten were cured by a single operation, three required more than one operation before complete union was obtained, and two failed altogether for the reason just mentioned, the loss of substance having been so great as to make it impossible to draw the edges into contact, even with the aid of incisions in the neighbourhood of the fistula to relieve the tension.

*Vesico-utero-vaginal Fistula.*—This form of urinary fistula is often included under the more common term of vesico-vaginal, but the distinction is worth making, as it is a variety which is not unfrequently met with, and a different plan of treatment is often required for its cure. In vesico-utero-vaginal fistulæ the upper part of the vagina and lower part of the anterior lip of the cervix uteri are involved. These fistulæ are often of large size from extensive destruction of one or both of these parts, causing them to gape widely open, so that it may be almost or quite impossible to bring their edges into contact. These cases are often remediable in no other way than by turning the uterus forwards into the gap and uniting the anterior or vaginal border of the fistula to the posterior lip of the os uteri, thus making use of the lower end of the uterus to fill up the deficiency and

causing it for the future to form part of the wall of the bladder, the vagina being converted into a blind cul de sac. In this way the incontinence of urine is prevented, and the menstrual secretion flows into the bladder and is discharged with the urine. It has been established by repeated observation that menstruation may take place through the bladder without detriment or inconvenience. The periodical function of the uterus is not interrupted on the one hand, nor on the other hand does the bladder resent the passage through it of the menstrual secretion. At the menstrual periods the urine becomes bright red and remains so for four or five days, and were it not for this, the patient would often be unaware of what was taking place. At the worst, a slight periodical irritability of the bladder is the only inconvenience complained of.

*Vesico-uterine Fistula.*—A vesico-uterine fistula is an abnormal communication between the base of the bladder and the uterus, always, in the cases hitherto observed, at some part of the canal of the cervix uteri, the vagina, and the os uteri as seen from the vagina, being in a sound and normal condition. It produces, of course, complete incontinence, the urine flowing through the fistula, and escaping by the os uteri into the vagina. These fistulæ are difficult to discover, and it is not improbable that they may sometimes have been overlooked, and the incontinence attributed to some other cause. On examination with the speculum, however, urine may generally be seen to flow from the os uteri into the vagina, and by careful manipulation, a sound may be passed from the bladder through the fistula, and made to touch another sound introduced into the cervix uteri. In a case which occurred to the writer, and which resulted from protracted labour, the os uteri was large enough to admit the finger, and the fistula could be distinctly felt, while a sound introduced into the bladder could readily be made to touch the finger in the cervix uteri.

Vesico-uterine fistulæ are very rare. The only surgeon who has paid much attention to the subject is M. Jobert de Lamballe, who states that he has operated on as many as fourteen cases. In this country they have attracted little notice. Sir James Simpson has recorded a curious case, in which an abscess formed between the bladder and uterus, and opened a communication between the two cavities. Nitrate of silver was applied to the opening, and it gradually contracted and closed. (*Obstetric Memoirs*, Vol. i., p. 232.) Dr. Leishman, of Glasgow, published an account of another case in the *Glasgow Medical Journal* for Oct. 1861. This was the result of a lingering labour. A spontaneous cure appears to have taken place by closure of the os uteri, for the incontinence gradually ceased, and menstruation was performed through the bladder. A year afterwards, the os uteri was found to be healthy in appearance, and “firmly closed.”

Two plans of operation were practised by Jobert. In the first, he made free lateral incisions through the os uteri and upper end of the vagina, so as to convert the lower part of the cervix uteri into two flaps, an anterior and a posterior, by separating which the fistulous aperture might be brought into view, so as to admit of its edges being pared, and sutures being applied. He carried his

incisions completely through the uterus into the loose areolar tissue of the broad ligament. He operated in one case in this way in 1849, and succeeded in curing the fistula, but the treatment lasted over a period of three months, and the patient's life was for a long time in imminent danger. (See *Traité des Fistules Vesico-Uterines*, 1852.)

In his subsequent cases, thirteen in number, as he informed the writer, of which eleven were cured, M. Jobert did not attempt to deal with the fistula itself, but contented himself with closing the os uteri by suture, thus shutting off the communication between the uterus and vagina. The urine, of course, still entered the uterus, but could not escape externally, and the remedy, so far as the incontinence was concerned, was as perfect as though the fistula itself had been closed, but the menstrual fluid had of course subsequently to be discharged through the fistula into the bladder. (See *Gazette des Hôpitaux* for July 19 and August 20, 1853; and *L'Union Médicale*, November 22, 1856; January 6, 1859; and October 18, 1860.)

The writer, at that time unaware that Jobert's second plan had ever been put in practice, operated by that method in St. Mary's Hospital in May 1862, in the case which has been already alluded to. The edges of the os uteri were denuded, and four sutures were inserted. Union appeared to be complete, no escape of urine took place, and menstruation was performed through the bladder; but three months afterwards menstruation ceased, and the uterus began to enlarge. Four months later, under the impression that the enlargement was caused by retained menstrual secretion, a puncture was made through the uniting medium in the situation of the os uteri, and the result was a miscarriage on the following day of a foetus of about four months. After the miscarriage the incontinence returned as before the first operation. The only probable explanation of the pregnancy in this case is that the seminal fluid must have passed through some minute communication between the uterus and vagina, possibly along the track of one of the sutures. If such aperture existed, however, it was too small to admit of the escape of any appreciable quantity either of urine or menstrual secretion.

The patient after her miscarriage, being again in the same miserable condition from incontinence, the os uteri was again closed in March 1863, by an operation similar to the first. Since this time to the present date, 1871, there has been no involuntary escape of urine, and menstruation has been performed regularly through the bladder. (See J. R. Lane, on *Vesico-uterine Fistula*; *Med. Times and Gazette*, Nov. 21, 1862; and *Lancet*, Feb. 20, 1864.)

*Urethro-vaginal Fistula.* — Occasionally, from pressure of the foetal head against the arch of the pubes during labour, a fistulous opening is established between the urethra and vagina. Usually the neck of the bladder is at the same time involved, and the incontinence of urine is therefore as complete as in the more common case of vesico-vaginal fistula. Urethro-vaginal fistulae are more accessible to the operator than the forms previously described, but they are more difficult to deal with successfully, on account of the thinness of the urethral walls, and the pressure on the

newly-united parts of the catheter, which it is necessary to retain in the bladder after the operation. The edges are to be denuded, and the sutures inserted in the manner already described, but in these cases Bozeman's leaden plate may be used with advantage: it serves to keep the united parts steady, and also to take off the pressure of the catheter. This latter important point is best accomplished by having the leaden plate long enough to project in front beyond the urinary meatus, and by making a notch in it at its anterior extremity for the catheter to rest upon.

The writer had under his care some years since a case of urethro-vaginal fistula, caused by a sloughing venereal ulcer on the anterior wall of the vagina. In consequence of the loss of substance, the treatment of this case was attended with considerable difficulty, but after three operations the closure of the fistula, which was about two-thirds of an inch in length, and involved the neck of the bladder, was successfully effected.

Sometimes the urethra is laid open along its whole length. The writer has treated two cases of this kind. In one the injury was caused by protracted labour, in the other by laceration of the canal in the extraction of a large calculus. In the latter there had been complete incontinence of urine for eight years. The course of the urethra is distinguishable in these cases by slightly projecting lips on each side, between which there is a streak of darker coloured mucous membrane. In both the examples alluded to, the urethral canal was re-established of the normal length by a single operation, and a perfect cure was the result. The leaden plate, projecting forwards for some distance, is especially necessary in these cases, for without it the whole weight of the catheter would rest upon the anterior extremity of the newly-united urethra.

Fistulous communications between the rectum and vagina are alluded to in the article on *Recto-vaginal Fistula*. The plan of operation is the same as in vesical fistulae; but as regards the after treatment the rectum is a more difficult viscus to manage than the bladder. The latter can be kept in a state of perfect rest by means of a catheter, and the urine flows away without the necessity of any expulsive effort; but it is impossible to prevent the rectum from becoming gradually distended with fecal matter, and it is impossible, also, for its contents to be got rid of without the action of its own muscular fibres, which, of necessity, interferes injuriously with the newly-united parts. After operations for recto-vaginal fistulae, the bowels should not be allowed to act for at least ten days, at the end of which time a full dose of castor oil should be given, and its operation assisted by enemata of warm gruel, the patient being directed to avoid straining as much as possible. The sutures should on no account be removed until after the rectum has been emptied.

James R. Lane.

VERRUCA. A wart. See WART.

VERTEBRÆ, DISEASE OF. See SPINE, DISEASES OF.

VINUM OPII. Take of extract of opium ʒj., cinnamon bark bruised, cloves bruised, of each ʒj.; wine, a pint. Macerate for eight days and filter. The thebaic tincture, or liquid laudanum.



num of Sydenham. In surgery, it is often preferred to the common tincture of opium, as an application to the eye.

VIPER, BITE OF. See WOUNDS.

**VISION.** All parts of the eye necessary for vision being healthy, to see an object with the greatest possible distinctness, it must have a certain size, be placed in good light, and at a distance which allows the rays which come from the object to be brought to a focus in the yellow spot of the retina, where a well-defined inverted image of the object is formed. This image, through the fibres of the optic nerve, must be conveyed to the brain, there perceived, and again projected in an inverted direction towards the object. The layer of rods and bulbs is supposed to be the perceptive part of the retina. At the yellow spot, where the most distinct vision takes place, this layer consists of small bulbs, with a few ganglion cells and optic nerve-fibres intervening between them and the vitreous chamber. Thus the rays of light reach the bulbs more directly than in any other part of the retina. The undulations of the rays of light, through passing into the elements of this layer, produce a change which is termed the perception of the object from which the rays emanated.

The part played by the other elements of the retina in the act of vision is not understood.

The optic nerve-fibres convey the impression received from the retina. They themselves do not possess perception of light. This is well known as regards the optic disc, or blind spot. That the same applies to the optic nerve-fibres upon the retina, is inferred from the fact that the shadows of the retinal vessels in our own retina can be made visible to ourselves in a dark room, by turning the cornea inwards towards the nose as much as possible, and by then moving to and fro upon the sclerotic the image of the flame of a candle or gaslight, brought to a focus upon the sclerotic by means of a 2-inch or 3-inch convex lens.

The blood-vessels ramify among and beneath the layer of optic nerve-fibres, and their larger branches being made visible, the perceptive part of the retina is supposed to lie behind the layer of optic nerve-fibres.

To determine the acuteness of vision ( $= V$  or  $S$ , vision or sight) of an eye, it becomes necessary to ascertain the size of the smallest object which can still be seen distinctly, and to devise a mode of expressing the result obtained, and with it the degree of the acuteness of vision.

The smallest angle under which, by the normal eye, an object can still be recognised distinctly, is one of five degrees ( $= 5^\circ$ ), e.g.: Take the letter *I*, which we suppose to be one inch high, its width being equal to one-fifth of its height; place that letter at 50 feet from the normal eye under examination, and it can be recognised. To ascertain under what angle it is seen, we have to draw a straight line from the extreme points, i.e. from the upper and lower ends of the letter to the two corresponding points of the small inverted image of the letter in the retina. These lines cross each other within the eye, and at the point of crossing form equal angles. If the letter is brought nearer—say to a distance of 40 feet or 30 feet—the image on the retina is larger, and the letter, therefore, can be better perceived, because its

image is spread over a larger number of perceptive elements of the retina. If the letter is held further off than 50 feet—say at 55 or 60 feet—it can no more be perceived distinctly, because the image on the retina is too small. If we measure the angle on either side of the point of crossing which the lines form with each other when drawn from the two ends of the letter to the corresponding point of the image in the retina, the letter being held at 50 feet, we find that each angle measures  $5^\circ$ , and express this by saying that the letter *I* is seen under an angle of  $5^\circ$ . If the letter is held nearer, the angle becomes larger; if it is held further off, it becomes smaller. The further from the eye the letter *I* is held, the smaller is its image on the retina, and the smaller the angle formed by the straight lines drawn from the two ends of the letter to those of its inverted image on the retina, and the greater the acuteness of vision if this image can still be perceived distinctly. Therefore, by determining the degrees, i.e. the value of the smallest angle which corresponds to the image of an object which can still be recognised by the eye, we determine the degree of acuteness of vision. This angle is termed the angle of vision, or the visual angle. Some persons see objects under a smaller angle, and therefore possess a greater acuteness of vision. But people in general, to see an object distinctly, must see it under an angle of  $5^\circ$ . It is not necessary directly to measure this angle, as long as we possess a series of objects the sizes of which are known, and the furthest distances at which they are still recognised by the normal eye have been ascertained by experiment.

For practical purposes, as objects with which to ascertain the acuteness of vision, 'test types,' or series of letters of different determined sizes, have been introduced, of which those of Dr. Snellen of Utrecht (Holland) are the most perfect.

An explanation of the principles adopted in selecting and arranging the letters, and of the conclusions which may be drawn from the results of examination with the "test types," are given by Dr. Snellen, together with the types. Those who may not be able to obtain the "test types" can arrive at tolerably accurate results by using any other type, as long as the thickness of the strokes of the letters employed is equal to one-fifth of their height. The height of the letters should be the same for each series, but vary according to the distance at which they are held from the eye.

Experiment has shown that the furthest distance from the eye at which a letter measuring about one-fiftieth of an inch ( $= \frac{1}{50}''$ ) in height, can be distinctly recognised by a normal eye, is one foot ( $= 1'$ ). That, when measuring about  $\frac{2}{50}''$ , the furthest distance at which it can be recognised is  $2'$ ; when measuring about  $\frac{3}{50}''$  or  $\frac{1}{10}''$ , it is  $3'$ ; when measuring about  $\frac{4}{50}''$  or  $\frac{1}{5}''$ , it is  $4'$ ; for letters  $\frac{5}{50}''$  in height,  $5'$ ; for those of  $\frac{6}{50}''$ , it is  $6'$ , &c.; provided always that the thickness of the stroke of each letter be one-fifth of its height. We may thus arrange a series of letters, numbering each series, so that the letters of the series No. 1, or of series I, measure each  $\frac{1}{50}''$  in height, and should be recognised at  $1'$ , and not further; those marked II, or No. 2, should be recognised at  $2'$ ; those marked XX, or No. 20, at  $20'$ , &c. &c. The number above each series, therefore, indicates the distance, in feet, at which

the eye under examination, if healthy, should recognise each letter of the series, and the acuteness of vision is normal if No. 1 can be recognised at 1' ( $V = \frac{1}{1}$ ); II at 2' ( $V = \frac{2}{11}$ ); XX at 20' ( $V = \frac{20}{XX}$ ); C at 100' ( $V = \frac{100}{C}$ ).

By this method the degree of acuteness of vision is expressed by a fraction, of which the number above the horizontal line represents the distance at which the test letters can be recognised by the eye under examination, and the number below the horizontal line the distance at which the test letters can be recognised by the normal eye; e.g.

$V = \frac{1}{1}$ , or  $V = 1$ , signifies that at 1 foot, letters

of No. 1 (i.e. those which at 1 foot should be recognised by a normal eye) can be recognised by the eye under examination, and that therefore that eye is normal as far as acuteness of vision for objects placed at 1 foot from the eye goes. Instead

of writing  $V = \frac{1}{1}$ , we may, then, write  $V = 1$ .

$V = \frac{20}{XX}$  signifies that at 20 feet letters of No.

20 (i.e. those which at 20 feet should be recognised by a normal eye) can be recognised by the eye under examination, and that therefore the eye is normal, as far as acuteness of vision for objects placed at 20 feet from the eye goes. Instead of writing

$V = \frac{20}{XX}$ , we may write  $V$  for distance = 1. If

letters which should be recognised at 20 feet can only be recognised at 10 feet, we write  $V = \frac{10}{XX}$

or  $\frac{1}{2}$ , or  $V = \frac{1}{2}$ ; if they can only be recognised

at 5 feet, we write  $V = \frac{5}{XX}$ , or  $\frac{1}{4}$ , or  $V = \frac{1}{4}$ .

&c. &c. The number above the horizontal line always expresses the distance at which the test letters can be recognised by the eye under examination, and the number below the horizontal line the distance at which the test letters can be recognised by the normal eye, or ought to be recognised by the eye under examination if normal.

The acuteness of vision is somewhat influenced by the size of the pupil. It is increased in weak light when the pupil is dilated, and in strong or diffused light when it is contracted. We should therefore pay attention to the degree of light employed in the examination.

The range of accommodation and the acuteness of vision diminish as age advances. The former is shown by the necessity of holding small objects further from the eye in order to see them distinctly, the latter by the eye being no more able to distinguish objects of certain sizes at the same distance at which they could be recognised in youth.

The images formed in and perceived by the retina and the functions of the optic nerve-fibres become less perfect. Up to the age of forty, vision remains about normal. At the age of sixty it has already much decreased, so that, for instance, letters of No. 20 can only be recognised at from 15 inches to 16 inches. At the age of eighty, the acuteness of vision is about half as good as it was at forty.

The field of vision (F).—We distinguish be-

tween direct and indirect vision. In direct vision the object perceived lies opposite the yellow spot of the retina, one or both the visual lines being directed to the same point of the object. In indirect vision objects are perceived which lie opposite other parts of the retina to those used in direct vision. In indirect vision the images of objects are formed on more eccentric parts of the retina. The place occupied by the image on the retina determines the part of the field of vision upon which the image is projected. Any object perceived indirectly, while one or both visual lines are directed to one point of an object, lies in the field of vision. Having determined  $V$ , or the acuteness of direct vision, we proceed to ascertain  $F$ .

The limits or boundaries of the field of vision ( $F$ ) are given by the most excentrically placed point of an object which can still be perceived while one or both visual lines are directed to a point of an object. We must distinguish between  $F$ , or field of vision, and field of fixation; the latter comprises those points in the field of vision, which without altering the position of the head or body can still be seen directly.

The field of vision of one eye and that of both eyes together have been measured. That of one eye is sharply divided into lateral halves, a temporal and a nasal half. (See HEMIOPIA.)

A line drawn through the points which limit the field of vision forms an ellipse. Vertically, the field measures about  $160^\circ$ ; horizontally, about  $170^\circ$ . Great prominence of the margin of the orbit and of the bridge of the nose limit the boundaries of the field.

The percipient elements of the retina decrease in a certain proportion from the centre, or yellow spot, towards the periphery, and more rapidly in the vertical than in the horizontal direction. Having ascertained the extent or boundaries of the field of vision, we may wish to determine the acuteness of the retina as regards the perception of objects situated in different parts of the field.

Modes of ascertaining the extent of the sensitive part of the retina, or the field of vision of one eye.—A record of the extent of the sensitive portion of the retina, to enable us to compare the course of retinal and other changes, the effect of treatment, &c., may be made in the following manner:—A sheet of dull dark blue paper, size two feet square, with a small white cross traced in the centre, and a vertical and horizontal line intersecting each other at the centre of the cross and dividing the paper into quarters, is fixed upon a wall. The patient stands at the distance of 12 inches from the paper, facing the white cross, which should be on a level with the eye under examination, while the other eye is kept closed.

The patient is directed to look steadily and continually at the cross while we move a piece of white chalk fixed on a black handle, from the margin of the blue paper towards the cross. A mark is made at the spot where the white disc of chalk becomes first visible. Repeating this movement from different parts of the margin of the paper towards the cross, and not from the latter towards the margin, we obtain a series of points which correspond to the most peripheral sensitive portions of retina. Through these we draw a line, and the figure thus obtained represents the extent of the sensitive portion of retina, or in other words



the limits of the field of vision of the eye under examination. This record, if taken from an impaired retina, should be compared with tracings of the limits of the field of vision of the retina of a corresponding healthy eye.

The field of vision thus obtained is termed the quantitative F, while the so-called qualitative F, refers to the perception of letters at varying distances from the white cross. The limits of both kinds can be marked on the same sheet of paper, and measuring horizontally and vertically from the cross, we state that the quantitative and qualitative perception horizontally outwards and inwards, and vertically upwards and downwards, amounts to so many inches, &c.

A useful and quicker mode of ascertaining the sensibility of the more excentric parts of the retina and with it the limits of F, is the following:—Suppose we wish to examine the retina of a patient's right eye; we place ourselves at a distance of two feet from and facing the patient, and then direct him to look steadily at our left eye, which during the examination is continually directed to his right eye. If, by moving our hand at equal distances from our own and the patient's eye and opposite the excentric parts of the retina, we find that the patient perceives these movements at the same distances as we do with our healthy retina, we suppose the peripheral portions of his retina sensitive. The patient has to look at our right eye, while his left eye is under examination. Each part of F refers to the retina opposite that part; suppose e.g. that, moving the hand in the outer and upper quarter of the field, its movements are not perceived by the patient, we infer that an alteration of sensibility of the inner and lower quadrant of the retina exists.

Whatever modes of ascertaining the sensibility of the excentric parts of the retina be adopted, care should be taken that the position of the patient's eye and its distance from our own eye remain unaltered during the examination, and that they are the same whenever the examination is repeated.

The size, form, and distance of objects.—In the formation of ideas of the sizes, forms, and distances of objects, we are guided by the sizes, &c., of the images of these objects in the retina, and by the degree of effort of the power of accommodation required to produce distinct images. For the same purpose we make use of certain movements of the eyes, of the head, and of the body.

If we have a knowledge of the exact sizes, forms, and distances of a few objects, we possess a guide in forming our judgment of the sizes, &c., of others. Thus, by a continuous repetition or modification of the muscular efforts which are necessary to see in succession different objects and their details, we acquire experience as regards the muscular power which each time is required to recognise the size, &c., of any particular object, and to this experience we appeal when examining new objects.

The size of the image of any object on the retina varies with the distance of the object; and knowing the sizes of some objects and those of their retinal images, we possess a second means by which we improve our ideas as to the sizes, distances, &c., of other objects. If the length or size of an image formed on the retina by an object be required: then having given the length

of the object, equal to any assumed length (e.g. 3 feet) and the distance of its middle point, measured along a line, which we assume a continuation of the optic axis, from the nodal point equal to 7 feet, we have AB (the length of the object) : ab (the length of its image in the retina) :: NE (the distance of the middle point of the object from the nodal point) : Ne (the distance of the middle point of the image in the retina from the nodal point)  $AB : ab :: NE : Ne$ , hence  $ab = \frac{AB}{NE} + Ne$ .

Now, we express the distance of the image on the retina from the nodal point; and this distance is constant. The distance NE varies, but the distance Ne remains invariable and is equal to  $\frac{5}{8}$  of an inch. The length of the image, expressed in fractional or decimal parts of an inch, is found by multiplying  $\frac{5}{8}$  by the fraction  $\frac{AB}{NE}$ .

In the case assumed,  $AB = 3$  feet, and  $NE = 7$  feet. Hence the length of image,  $= \frac{3}{7} \times \frac{5}{8}$  inch  $= \frac{15}{56}$ , or  $\cdot 26785$  inch. It is necessary that A B and NE be expressed in, or be reduced, to the same denomination. Thus, if it be required to find the size or length of an image formed by an object 10 inches in length, and placed at the distance of eight feet from the nodal point, then length or size of image

$$= \frac{10}{8 \times 12} \times \frac{5}{8} \text{ inch} = \frac{25}{384}, \text{ or } \cdot 0651 \text{ inch.}$$

The idea of bodily form of any object is chiefly developed through the dissimilarity of the retinal images of the two eyes. While looking at one point of an object this point appears single, and all others appear double. By then viewing in succession other points of the same object, we each time alter the convergence of the eyes as well as the sizes of the two retinal images, and with these the distances of those points of an object which are seen double. We thus gradually acquire an idea of what is termed the form or solidity of an object.

We must more particularly allude to the mode in which an idea of the size of an object is developed. Suppose we distinctly see a line of unknown length at a known distance, and are required to state what the length of the line amounts to. To do this we direct the visual line first to one end of the line, then along the line to the other end. The visual line has thus to describe a certain angle, or to travel over a certain distance, and upon the estimation of this angle, or this distance (that is, upon the amount of muscular power required to describe the angle), depends our statement as regards the length of the line; e.g., if we look from one end of a line, which is one foot long, to the other end, our visual lines have to travel a shorter distance than when looking in the same way at a line which is five or ten feet long, or more. Less muscular power is required to look over the first than over the other lines, and it is from the experience acquired by repeating the experiment unconsciously upon objects which surround us that we finally possess the power of rapidly stating the size of any object—its height by estimating the distance of its two extreme points from each other in a vertical direction; its width by estimating the two extreme points in a horizontal direction.

Our estimation of the rate of motion of an ob-

ject depends upon the muscular power which is required to maintain a distinct view of the object in motion. The sensation of the movement of our muscles gives rise to the idea of motion. To form an idea of the rate at which other objects move, we must either be at rest, or we must know our own rate of motion.

*Perception of Colours, and its Anomalies.*—Colours, to be recognised as such, must occupy a certain amount of surface, and be illuminated by a certain quantity of light. These conditions vary with different colours; e.g., a red square figure of a certain size, and on a white ground, if badly illuminated, or very small, may still be recognised as regards its square shape, but no longer as regards its colour, which appears black. A blue square figure appears black at a shorter distance from the eyes than a red one.

The power of distinguishing colours is greatest in the region of the yellow spot, and decreases towards the periphery of the retina, though not with equal rapidity in all directions. A square figure of any colour painted on a white background, when carried slowly from opposite the yellow spot to opposite the more peripheral parts of the retina, gradually becomes indistinct, and finally black. It at first appears smaller, and becomes at last ill-defined. The colour of the figure becomes indistinct sooner than its shape. A yellow, green, blue, or red square on a black background gradually becomes white.

The larger the coloured surface, the further from the yellow spot can its colour be recognised. No exact relation exists, however, between the rapidity with which the power of recognising a colour decreases, and the size of the coloured surface. The power of recognising colour is limited by the time during which it is exposed to view, and this varies for different colours. Any colour when looked at for a certain time, gradually fades.

We distinguish, as regards anomalies in the perception of colours, between those cases in which, in the course of a gradually increasing amblyopia, the perception of tints, and finally that of pure colours, is lost; and those in which vision, as regards acuteness, is not at all, or but slightly impaired. To the latter group the term Daltonism, or colour blindness, is applied. There may be complete loss of perception of colours, or only loss of perception of some colours. Complete colour blindness—achromatopsia—in which condition only black and white can be recognised, is rare. Generally the defect is confined to a few colours, while varieties in the intensity of those colours which can be recognised are often more rapidly perceived than by a healthy eye. Red or yellow are distinguished with difficulty, or not at all, from grey, blue, and other colours. Frequently red and orange cannot be recognised, rarely green. Some eyes can only distinguish tints of yellow or blue; few can distinguish yellow.

In the slight degrees much light is required to recognise the colour for which the sensibility is diminished. Daltonism is congenital, and is observed in children from parents of blood relationship; it is frequently hereditary; it is incurable, and continues for life.

Chromato-dysopia means the mistaking of colours which in the solar spectrum are very distant from each other. More frequently colours which are related to each other, or shades of the

same colour, particularly violet and lilac, are mistaken.

*Coloured vision (Chromopsia, or Chrupsia).*—Persons suffering from this affection complain that all objects appear of one colour—yellow, green, or red. Coloured vision may be intermittent, or change from one colour to another. It occurs in the course of cerebral diseases, after undue exertion of the eyes, and after operations for cataract. To persons who have taken a large dose of santonin, grey objects appear greenish-yellow. Pure white santonin, if exposed to light as in the media of the eye, turns yellow.

In some cases benefit has been derived from prescribing spectacles with tinted glasses of the colour complementary to the one under which objects appear to the patient. Cases of coloured vision have occurred in which, in a word, or in a series of figures, different letters or figures appeared of different colours.

*Photopsia (Spintherismus, Phosphenes, flashes of light).*—Photopsia is observed in blind as well as in seeing persons. "Fiery wheels," "balls," "stars of yellow, green, and red colours," "flashes of lightning," "rain of fiery sparks," "a mass of fire floating in the eye," "an appearance as if the eye were lighted up by moonlight," and similar photopsiæ are observed during sudden movements of the eyes, after blows on the eyes, after undue exertion, especially in bright light; during inflammatory changes, affecting the relations of the rods and bulbs to the adjoining parts, during extra-ocular changes causing hyperæmia of the optic nerve-fibres, after poisoning by various gases, by alcohol, &c.

To test the power of the retina for perception of light, we use artificial light. A record of the degree of this power becomes necessary if the patient has only perception of shadows, or can merely distinguish light from dark, as in advanced cataract, or in amblyopia.

The patient being placed as for ophthalmoscopic examination, we throw the light of the ophthalmoscope upon the different parts of the sclerotic, iris, and pupil, and vary the quantity of reflected light by decreasing the intensity of the flame, or by holding the instrument further from the eye.

The experience obtained from the comparison of different eyes, with or without cataract, but having healthy retinæ, examined in this way teaches us the quantity of light which should be perceived by a healthy retina. If no light at all can be perceived, e.g., when thrown from above upon the upper half of the sclerotic, so that it should reach the lower half of the retina, while the direction from whence it comes is readily recognised when it is thrown on other parts of the sclerotic, we may rest satisfied that the lower half of the retina does not perceive light.

*Duration (persistence) of retinal impressions.*—Many of us must have observed that after looking for a short time at the red disc of the setting sun, the disc often remains visible for a few minutes, though the eyelids be closed; the retinal impression having remained persistent beyond the usual time. One-eighth of a second is the average time during which a retinal impression at the yellow spot persists before another one can take its place. The time of persistence can by practice (by looking at a clear line on a dark background for a certain time), be increased to half a minute.



At the yellow spot, a more persistent retinal impression fades away gradually in some, with intermission in others, while in the more peripheral parts of the retina it always disappears by intermissions, i.e., it disappears, then suddenly re-appears somewhat fainter, and so on.

In some morbid changes of the visual apparatus, the persistence of retinal impressions has been known to continue for days and weeks, and to return whenever the patient's thoughts have reverted to the objects of the impressions.

*Binocular vision.*—By binocular vision, i.e., by vision with both eyes at the same time, we obtain :—

1. A larger field of vision. The inner (nasal) half of one retina perceives objects which are not seen simultaneously by the inner half of the fellow retina. 2. A better idea of the bodily forms of objects (each eye viewing the same object from different sides) and of the rate of motion, especially of those objects which recede from or approach the eyes.

A difference in the shape and with it a difference in the refraction of the two eyes, if exceeding certain limits, disturbs binocular vision, and that eye is used with which at the required distance vision is most acute. For superficial observation of objects, especially if the power of converging the eyes is well developed, binocular vision may exist even with great differences of refraction. Protrusion of one eye, or differences of size between the two eyes, within certain limits, cause an object placed at the same distance from both eyes, to appear smaller to one, i.e. to the less prominent eye, because the crossing point of the rays in the eye lies nearer the retina ; and larger to the other, i.e. to the more prominent eye, through the crossing point being situated further from the retina. With both eyes open, the object appears of a size which is the medium between that which it would appear to one eye and that it would appear to the other. Binocular vision is lost, in consequence of changes which impair vision of one eye only, and also through strabismus. The existence of binocular vision is established by alternately covering each eye during reading, when the uncovered eye should continue to read ; or by placing a prism before one eye, with the refracting angle upwards, when diplopia should appear with the double image, possessing the same distinctness as the true one. If binocular vision is absent we should never neglect examining the defective eye, and by practice we should increase its acuteness of vision.

Combined vision, though it be no more binocular, exists if the two eyes assist each other, e.g. in judging of the shape, distance, &c. of an object, as is the case if a cataract has been removed from one eye ; though there be differences in the distinctness and sizes of the images formed in each retina, yet the field of vision remains undisturbed and the functions of both retinæ are maintained in greater perfection. In myops operated upon for cataract in one eye, it occasionally happens that the eye operated upon is used for viewing distant objects and the other for reading.

Vision with one eye.—The sensation of muscular action experienced during accommodation, and during convergence (especially if the other eye is not destroyed), is the only means by which one eye can judge of the sizes, distances, and shape of

objects. Assistance is afforded in this, by the movements of the head and body.

#### ANOMALIES OF VISION.

The anomalies of vision, independent of those arising from disturbances caused by the "appendages of the eyeball," the eyelids, lacrymal apparatus, and conjunctiva, are at present subdivided into those which are the result of anomalies (1) of the refracting surfaces ; (2) of the transparent media ; (3) of the parts concerned in accommodation ; (4) of the retina ; (5) of the optic nerve or brain.

A short recapitulation of the numerous terms which were in use to designate the different kinds of impaired vision, previously to enlarging upon this classification, is necessary, together with an indication as to where the explanation of such terms may be found. Many of these terms are still employed, others are used in different or less restricted senses.

(A) Lesions of the power of recognising the positions, distances, forms, and rates of motion of objects. The patient states :—

1. "That he cannot recognise objects, situated at some distance, and that to read &c. he has to hold the type close." (See *Myopia* at the end of this article. See also *Presbyopia*.)

2. "That he can see well at a distance but has difficulty in recognising objects when held near." (See *Hypermetropia*.)

3. "That with both eyes open he sees double" (this is diplopia).

4. "That with one eye alone he sees double, treble, &c." (this is polyopia monocularis).

5. "That objects seen with one or with both eyes appear too small" (this is termed mikropia, and is frequently observed during anomalies of accommodation or sudden changes in the position of the crystalline lens).

6. "That objects seen with one or both eyes appear too large" (this condition is termed megalopia). The causes are similar to those just stated, but act in an opposite direction.

7. "That an object can only be recognized by rolling the eye about or holding the object sideways." Corneal opacities and lesions of the yellow spot have been observed among other causes.

8. "That objects appear distorted, bent, &c." (metamorphopsia). Anomalies of the light-refracting parts, and lesions of the retina or brain may be the causes.

9 "That only half or part of an object can be seen." (See *Hemipopia* and *Scotoma*.)

10. "That objects which are at rest appear in motion." (See *Paralysis* and *Paresis*.)

11. "That the distance of an object is judged wrongly, or cannot be determined at all." The usual causes are :—sudden loss of one eye ; the use of spectacles for going about, by persons advanced in age who have not worn any before ; the use of spectacles by those who have been operated upon for cataract ; paresis and paralysis of the muscles which come into play during accommodation.

12. "That he is obliged to look for some time before he can recognise an object" (= slow vision). This symptom is connected with lesions of the retina, optic nerve, or brain.

13. "That objects can be seen standing before the eyes for some time after they are closed"

(= persistent vision). See *Duration of Retinal Impressions*.

14. "That the images of objects just perceived, vanish and return, the eyes being kept closed" (= intermittent vision). See *Duration of Retinal Impressions*.

15. "That after looking, especially at small objects for some time, they become misty, but that on closing the eyes for a moment, or rubbing them, the object can again be seen distinctly for a short time (= weak sight, impaired vision, &c.) See *Asthenopia* and *Circles of Diffusion*.

(B) *Lesions of the power of recognising colour.* The patient states:—

1. "That all objects appear of the same colour (= coloured vision—chromopsia). This symptom is observed occasionally in persons who have been operated upon for cataract, and in those suffering from changes of colour of the transparent media, as may occur, e.g., during jaundice.

2. "That objects—the flame of a candle, &c.—seem surrounded by rainbow colours." (See *GLAUCOMA, CONJUNCTIVA, and CORNEA*.)

3. "That colours cannot be perceived at all, or that only some can be recognised, or that colours are mistaken" (= colour-blindness). See *Perception of Colours*.

(C) *Lesions as regards the sensibility to light.* The patient states:—

1. "That the light dazzles the eyes." (See *PHOTOPHOBIA*, or intolerance of light, which is observed congenitally in albinos and in persons without irides.) The usual causes of this condition are corneal opacities and other superficial changes of the cornea. It is also observed during hyperæmia of the optic nerve, and in many cases of myopia and in commencing glaucoma.

2. "That much time is required before he can see when coming from a light into a dark room." (See *NYCTALOPIA*.)

3. "That the ordinary amount of light is no more sufficient to see small objects." (See *PRESBYOPIA*.) The functions of the retina and brain should be examined.

4. "That on closing the eyes, or in the dark, he sees flashes of light, fiery circles, falling stars, &c." (= photopsia phosphenes). See *Myopia and Morbid Changes of the Optic Nerve and Retina*.

The diagnosis and treatment of the anomalies of vision are most facilitated by ascertaining in succession the functions of the parts necessary for vision. These are:—

1. The light-refracting portions of the eye (comprising the cornea, the aqueous humour, the crystalline lens, the vitreous substance), together with the retina (the screen upon which an inverted image of an object is to be formed), as far as regards its distance from the nodal point, and with it the shape of the eyeball. Anomalies of the curvature of one or several of these structures give rise to impairment of vision through disturbing the refraction. To this group belong myopia, hypermetropia, and astigmatism, &c.

2. The media of the eye, i.e. the parts which in health are transparent when viewed with the unaided eye, excepting the retina and the optic disc. The kind of disturbance of vision caused through impaired transparency of the media is described under *CORNEA, OPACITIES OF, PUPIL, CLOSURE OF, CATARACT, &c.* The light, instead of reaching the retina in the usual way, is diffused over it, and

objects appear misty, and the contrast between light and shade is diminished.

3. The parts concerned directly or indirectly in the accommodation of the eye. These are the crystalline lens, the ciliary muscle, the parts immediately adjoining these, and the external muscles of the eye. The number of persons whose vision is disturbed through anomalies in these parts is very great. The anomalies of refraction often make themselves felt by disturbances of the accommodation. Most cases of what by some is termed painful vision belong to this group. Senile changes affecting the contractility of the iris and ciliary muscle, and the elasticity and consistence of the crystalline lens, are a fertile source of derangements of vision.

4. The retina, optic disc, and the tunics adjoining them.

5. The brain and those other parts of the nervous system which are essential to vision.

The impairment of vision through lesions of the parts mentioned under 4 and 5, whether the lesion has originated in the part, or the latter has become impaired secondarily, is termed amblyopia (*ἀμβλύς* = obtuse, and *ὤψ* = eye), as long as there is perception of light; amaurosis (*ἀμαυρός* = blind), if the vision is entirely destroyed.

Previously to ascertaining the state of the parts just mentioned, we must not neglect examining the appendages of the eyeball, the eyelids, the conjunctiva, the lacrymal apparatus, since but slightly perceptible changes of these parts may give rise to changes of vision which much distress the patient—e.g. the mucus of slight catarrhal ophthalmia may give rise to muscæ or to chromopsia.

Impairment or destruction of the functions of certain portions of the retina or of the optic nerve-fibres often give rise to anomalies of vision, which in themselves are characteristic of the morbid changes of which they are symptoms.

The following are some of the forms of amaurosis and amblyopia frequently observed:—

Amblyopia, or amaurosis of circumscribed portions of the retina.

A circumscribed amblyopic or amaurotic portion of the retina is termed a 'scotoma.' It gives rise to interruption of the field of vision.

1. Scotoma in the region of the yellow spot—central scotoma, central interruption of the field of vision, impairment of direct vision.

A scotoma in this region has been observed after looking into strong light or after working too much at the microscope. It may appear in both eyes if both are used in succession. In the eye thus used a yellowish mist, whose place, if the work be continued, becomes occupied by a deep brown one, is noticed. Objects placed opposite this region can no more be perceived. Hours may elapse before the mist has cleared away and vision has become normal again.

The boundary of the impaired portion of retina is ill-defined, while the function of the more peripheral parts may continue undisturbed. With the ophthalmoscope an increased greyish haze surrounding the reddish centre of the yellow spot is observed. From this kind of scotoma, which may recur whenever cause is given, we distinguish the one which appears more gradually, without any apparent cause, often in both eyes, and remains permanently.

On ophthalmoscopic examination we may find



choroido-retinitis, loss of transparency, followed by local pigmentation and atrophy.

In these cases more peripheral parts of the retina sometimes arrive at a degree of acuteness which is not possessed by equally excentric parts of the healthy retina.

Another form of central scotoma is the one caused by cerebral or extra-ocular changes in which the ophthalmoscopic examination is often negative, and the boundary of the impaired portions of retina very irregular. The arrest of the function of a certain number of optic nerve-fibres, e.g., from cerebral changes, give rise to impairment of the function of the retina, to which those fibres belong, and to a scotoma which lies opposite the impaired part of the retina, while the rest of the retina remains normal. But if a portion of the retina and of the entire adjoining layer of optic nerve-fibres is destroyed through intra-ocular changes, then the function of the more excentric part of the retina is abolished, as far as the nerve fibres are concerned, which have to pass from other parts through the destroyed portion.

The following mode of ascertaining the extent of small central scotomata, the fellow eye being healthy, has been proposed:—The patient is directed to look with both eyes at a white spot on black dull paper. To healthy eyes the white spot, viewed through a blue-tinted glass, held before one, and through a yellow-tinted glass held before the fellow eye, appears of a dirty green colour; while if the region of the yellow spot of e.g. the left eye is impaired, the healthy right eye looking through the yellow, and the left through the blue-tinted glass, at a piece of white chalk held at the side of the white spot, the spot and piece of chalk appear yellow. Now, on moving the piece of chalk along the black paper away from the white spot (both eyes fixed on the latter), the chalk appears of a dirty green colour the moment a point is reached where both retinae participate in the act of vision. The shape of the impaired portion of retina can be found by ascertaining a certain number of these points.

2. An amblyopic or amaurotic portion, i.e. a scotoma, adjoining the optic disc, and most frequently the portion next the yellow spot. "Enlargement of the blind spot."

Small blind or impaired portions of the retina adjoining the optic disc are generally not noticed by the patient. Large ones, if encroaching upon the region of the yellow spot, betray themselves in consequence of portions of an object situated outwards from the point of the object directly looked at appearing indistinct or missing. The impaired portion is rarely irregular, generally transversely oval. Atrophic changes commencing at the choroido-retinal aperture, and following inflammation or simple distension, as in extreme myopia, are the usual cause.

If recent and appearing rapidly, they for a time impair ("dazzle") vision of the fellow eye.

3. Amblyopia or amaurosis of other parts of the retina; excentric scotomata; excentric interruptions of the field of vision.

If excentric portions are not destroyed, but only more or less impaired, they appear as differently-shaped grey, black, or coloured spots, either entirely obscuring portions of an object, or causing them to appear indistinct, misty, or distorted, or smaller or larger. Small impaired spots are often overlooked,

especially if confined to one eye, and are best perceived if the other eye is closed. They are generally the result of choroido-retinitis.

4. Amblyopia or amaurosis progressing from the periphery (margin) of the retina towards the yellow spot; contraction or limitation of the field of vision.

*The impairment of vision*—(1) May be confined to one half of the retina ("hemioptic limitation").

(2) It may advance to an equal extent from all points of the periphery of the retina towards the yellow spot ("concentric limitation"), as frequently occurs in both eyes of the same patient, a zone of amblyopic retina joining the amauroticone.

(3) It may advance more rapidly from one side ("irregular limitation").

Of this latter, different varieties occur, e.g., it may progress more rapidly from the outer margin of the retina, as in cupping of the optic disc; or more rapidly from above and below, as in anæmia and atrophy of the optic disc; or irregularly from all sides, as in the different forms of choroido-retinitis.

The "amaurotic" portions of the retina may join healthy portions, but more frequently they are contiguous with "amblyopic" ones.

Cerebral changes affecting vision lead simultaneously to excentric limitation and to impairment of direct vision; not so morbid changes in the retina.

The prognosis is better if, from impeded innervation or from non-use, direct vision is much impaired while the excentric parts of the retina remain sensitive throughout, than if direct vision is good, but the excentric parts are much or irregularly impaired.

5. Hemioptic; half vision. The right half of the retina of the right and of the left eye (the outer or temporal half of the right and the inner or nasal half of the left retina) are supplied by the right optic nerve tract, and the left half (the outer half of the left and the inner half of the right retina) by the left optic nerve tract. The right and left optic nerve tracts meet at the chiasma. The fibres of the outer half of each tract go, those of the right tract to the optic nerve of the right eye, and thence to the outer half of the retina of the right eye, those of the left tract to the optic nerve of the left eye, and thence to the outer half of the retina of the left eye; while the fibres of the inner half of each tract cross each other at the chiasma, those of the right tract crossing over to become the inner half of the left optic nerve, and to go to the inner half of the left retina, those of the left to become the inner half of the right optic nerve, and to go to the inner half of the right retina.

Non-crossing of the tracts of the optic nerves, or absence of the chiasma, with and without impairment of vision, have been observed by several anatomists. There occur in the chiasma also fibres, which go from eye to eye, and others which pass from one side of the brain to the other.

The varieties of hemioptic are in order of frequency—(1) Loss of vision of the outer half of the right and of the inner half of the left retina, from paralysis of the right optic nerve tract, and loss of vision of the outer half of the left and of the inner half of the right retina, from paralysis of the left optic nerve tract. The line of demarcation between the sensitive and blind part of the

retina is vertical and sharply defined. On examination with the ophthalmoscope, we may find both optic discs healthy or hyperæmic, but never any morbid change confined to one half of the disc only. These two forms are most frequent, and are observed in the course of tumors, of apoplexy with hemiopia, of diabetes, &c. The morbid changes which cause the hemiopia are situated on one side of the brain. We infer, if loss of vision of the entire retina follows, that these changes are no longer confined to one side of the brain. Hemiopia after apoplexy remains stationary in many cases, and blindness need not necessarily follow.

Tumors and periostitis, at or near the chiasma, may give rise to any of the above or subsequently to be mentioned forms of hemiopia. The hemiopia caused by changes about the chiasma is often followed by loss of vision and not unfrequently by recovery of the functions of one optic nerve, the hemiopia remaining stationary for years.

(2) Loss of vision of the outer half of each retina (of the right half of the right, of the left half of the left eye). This form, as regards vision, is the least troublesome.

(3) A very rare form is paralysis of the inner half of each retina. It has been observed in the course of intracranial tumors.

6. Night blindness (*hemeralopia*) is an anomaly characterised by a sudden impairment of vision, amounting in rare cases to loss of vision, as soon as the quantity of light decreases beyond a certain point, while for the function of the healthy eye that amount of light is still sufficient. Persons suffering from this affection, in full daylight often enjoy normal, or nearly normal, vision. Night blindness varies in degree, and frequently in the two eyes of the same person.

The dilated and sluggish pupil, and the want of contractility of the ciliary muscle, with insufficiency of the internal recti muscles, observed in many cases, seems not to be owing to paresis of the third nerve, since the application of tincture of opium to the conjunctiva causes active contraction of these parts. In rare instances only the region of the yellow spot is affected, a dark brown cloud obscuring the object, which when held opposite lateral parts of the retina, is distinctly recognised. Red, blue, or violet light is not perceived so readily as green, yellow, or white light. If this affection appears suddenly following exposure of the retina to bright light, it may continue for months, e. g. until winter, and return again in spring. In fresh cases, or after a good night's rest, it does not appear in the forenoon, though the day may be dull; while after mid day, with the same degree of light, it becomes felt. The result of an ophthalmoscopic examination is negative in many cases. Choroido-retinitis and its effects, or hyperæmia of the optic disc and retina, may be found.

As causes are mentioned—(1) Various forms of choroido-retinitis and intra and extra-ocular morbid changes, affecting first the periphery of the retina. In these cases the night blindness is a forerunner of amblyopia or amaurosis.

(2) *Scurvy*, of which it may be the only symptom; *ague*.

(3) *Exposure*, especially if frequent, of the retina to direct or reflected sun or moonlight. It has appeared as an epidemic among sailors, and soldiers, though not all exposed to the same causes

may have suffered from it. It is more frequently observed in spring.

Treatment (see treatment of the various forms of choroido-retinitis). If occurring during or after *ague*, one grain doses of camphor, three times daily, have removed it. Complete exclusion from light (if following exposure to this agent) for from one to five days, and good nourishment, though not preventing a relapse, cures it for a time.

7. *Snow blindness* is observed at the beginning of winter in many persons, and in animals exposed to the white reflection of the snow. It may reduce vision to perception of light. It soon subsides spontaneously, and has been known to act beneficially in cases of anæmia of the retina.

8. *Amaurosis* or *amblyopia*, from over-use of the eyes through fine work, microscope or telescope work, or from sudden exposure to strong light (lightning). The region of the yellow spot is the part mostly impaired.

With the ophthalmoscope we may find choroido-retinitis. Exposure to strong light has even given rise to ophthalmitis of the exposed eye. In other cases no changes are discoverable within the eye with ophthalmoscope.

Anomalies of vision from extra-ocular, and especially from cerebral causes, often present no marked objective symptoms beyond the impairment of vision. The eye, whose vision is disturbed, may appear quite healthy, or there may be but slight alteration of colour of the optic disc. For the prognosis and treatment of such cases it becomes necessary to examine the other functions of the body, so as to obtain a clue to the seat, &c., of the lesion which has implicated the optic nerve-fibres.

The following are symptoms which frequently precede or accompany cerebral lesions which give rise to impairment or loss of vision:—

*Headache*.—This in itself is no guide as to the cause and seat of the lesion which may have given rise to impaired vision. It may precede the latter for years, and is attributed to morbid changes in the *dura mater*. It is a symptom which frequently appears during or previous to impairment of vision, as the result of disturbed menstruation, and also during congestion of the cerebellum. Anæmia and atrophy of the optic disc of both eyes is the change which finally is observed with the ophthalmoscope.

*Vomiting*.—We should ascertain what kind of vomiting there has been, whether of bile (the age of the patient attacked by this kind of vomiting, as a rule, varies between eighteen and thirty), or of blood (the age of the patient varies between forty and fifty); whether there has been obvious cause for it; whether it has appeared after meals, or at any other time. It may be a reflex action, which ceases as the ocular changes progress, or it may be connected with morbid changes about the *medulla oblongata*, or at the roots of the eighth nerve.

Vomiting and headache, with amblyopia or amaurosis, as a rule, are signs of cerebral disease. Inflammation of the optic disc of both eyes is the morbid change frequently found on ophthalmoscopic examination.

Giddiness is often complained of for a long period before any lesions of vision occur, especially by persons suffering from heart disease, with intermittent pulse, from rigid arteries and from derangement of circulation by cerebral changes.



*Convulsions, "epileptic fits" of otherwise healthy or of paralysed parts.*—Neither their character nor their frequency is a guide as regards the nature of the lesion which may have given rise to defective vision. If confined to one side, we may suspect the cause of impaired vision to lie near or at the corpus striatum. The fit, sometimes, is preceded by complete blindness, the latter being attributed to temporary anæmia of the retina from spasm of the coats of its blood-vessels.

Hemiplegia is a frequent forerunner or companion of disturbances of vision. If the two appear simultaneously, they are attributed to apoplexy near or in the corpus striatum or thalamus opticus. If the hemiplegia precedes the amaurosis for a long time, then we may attribute the latter to secondary cerebral lesions, and to fresh apoplexy if it occurs suddenly.

In amaurosis, with hemiplegia of the right side, and with loss of speech, both hemispheres have repeatedly been found diseased.

Amaurosis, when occurring on the same side as the hemiplegia, is attributed to embolism. Amaurosis from inflammation of the optic discs of both eyes without anomalies of locomotion, is generally complicated with, or caused by, lesions of the cerebellum or of the hemispheres.

*Ataxy of locomotion.*—Of patients suffering from this anomaly, fourteen have come under observation within the last four years. They were middle-aged persons, and complained at first of great general weakness, including that of the genital organs; of a sensation of "pins and needles" in the lower extremities preceding numbness, accompanied by a painful feeling of constriction of the chest. Then followed cramps in the feet, and trembling of the hands, especially when attempting to seize any object. Two months after the first symptoms of ataxy, vision became impaired, a mist "appearing before the eyes," which gradually got thicker, and rapidly reduced vision in some to perception of light, in others destroying it completely. The blood supply to the retina and choroid remained normal, but the optic disc rapidly became anæmic, and remained so even in the cases where the acuteness of vision rose from  $\frac{1}{16}$  to  $\frac{1}{2}$ .

The treatment of these cases by nitrate of silver has given favourable results. It is supposed to have restored the normal relation between the optic nerve-fibres and the nerve cells in the corpora quadrigemina.

In the cases in which there was no perception of light, no effect was produced, while in those who could still read large letters, the acuteness of vision rapidly (within from four to ten days) increased from  $\frac{1}{16}$  to  $\frac{1}{2}$ . After six weeks, all signs of the ataxy had disappeared. The nitrate of silver is given twice daily, at first in doses of  $\frac{1}{4}$  of a grain, gradually increasing it to one grain.

*The Causes of Amblyopia and of Amaurosis.*—

(1) Ocular (retinal, choroidal, or in the optic nerve). (2) Extra-ocular (orbital). (3) Cerebral, or spinal.

In cerebral changes accompanied by great disturbance of the circulation within the head, as observed in rapidly growing tumors, and during meningitis, hyperæmia of both the retina, rupture of the blood-vessels, swelling of the optic discs, are among the frequently observed ocular affections. In chronic cerebral changes, anæmia and atrophy

of the optic nerves are the usual changes observed with the ophthalmoscope.

The changes may be far away from the optic fibres, and yet through pressure impair their functions. There may be extensive disease of the hemispheres with perfect vision. Morbid changes of the right hemisphere are more often complicated by amaurosis.

Changes confined to one side of the brain may cause hemiopia, but never complete amaurosis, unless the latter appears secondarily.

*Amaurosis, or Amblyopia (a) from various kinds of intracranial and cerebral tumors.*—The usual seat of such tumors is the basis cranii, especially the sella turcica and the neighbourhood of the cerebellum.

They produce loss of vision, either mechanically, by pressure, impeding the functions of the optic nerves or the circulation; or by becoming complicated with inflammation of the optic nerves, with meningitis, &c. The latter complication frequently prevents our drawing conclusions from the nature of the impairment of vision as to the seat of the tumor. The most frequent changes observed with the ophthalmoscope in the course of cerebral tumors are—hyperæmia, or œdema, or inflammation of the optic disc and retina, and anæmia, or anæmia with atrophy of the optic disc. Slight protrusion of the eyeball, with fulness of the veins about the eyelids, is an occasional complication of tumor at the sella turcica, or at other parts of the basis cranii.

(b) *From morbid changes at the base of the brain.*—The most frequent is meningitis (tubercular, pyæmic, typhoid). In some cases the impairment of vision appears at the time of the meningitis; in many, however, long after it has passed. Both optic nerves, or one, or only part of an optic nerve, may be affected.

Amaurosis of both eyes in these cases is generally complicated with paralysis of other cerebral nerves.

(c) *Following apoplexy, softening, tuberculosis, abscess of the brain.*—The lesion of vision is often complicated with paralysis of separate spinal nerves, or of other cerebral nerves with hemi- or paraplegia. Apoplexy is a frequent cause. It may appear simultaneously in the eye and brain. Monolateral hæmorrhage into the thalamus opticus causes hemiopia. To produce blindness it must affect both sides. Hæmorrhage into the chiasma may cause blindness. When occurring at other parts of the basis cranii it generally also affects the third nerve.

(d) *Amaurosis through constriction of both optic nerves,* causing indentation, partial, or total destruction, through the two arterial communicantes posticæ.

(e) *Amaurosis or Amblyopia following injuries, especially blows or falls,* causing concussion of the brain, pain in the head, fits, peculiar anomalies of locomotion, frequently accompanying the impairment of vision. All hope of recovery of vision is lost, if once atrophy of the optic disc and retina has set in.

(f) *Hereditary amaurosis or amblyopia, from incomplete development of the brain or eye, microphthalmus, hydrophthalmus (coloboma), or from morbid changes appearing in the brain (hydrocephalus), or eyes during growth or in advanced life.*—One or several members of the same family

may suffer from this affection for several generations. In hydrocephalus the tracts of the optic nerves which run below the lower surface of the ventricles are unduly stretched during the distension of the latter by fluid, and the thalami optici and crura cerebri are pressed asunder. The floor of the third ventricle, the tuber cinereum, the chiasma, the sella turcica, and the adjoining part of the sphenoid bone, suffer likewise from the distension. Atrophic changes following choroiditis, and anæmia and atrophy of the optic disc and retina, are the changes most frequently observed simultaneously.

*Simulation of amaurosis, or of amblyopia* (1) *of both eyes* may occur in insane persons, or with a view of obtaining a certificate of blindness. We may suspect simulation if both the patient's pupils are active, and if he states that he cannot perceive light. If he says that he can see light, but cannot recognise objects, we may be unable to express an opinion.

(2) *Of one eye, generally of the right.*—If the pupil of the supposed blind eye (provided it be not under the influence of a mydriatic, and the fellow eye be thoroughly excluded from light), does not contract when suddenly exposed to strong light, but does do so when both eyes are open, we can pronounce the first eye to be blind. We should, if any doubt remains after having carefully examined the "supposed" blind eye, place a strong prism, e.g. one of  $12^\circ$ , with the refracting angle downwards, before the patient's good eye, causing him to look at the flame of a candle, when the simulation at once becomes apparent if the patient states that he sees two flames (attributing them to the action of the prism on the second eye.)

*Amaurosis or amblyopia, with disease of the spinal cord.*—Tenderness on pressure in the region of the first cervical vertebra, with impairment of vision, has been observed to precede the amaurosis.

The ophthalmoscopic symptoms in advanced cases are anæmia and atrophy of the optic discs and retina. The atrophy of the optic discs is in some cases the first of a series of symptoms arising from spinal changes. Much benefit has been derived in some cases by repeated blisters to the cervical region.

The *post-mortem* examination of some cases has shown atrophy of the trunks of the optic nerves, and morbid changes, e.g. atrophy in the thalami optici.

As causes have been observed—injuries, inflammation, atrophy.

*Reflex amaurosis, from "irritation," originating in one of the sensitive nerves, or from "irritation" of other parts of the nervous system.*—Cases of this group occur not unfrequently without any apparent changes in the eye (the optic disc, among other parts, appearing healthy), or in the functions of the cerebrum or cerebellum. The amblyopia or amaurosis is attributed to alterations in the tubercula quadrigemina, which are supposed to be the result of "irritation" elsewhere, e.g. of injuries to the spinal cord, of irritation of the frontal nerve, of neuralgia of the face, of gastralgia, of irritation caused by worms.

The appearance of the disturbance of vision after such irritation, its increase or decrease keeping step with the irritation, and its removal or relief on cessation of the supposed cause, justify the assumption of a reflex amaurosis.

*General or Constitutional Causes.*—Amaurosis or amblyopia appears—(a) Among other symptoms of albuminuria. (b) During syphilis. (c) During diabetes mellitus. (d) Through embolism.

The morbid changes comprised under *a, b, c, and d*, when localising themselves in the eyeball itself, assume certain characteristic forms, e.g., that of effusion of lymph in syphilis, that of peculiar infiltrations, with rupture of blood-vessels in albuminuria, &c., &c. If, on the appearance of amaurosis or amblyopia, we find the eyes intact, and after examination of either organs discover albuminuria, syphilis, &c., we adopt the same general treatment which would have been carried out if the eyes had been attacked.

(e) During irregularities of menstruation, during pregnancy, parturition, or lactation.

Sudden amaurosis, appearing about the time when menstruation was expected, has been observed in two cases to subside again after the re-appearance of that function. Vision returned gradually in both cases, and has remained normal.

Cases of recurrent amblyopia or amaurosis, commencing at some period of pregnancy, and subsiding after parturition, have repeatedly been recorded.

A frequent cause of amblyopia or amaurosis after sudden arrest of menstruation is the occurrence at that period of intra-ocular or of cerebral hæmorrhage which has been preceded in several cases by severe pain in the head, with unconsciousness.

The morbid changes which give rise to the lesion of vision during the above changes in the body, in many respects resemble those observed during albuminuria, and may be divided into three groups—those whose chief symptom is hæmorrhage with œdema of the parts adjoining the seat of hæmorrhage; those which appear with infiltration, inflammation, and the subsequent changes of texture in the eye (generally at and near the optic disc) or in some other part of the body; and those in which no lesion is discoverable within the eyes.

(f) Through general anæmia (ischæmia).

1. From general causes, diabetes, diarrhœa, spermatorrhœa, loss of blood, e.g. by vomiting. Vision in these cases is lost, in some gradually, in others suddenly. Much good may be done, if the impairment is not considerable, by improving the general health; while if the ophthalmoscopic signs of atrophy of the optic nerve and retina have appeared (and the sooner the worse) little hope remains, though the general health may have been restored.

Vomiting of blood in several patients from forty to fifty years of age (of whom a few suffered from ulceration with sloughing of the mucous membrane of the stomach) has been accompanied or followed by sudden loss of both eyes, or of one, the other eye becoming impaired from one to six months later. Vision in such cases, if lost suddenly, often remains lost, though the general quantity of blood may have been restored. The anæmia and atrophy of the retina and of the optic disc appear at a later period.

There may have been amaurosis for some time, while with the ophthalmoscope we find slight anæmia, or no changes at all. The quantity of blood lost, or anæmia of the brain, does not explain the loss of vision, since other cerebral functions return as the quantity of blood increases.



The amaurosis sometimes appears while the patient is recovering from the loss of blood. In some cases the loss of blood was so slight that the amaurosis could not be attributed to it.

2. Through anæmia, from local causes. Gradual compression of the artery of the retina is followed, at first, by impairment of the functions of the retina in the region of the yellow spot; sudden obstruction, by sudden amaurosis. The less arterial blood enters the retina, the more vision is impaired.

(g) Produced by tobacco, lead, quinine, or alcohol. These and other substances often produce spasm, or paresis, or paralysis of the accommodation as well. We should guard ourselves against mistaking the disturbances of vision due to these later conditions for amblyopia or amaurosis.

*By tobacco.*—The patients generally are of middle age, thin, pale; rarely complain of pain, and often state that the impairment of vision progressed slowly. Vision may, however, within six months, be reduced to perception of light. In the majority, if the disease is progressing, it reaches this degree in from six to eighteen months. It always affects both eyes, though it varies in degree; one eye may become blind without the patient being aware of it. Night blindness and decrease of the acuteness of vision for distance are often its earliest objective symptoms. Photopsia frequently appears, and sometimes after all vision is lost. With the ophthalmoscope we observe anæmia, and finally atrophy of the optic disc and retina. The greater the diminution of the number of arteries in the retina, the greater the impairment of vision. Post-mortem examinations have shown traces of basilar meningitis, affecting, besides the optic nerve, also the third and other facial nerves.

*By lead.*—Impairment of vision has followed medicinal application of lead in two cases, and working at lead in several. In the former, protracted headache was followed by sudden loss of vision in the right, and twenty-four hours later in the left eye, with paralysis of the ciliary muscle and iris, and with some increase of temperature. In a similar case vision returned after the use of mercury (to salivation) followed by that of iodide of potassium. In one of the latter cases, on post-mortem examination, except extreme anæmia, no morbid changes were discovered.

*By quinine.*—Deafness or noises in the ears are usual complications. With the ophthalmoscope we find a tortuous condition or at least an overfulness of the veins of the retina, in the otherwise healthy eye. Much benefit has been derived from repeated bleeding.

*By alcohol.*—In a case in which vision was reduced to perception of light during prolonged abuse of alcohol, the optic disc appeared healthy; vision after discontinuing drinking and by applying leeches to the temples rapidly returned, so as to allow the patient to follow his employment.

*Amblyopia through non-use, after prolonged exclusion, of one eye.*—This form of amblyopia reaches a high degree only if it be congenital, or of very long standing. It may remain undiscovered for years. The functions of the retina of one eye interfering with those of the fellow eye, may finally lead to "suppression" of direct vision. The development of higher degrees of amblyopia sometimes seems to be prevented through the pupil becoming closed or

cataract developed. Paralysis or paresis of the iris, of the accommodation, opacities of the cornea, and especially strabismus of one eye, are usual complications. Signs that the functions of the retina are nowhere interrupted are the integrity of the field of vision, and the proportionate decrease of the sensibility of the retina from the periphery towards the centre.

**HYPERMETROPIA.** (*Hyperpresbyopia*. *Hyperopia* = *H.*)—The term hypermetropia is given to an anomaly of refraction which is connected with a very frequent congenital alteration of the shape of the eyeball. The eyeball not only is too small, but the curvature of its tunics is abnormal and the retina stands too close to the crystalline lens. This gives rise to peculiar disturbances of vision.

Alteration of the elasticity and of the curvature of the light-refracting surfaces with a decrease of their refracting power constitute one of the senile changes of the human eye and give rise to a species of hypermetropia.

An eye without a crystalline lens, having only the cornea left to refract the light, is also termed hypermetropic, though the position and curvature of the retina be normal.

We shall here treat only of the hypermetropia which is the result of congenital anomaly of shape of the eyeball.

Hypermetropia occurs as a rule in both eyes, and frequently varies in degree in each. It is congenital and often hereditary.

Extreme hypermetropia is readily recognised by comparing the curvature of the sclerotic, e.g. from the outer margin of the cornea towards the nearest part of the optic nerve of the healthy eye, with that of the hypermetropic eye. In the latter, the sclerotic round the cornea is too slightly curved. Beyond the greatest transverse diameter of the eye, which appears to lie too near the cornea, it curves too abruptly towards the optic nerve. This acute curvature becomes more conspicuous by directing the patient to look towards the nose, so as to expose the outer aspect of the sclerotic. The eyeball appears flattened from before backwards, and its anterior and posterior poles are supposed to stand too near each other. The palpebral aperture in extreme cases appears much too large for the eyeball, and a recess of conjunctiva is observed near the outer canthus.

For the method how to recognise with the ophthalmoscope the existence, and in a great measure, the degree of hypermetropia, see **OPTHALMOSCOPE**.

*Examination with the ophthalmoscope. Examination of the erect image, &c.*—Many of the peculiarities of the hypermetropic eye, observed with the ophthalmoscope, can be explained by the anomaly of shape of the eyeball. Such as—the facility with which we obtain a distinct view of the erect image of the optic disc and of the retinal vessels at a great distance from the eye, and the apparent prominence into the vitreous chamber of the retina next the optic disc, with a corresponding alteration of the course of its blood-vessels.

Peculiarities which are attributed to abnormal development, are:—

1. A crescentic well defined white figure skirting the lower margin of the optic disc of one or of both eyes. This figure is readily distinguished

from the one observed in Myopia, by the absence of choroidal atrophy near it, and especially by its appearing to project into the vitreous chamber.

2. A defective blood-supply to the retina and optic disc, giving rise to some anæmia of the former. The high degrees of amblyopia occasionally met with in hypermetropia are accompanied by great hyperæmia in some, by anæmia of the optic disc in other cases.

3. An oval shape of the optic disc (the long axis of the oval standing vertically).

4. The abnormal shape of the eyeball.

The tunics within the sclerotic participate in the alteration of curvature of the sclerotic. The retina, and especially its centre (yellow spot), instead of being placed as in health at the principal focal distance of the dioptric system (cornea and lens), lies too near this system. This statement is borne out by dissections, and by measurements on the living eye. It might be supposed, though the shape be abnormal, that this is compensated by increased curvature of the cornea or of the lens, or of both, or that the retina occupies the normal position, but that the cornea and lens, or both, are too flat, and thus prevent the formation of defined images in the retina. Measurements of the cornea and lens of hypermetropic eyes have, however, shown that their curvature and position is normal, or, if deranged, that it rather tends to remedy the faulty position of the retina.

*Vision of Hypermetropics.*—Most of the disturbances of vision of hypermetropics must be sought in the too short distance of the retina from the cornea and lens. The emmetrop (the person with normal eyes) sees distant objects without making use of his power of accommodation (the retina being placed at the principal focal distance of the cornea and lens). The hypermetrop cannot do the same. He is obliged even when looking at distant objects (from which proceed parallel, or but slightly diverging rays) to use adjusting power, i.e. to cause the ciliary muscle to contract. The hypermetropic eye consumes muscular power when the emmetrop eye uses none.

The nearer to the eyes an object is held, the more do the rays diverge which come from the object, and the more adjusting power is the normal eye obliged to use to bring these rays to a focus. Now, the hypermetrop, to be able to see distinctly a distant object, is already using adjusting power as shown above, while the emmetrop is not yet compelled to do so.

The hypermetrop, when looking at near objects, does therefore not start with the same quantity of adjusting power, but having already made use of some has not sufficient when much is required; as e.g. for prolonged reading.

The disproportion between the shape of the hypermetropic eyeball, and the power of accommodation necessary to render acute vision possible, have led to the distinction of different kinds and degrees of hypermetropia.

*Kinds of Hypermetropia:*—

1. If the shape of the eye is but slightly altered (slight hypermetropia), and the power of accommodation normal, no complaints arise so long as that power suffices for easy distinct vision. The hypermetropia is stated to be altogether latent (— III). Some hypermetropia always remains latent as long as any power of accommodation is left. If the accommodation is paralysed (through

atropia), or only slight, as in advanced age, all, or most of the hypermetropia becomes manifest.

2. If complaints arise as regards vision, they are, as a rule, a symptom that some of the hypermetropia becomes manifest ( $= Hm$ ). General illness, or local causes, which tend to weaken the ciliary muscle, may cause the hypermetropia rapidly to become manifest.

3. Absolute hypermetropia exists if, with the greatest effort of accommodation, parallel rays or the images of distant objects cannot be brought to a focus in the retina.

The term relative manifest hypermetropia signifies that the relation is disturbed between the point towards which the hypermetropic eyes converge and the point from whence the rays come, e.g. if, when reading, the book is held at 16 inches from the eyes, then do the rays which come from the letters diverge from a point 16 inches distant, while the eyes may converge towards a point situated only at 12 inches from the eyes. In this case the convergence is too great. With greater convergence more power of accommodation can be exerted and improvement of vision is obtained. This explains the occurrence of this form of manifest hypermetropia.

*Degree:*—

The degree of hypermetropia necessarily varies with the distance of the retina from the cornea and lens (from the dioptric system), and may be expressed by the refracting power of that convex lens which, held close in front of the cornea of the hypermetropic eye, refracts rays coming from very distant objects (termed parallel rays) sufficiently to cause them after entering the eye, i.e. after refraction by the dioptric system at rest (the accommodation being paralysed by atropia) to come to a focus in the retina.

To determine the degree of the hypermetropia we must first paralyse the accommodation by atropia, and then find the strongest convex lens which, held close in front of the cornea, brings rays from very distant objects to a focus in the retina. Suppose the hypermetropic eye (its accommodation being paralysed by atropia) to look at a distant object, say at letters of No. 40 placed at 20 feet, or at letters of No. 20 placed at 40 feet. We find that to spell those letters, a convex lens of 20 inches focal distance is required, and that this cannot be done with any stronger convex lens. We therefore state the degree of hypermetropia as  $= \frac{1}{20}$ . If the eye requires a convex lens of 10 inches focal distance the hypermetropia is  $= \frac{1}{10}$ , &c.

The highest degree of hypermetropia on record is one of  $\frac{1}{1\frac{1}{2}}$  (requiring a concave lens of  $1\frac{1}{2}$  inch focal distance to bring parallel rays to a focus in the retina).

The degree of the manifest hypermetropia, i.e. the degree of the hypermetropia which shows itself when the accommodation is not paralysed, is also ascertained with concave lenses; e.g. if we find that  $\frac{1}{20}$  is the strongest convex lens with which letters of No. 20 can be recognised at 20 feet, we state the manifest hypermetropia to be  $\frac{1}{20}$  ( $Hm = \frac{1}{20}$ ). If, after paralysing the accommodation by atropia, we find  $\frac{1}{10}$  to be the strongest convex lens with which letters of No. 20 can be recognised at 20 feet, we state the absolute hypermetropia to be  $\frac{1}{10}$  ( $H = \frac{1}{10}$ ). In this case one



half of the existing hypermetropia had been masked by the accommodation.

If the power of accommodation is strong, as in young persons, and the degree of the hypermetropia moderate, the latter does not become manifest for a considerable time.

*Complaints of the hypermetropic patient:—*

The hypermetropia, if slight, is not felt, as long as the accommodation can overcome it with ease. The power of accommodation in all eyes diminishes as age advances, and the higher the degree of hypermetropia the sooner do difficulties of vision (termed asthenopia) arise.

*Asthenopia.*—Weak sight. Impaired vision. Impaired vision for near-work. Dulness of sight. Dimness of vision. Slowly adjusting sight. Affection of the retina from excessive employment. Debilitas visus. Hebetudo visus.

The two groups of muscles which, through want of power, give rise to asthenopia are the ciliary muscle and the external muscles of the eyeball.

To be able to read, or to do near-work with ease, and for a prolonged time, it is necessary that the contraction of these muscles should be possible, and be kept up efficiently for the time of work. The power of contraction may be destroyed by paralysis, or may be inefficient from paresis or weakness. It may be normal, but become exhausted too soon through the muscles being obliged to do work under circumstances under which in the normal eye they are at rest, or, at least, are less contracted. The latter is often the case in hypermetropia. The fatigue of the ciliary muscle is accelerated by the tendency which the crystalline lens has to return, by force of its own elasticity, to the shape and curvature which it has when at rest. The continued resistance offered by the crystalline lens tends to distend the contracted fibres of the ciliary muscle, and thus an additional increase of contraction becomes necessary. The term Accommodative Asthenopia has been used by some for want of power of the ciliary muscle. Many symptoms which accompany asthenopia do not essentially belong to it. We shall first treat of the symptoms of true asthenopia, and then of those which wrongly have been grouped with them.

*True Asthenopia.* (Accommodative Asthenopia.)—The patient complains that, when reading or engaged in other “near-work,” the letters or the finer details of the work become “dim” or disappear suddenly, or become indistinct gradually. After “rubbing” the eyes, or “closing the lids” for a short time he is again able to resume the work for some time. In high degrees of asthenopia these attacks of dimness appear frequently; in slighter degrees only during work by artificial light, or after prolonged work. They appear sooner during ill-health, or during any other change which affects the contractility of muscles. Asthenopia may continue for years without ever interfering with the acuteness of vision. In high degrees of hypermetropia the rapidly appearing “dimness” prevents the occurrence of other symptoms of fatigue. In a large number of cases the dimness of vision is preceded by a sensation of tension over the eyebrows, amounting sometimes to pain.

The rapidity with which the Asthenopia appears and its duration vary, and are connected with the nature of the work. It has been stated

that, in the usual course of hypermetropia, the age at which asthenopia appears is about equal to the denominator of the fraction which expresses the degree of hypermetropia, e.g. if the asthenopia appears about the age of ten years the hypermetropia is  $= \frac{1}{10}$ . Asthenopia is more severe and appears sooner in those engaged in much “near-work,” though in rare cases it even appears when looking at distant or at near large objects.

The true form of asthenopia is observed in hypermetropia and in astigmatism.

Persons suffering from true asthenopia only, are as a rule cured by spectacles with convex lenses. Much benefit is also derived from the powdered secale correntum (5 to 10 grains to be taken four times daily) with some carbonate of magnesia, or of iron.

*Apparent, not true Asthenopia.*—The patients complain, when reading, &c., or even when looking at a distance, of the eyes aching and “watering,” of pain in the ciliary region, and sometimes at the back of the eyes. The pain may be permanent and increase when attempting to work. In most cases, this is accompanied by a sensation of tension over the eyebrows, and in many by smarting of the eyelids, by photophobia, and occasionally by phosphenes. The symptoms may increase to an extent that even going about in bright light becomes impossible.

Dimness of vision may accompany these symptoms, but it is the pain, &c. which compel the patients to desist from work often for months.

Apparent asthenopia occurs often in myopia, and occasionally in hyperæmia of the optic disc and retina. It is termed hyperæsthesia of the retina if no organic changes are discoverable.

The asthenopia arising from weakness (“insufficiency”) of the internal recti muscles, by some termed muscular asthenopia, is often met with together with accommodative asthenopia. Sometimes it is mistaken for it.

*Treatment.*—Asthenopia, whether true or apparent, is a symptom which as a rule subsides under proper treatment of its cause. (See the Treatment of Hypermetropia, Astigmatism, Myopia, Insufficiency, Paresis).

*Vision of hypermetrops.*—In the slighter degrees of hypermetropia, vision is generally acute, and difficulties arise not from any anomaly of the retina but from exhaustion of the accommodation. The usual complaint is, that very small type cannot be read, that large type can be seen with greater ease when held further from the eyes, and that after having been reading or working for some time, the letters or work become confused or disappear altogether. After rubbing the eyes, or closing them for a short time, work can be continued. These symptoms are those of asthenopia.

In high degrees (of  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and more) the acuteness of vision is rarely perfect, and asthenopia appears sooner. The cause of this in some is astigmatism, in others it must be attributed to congenital anomalies of the retina or optic nerve. Occasionally we meet with hypermetropia in which the optic disc and retina, as far as ophthalmoscopic appearances go, are quite healthy, and yet vision is reduced to perception of shadows, or only  $= \frac{1}{100}$  or  $\frac{1}{1000}$ .

The acuteness of vision may still be called perfect, if with the assistance of convex glasses it can be made to reach that of the normal eye; e.g. if

No. 1. can be read at 1 ft., No. 6 at 6 ft., No. 10, at 10 ft., &c.

If one eye alone is highly hypermetropic, the other but slightly, the former through not being used becomes amblyopic. Rapid improvement of vision is obtained when practising the amblyopic eye alone frequently with convex lenses.

*Treatment.*—Most of the inconveniences arising from hypermetropia can be removed by the use of spectacles with convex lenses. Persons who object to spectacles have to put up with the inconvenience arising from the hypermetropia.

Hypermetropic persons often attribute the asthenopia to commencing amaurosis, and their minds are much relieved by an explanation of the nature and cause of these symptoms.

Few hypermetropics object to wearing spectacles, since in most cases they have only to be worn for "near-work." It is well, by paralysing the accommodation with atropia to ascertain the absolute degree of hypermetropia. In persons engaged in business, or of nervous temperament, this may be dispensed with, provided we explain to the patient the nature of the case, and the necessity of having the spectacles altered, as soon as the symptoms of asthenopia reappear.

The object of wearing spectacles with convex lenses is, to remedy the faulty refraction arising from the malposition of the retina, to prevent the power of accommodation from being used unnecessarily, and to remove the asthenopia, and often the convergent strabismus.

A hypermetrop who, to see without effort of accommodation at distance, requires spectacles with convex lenses of ten-inch focus ( $=\frac{1}{10}$ ), who has therefore a manifest hypermetropia of  $\frac{1}{10}$ , and whose nearest point of distinct vision without the convex lens  $\frac{1}{10}$  lies at 20" from the eyes, has a range or power of accommodation of ( $\frac{1}{10} + \frac{1}{20}$ ) a little more than  $\frac{1}{6}$ . To overcome the hypermetropic shape of the eye he is compelled to increase the convexity of his crystalline lens to an extent which is equal to the addition to it of a convex lens of ten-inch focus. In this case a large quantity of the power of accommodation is used to overcome the hypermetropia.

The region of accommodation in the above case extends from twenty inches to  $\infty$  ( $=$  infinite distance), i.e., objects placed at twenty inches, and at any distance beyond twenty inches, can be seen distinctly. To make useful the power of accommodation (of  $\frac{1}{10}$ ) which is employed to overcome the hypermetropia, we give spectacles with convex lenses of ten-inch focus. With these distant objects are seen distinctly without an effort of accommodation.

The absolute power of accommodation has not become increased by the use of these spectacles, but the power which was wasted is made useful; and objects which are placed at about 6" from the eyes can now be seen distinctly. Thus the region of accommodation, instead of extending only from twenty inches to a great distance (from twenty inches to  $\infty$ ), extends, with the aid of spectacles, from 6" from the eyes, to  $\infty$ .

No spectacles need be worn as long as vision for distance is good, and no asthenopia complained of. To find the proper spectacles, we first ascertain the amount of manifest hypermetropia, by placing the patient at twenty feet from the letters of No. 20. If he cannot spell these at that distance, we direct

him to walk slowly towards the letters, and to stop when he can spell them.

We commence the trial with lenses at that distance. If both eyes are equal, we try both eyes simultaneously. If he can only spell the letters with one eye, vision of the other being defective, we keep the defective eye closed during the examination of the other.

We then try whether, when looking through a convex lens (commencing with No. 60 convex), the patient can spell the letters; if so, we continue trying convex lenses until we have found the strongest with which this can still be done. Suppose the patient spells the letters of No. 20 at twenty feet, and can do the same with No. 40, 30, or 20 convex, but no more with No. 18 convex. From this we infer that No. 20 is the strongest convex lens which brings the rays coming from the letters of No. 20 to a focus on the retina, and we advise spectacles with lenses of twenty-inch focus to be used for both eyes for reading and other near-work. These spectacles remove the manifest hypermetropia, and often allow the patient to continue work for several years without fatigue.

We must insist upon the spectacles being altered as soon as the eyes become fatigued at work. E.g., suppose in the above case spectacles with No. 20 convex to have been worn for two years, after which time asthenopia appears again. We again determine the strongest convex lens with which the patient can now spell letters of No. 20 at the distance at which he can spell them without lenses. Suppose we find No. 16 to be that convex lens, we order the patient to have the twenty-inch convex lenses removed, and sixteen-inch convex lenses inserted into the same spectacle frame. These spectacles are to be used for reading, &c., as before, until symptoms of fatigue appear again.

All hypermetropia becomes manifest as age advances, and the power of accommodation becomes less. Therefore at the age of 40, 45, or 50, as far as the hypermetropia is concerned, the spectacles need no more be changed. At that age presbyopia must be taken into account. (See PRESBYOPIA.)

In one patient, who commenced with No. 20 convex, we may find that, all hypermetropia having become manifest, he recognises the letters of No. 20 at twenty feet, with No. 10 convex. Now in this case, if it had been desirable at the time when spectacles with No. 20 convex lenses were ordered, to know the degree of absolute hypermetropia (i.e. not only the manifest, but also the latent hypermetropia), we should have found that after paralysing the accommodation with atropia, the absolute hypermetropia did amount to  $\frac{1}{10}$ .

The patient, when beginning to wear spectacles for work, should at first only use them for half an hour at a time frequently during the day. In about three weeks later he may use them continually during the day, and some weeks later also at night.

If the spectacles do not suit, and on enquiring we find that the patient, when reading, gradually brings the book nearer and nearer, because he cannot see the letters distinctly at the distance at which the book was held at first, we ascertain—1. Whether the range of accommodation (considering the age of the patient) is normal. If so, we



act on the supposition that the accommodation (the contraction of the ciliary muscle) is still too strong. This is the result of habit, through the patient not having worn spectacles, or not the proper kind. The patient, although the spectacles remedy the latent hypermetropia, exerts the accommodation too much. Vision thus becomes indistinct, and the book, to obviate this, is brought nearer and nearer. "The eyes ache" partly from undue contraction of the ciliary muscle, partly from the effort which the internal recti muscles have to make to maintain the convergence of the eyes which is necessary for reading when the book is held too close.

In such cases, we at first try spectacles with convex lenses; e.g. in manifest hypermetropia of  $\frac{1}{20}$ , we prescribe, instead of No. 20 convex, No. 30 convex, for reading. The spectacles are to be used for all near-work. The work should be interrupted frequently, to rest the eyes, and also as soon as, through vision becoming indistinct, the desire arises to bring the work nearer to the eyes. In this way the action of the ciliary muscle—the accommodation—is gradually regulated. We give stronger lenses and proceed as directed above as soon as near work can be performed without fatigue.

Such cases appear to recover more rapidly when wearing the spectacles at first continually, assisting the efforts of accommodation at all distances.

*Myopia* (= M.) (Short-sight. Brachymetropia.) In many of the modern books on ophthalmology we still find it stated that myopia is the result of too great refractive power of the cornea and lens causing the image of objects to be formed in front of the retina. A faulty state of the light-refracting portions of the eye is supposed to be the cause of myopia. Dissection, measurements, and ophthalmoscopic examinations have, however, shown that in nearly all cases of myopia the light-refracting parts are normal as regards their curvature, but that the retina (and the adjoining tunics) lie at too great a distance from the cornea and lens. The principal focal distance of these (of the dioptric system) thus comes to lie in front of the retina.

No doubt cases occur in which myopia arises from too great convexity of the cornea (as in conical and globular cornea), or from displacement or too great convexity of the lens, e.g. during spasm of the ciliary muscle.

We shall speak here of the myopia which is the result of an anomaly of the shape, and with it, of the position of the tunics (sclerotic, choroid, and retina). This anomaly is the opposite to the one found in hypermetropia, and consists in an undue extension of the sclerotic, choroid, and retina, especially round the optic nerve and in the region of the yellow spot. If in the latter part the extension is prominently great, it is described as posterior staphyloma (staphyloma posticum). The hypermetropic eye is small (short from before backwards); the myopic eye is enlarged or elongated (long from before backwards—egg-shaped). Connected with this abnormal shape are alterations of the tunics and of vision, and a series of morbid changes.

The diagnosis of myopia is made out of the distance of the tunics from the dioptric system

(cornea and crystalline lens), and out of the alteration of these tunics, especially round the optic disc and in the region of the yellow spot, as seen by the ophthalmoscope. In this we are assisted by the state of vision, and by the trial with concave lenses.

*Examination with the ophthalmoscope.*—An observer with normal eyes can by direct examination with the ophthalmoscope recognise the shape of every eye, whether the eye be too short, normal, or too long, as long as the optic disc is visible. He can, after some practice, in the myopic by this means even determine the average degree of the myopia. The sooner, during direct examination, the well-defined outlines of the inverted image of the optic disc of the myopic eye (under the influence of atropia) appear indistinct, when approaching the eye from the distance at which they were seen distinctly with the ophthalmoscope, the higher is the degree of the myopia. In slight degrees of myopia (of  $\frac{1}{30}$  and less) the erect image can also be seen; in the higher degrees, to do this, a concave lens strong enough to neutralise the myopia must be placed behind the sight-hole of the ophthalmoscope.

The indirect ophthalmoscope examination is conducted in the usual way.

The optic disc, &c., of the myopic eye generally appear small. A convex lens of from 6 inches to 10 inches focus is placed behind the sight-hole of the ophthalmoscope, if it is thought desirable to make the optic disc, &c., appear larger. While holding the convex lens, as is usual during examination of the inverted image, we approach the eye up to from 2 inches to 3 inches, while looking through the sight-hole of the ophthalmoscope and through the convex lens behind it, when we perceive the magnified inverted image of the optic disc.

The different parts of the myopic eye are examined in the succession usual in ophthalmoscopic examination, paying particular attention to the outer margin of the optic disc when examining the erect, and to its inner margin, when examining the inverted image.

*Alterations of the tunics.*—The following description of the alterations of the tunics of the myopic eye is the combined result of dissection and of ophthalmoscopic examination.

The abnormal shape of the myopic eye (of the curvature of its tunics, especially of the part which extends from the outer margin of the cornea towards the optic nerve) is as readily perceived as that of the hypermetropic eye.

By directing the myop to turn the eyes in different directions, we readily observe the abnormally great distance which exists between the margin of the cornea and the region near the optic nerve. Combined with this we find a too slight curvature of the sclerotic.

Generally, all diameters of the myopic eye are enlarged, but as a rule the one from before backwards most. The sclerotic in the region of the yellow spot appears bluish and thinned if the distension of the tunics in that part is very considerable. In some cases it has been found nearly transparent. Inflammation may cause this part to become swollen and edematous, and to appear thicker than other parts of the sclerotic. This, however, is a very unusual

occurrence. The most bulging part of the distension often corresponds to the region of the yellow spot, or lies somewhere between this spot and the nearest margin of the optic disc, and may project as much as  $2''$  beyond the general curvature of the sclerotic. The distension round the optic disc may be very considerable without there being any circumscribed protrusion of the eyeball at all. The antero-posterior diameter of the eye in some cases amounted to from  $14''$  to  $15''$ , and the transverse diameters to from  $10''$  to  $12''$ . Corresponding to the externally perceptible changes of curvature and colour of the sclerotic, we find changes in the choroid, the optic disc and the retina.

*The Choroid.*—In this tunic occur changes which, once seen with the ophthalmoscope, can hardly be mistaken again. The changes are those of atrophy preceded by hyperæmia. They are the result of distension, and are most conspicuous in the choroid on account of the great alteration of its colour. The signs of atrophy become more conspicuous as the myopia advances. They are often visible at birth. They indicate progress of the myopia if they are considerable near the crescent, and shade off into the healthy choroid. About the age of forty, the atrophy becomes more conspicuous, and its boundary more irregular. With the ophthalmoscope we first look for the optic disc and for the tunics immediately adjoining it; then for the region of the yellow spot, and lastly inspect the more peripheral parts of the choroid, the optic disc, and the tunics immediately surrounding it.

Nearly in all myopic eyes we find a white figure, which in most cases has a crescentic form (and is termed "the crescent") adjoining the portion of the margin of the optic disc which lies next the yellow spot. When examining the inverted image we of course see the crescent on the (inner) nasal side of the optic disc. The convex side of "the crescent" is directed towards the region of the yellow spot. The crescent varies in size. The rule is that it is the broader, i.e. its axis the longer, the higher the degree of myopia. When extending all round the optic disc, or more in some directions, it loses the crescentic shape and changes into an irregular white figure which, however, in all cases is broadest towards the region of the yellow spot. In high degrees of myopia it may reach to, or even pass beyond, this spot. Its white colour is caused by the sclerotic shining through the atrophic choroid. The more clearly the white sclerotic is visible, the higher is the degree of atrophy. The colour of the crescent may be varied by blood in the vessels of the choroid or by portions of choroidal pigment.

Minute examination of the transparent atrophic portion of the choroid (of "the crescent") shows that it is thinnest where it joins the optic disc, and that though atrophic (deprived of its pigment and capillaries), it can be traced up to the margin of the disc. Traces of the walls of the larger blood-vessels are frequently found in it. The term *staphyloma posticum* is applied to the thinned portion of the tunics if it project towards the orbit beyond the general curvature of the eyeball. The boundary of the crescent, if sharply defined by the natural colour of the choroid, indicates that the myopia is not, or but slightly, progressing.

Atrophic changes in the part of the choroid adjoining the crescent are observed in increasing myopia. These atrophic changes are, in fair persons, a light red colour of the choroid, which is most marked along the crescent, and does not entirely mark the larger choroidal vessels. These vessels stand farther apart than in the healthy choroid. In persons with strongly pigmented choroids ("in dark persons") the pigment spots along the crescent are particularly well marked.

On minute examination of the atrophic parts, we find (1) alterations in the stellate pigment cells of the choroid.

The cells become paler, even sooner than the granules of the hexagonal cells; e.g. from a deep brown they change into a pale yellow colour, and finally disappear. The pigment molecules disappear before the cells. The changes of atrophy in the choroid are most advanced where the thinning of the tunics is most considerable. The walls of the hexagonal cells disappear; their pigment granules are scattered about as groups of brown or black spots, or as solitary brown granules.

*Alterations in the blood-vessels of the choroid.*—The large veins near the atrophic parts are filled with blood and broad. They do not stand so wide apart as those in the more atrophic and distended portions. A uniform red colour of the choroid round the atrophic parts, compared with that of less distended and more distant portions, is a sign of hyperæmia of the choroid, which often precedes atrophy.

*The alterations of the optic disc.*—The optic disc, like the adjoining distended tunics, is pushed backwards and displaced towards the inner wall of the orbit. Its position is altered.

In the healthy eye, the tunics are thickest round the optic nerve ("round the optic disc"). The attachments of the nerve to the tunics is particularly strong. In the myopic eye, the tunics, especially at the outer margin of the optic disc (and in high degrees of myopia, all round the nerve) are abnormally thin. A fibrous sheath surrounds the optic nerve in the orbit. On reaching the sclerotic, it becomes firmly attached to the latter. Its fibres mix with those of the sclerotic. This sheath is separated from the optic nerve, or, properly speaking, from the fibrous tissue which immediately surrounds the nerve fibres, by loose connective tissue. Those fibres of the fibrous tissue which immediately surround the optic nerve-fibres and which lie nearest the tunics, are attached to and pass into the choroid and into the upper margin of the sclerotic aperture. The tunics, as well as the fibrous tissue of the optic nerve joining them, become distended at this spot; and it is here, and especially on the side next the yellow spot, that the distension and thinning become apparent in the choroid as "crescentic atrophy." The greater the distension, the more does the optic nerve recede from the distended margin of the sclero-choroidal aperture. The sheath of the optic nerve is connected loosely with the nerve, but firmly with the sclerotic by connective tissue. The more the portion of fibrous tissue which connects the disc with the choroid and sclerotic becomes distended, the more does the optic disc recede and the larger becomes the space (crescent) between the disc and the tunics. The loose con-



nective tissue which intervenes between the nerve and its sheath does not oppose the distension. The tunics adjoining the "crescent" also become distended.

The optic disc, as a rule, appears smaller than that of the emmetropic eye. The curvature of its surface on the side adjoining the "crescent" is flat, or may be cupped. It is unusually convex on the opposite side. The shape of the disc is frequently oval, the long axis of the oval being vertical. The optic disc may in reality be round, but appear oval: 1. If through great distension of the tunics and of the attachments of the disc, it is much displaced towards the inner wall of the orbit. It is then seen more sideways when viewed, e.g., with the ophthalmoscope. 2. If the choroid and retina, opposite the distended margins, encroach upon the disc. The optic disc rarely has the natural pink colour throughout. It often is too red (a hyperæmia which generally accompanies rapidly progressing myopia), or it has a greyish-pink colour. Frequently we find that portion of the optic disc anæmic which joins the most distended and atrophic part of the tunics, while the rest of the disc has a pink colour. The vessels of the retina, where they pass through the optic disc, are rarely quite like those of the emmetropic eye. They are too numerous in rapidly increasing myopia. The veins are tortuous and full. In all cases, their course differs in the more distended from that in other parts of the optic disc and retina. In the distended parts of the retina they stand further apart, and follow the curvature of that tunic. If the boundary of the distended part is abrupt, their abrupt curve from it upon the more normally curved parts of the retina is very conspicuous.

The region of the yellow spot is not only distended, but also somewhat displaced towards the inner wall of the orbit. The distension, as round the optic disc, is accompanied by changes of structure (atrophic changes). These are most conspicuous in the choroid. The many apparent varieties of atrophy chiefly depend on the tint of the pigment and on the degree of distension.

Irregular light and dark brown spots (groups of stellate pigment cells), bright red or whitish spots, and in extreme cases, well-defined white spots or fissures (transparent portions of choroid, devoid of blood and pigment) may be found. In rare cases we find the atrophic changes far advanced and well marked in this region, while round the optic disc they are less conspicuous, or separated from the disc by a more healthy-looking portion. Generally, however, the atrophy at the outer margin of the optic disc merges into that of the region of the yellow spot, where it is less conspicuous through the choroid being more richly pigmented.

*Degree of Myopia.*—Myopic persons see distinctly only at a certain distance. The further the retina lies from the cornea and lens (from the dioptric system) the shorter is that distance, i.e. the nearer the eyes lies the furthest point of distinct vision. Beyond that distance objects appear confused, or are not visible at all.

The degree of myopia is known if the distance ( $= R$ ) of the furthest point of distinct vision ( $= r$ ) from the nodal point (from the point within the eye where the refracted rays cross each other)

is known. If the furthest point of distinct vision lies at 10 inches, the myopia is  $= \frac{1}{10}$ th; if it lies at 5 inches, the myopia is  $= \frac{1}{5}$ th, &c.

To determine the furthest point of distinct vision accurately we make use of concave lenses.

The rays which come from objects situated at the furthest point of distinct vision are still sufficiently divergent, after refraction by the cornea and lens, to be brought to a focus in the retina. Rays of less divergence, i.e. coming from objects further distant than the furthest point of distinct vision, must, by the aid of some concave lens, be made more divergent, to bring them to a focus in the retina. The weakest concave lens, which give sufficient divergence to parallel rays (i.e. to rays from very distant objects) to cause them after refraction by the eye to be brought to a focus in the retina, expresses the degree of myopia. To find this lens quickly, we ascertain the furthest point at which the patient can read ordinary type.

Suppose he reads type No. 1. at 10 inches and not further, we try No. 10 concave; if he reads No. 1 at 5 inches, we try No. 5 concave, &c. This lens, or one a little stronger or a little weaker, is as a rule the one which improves vision for distance most. We try both eyes at the same time, if both are equally myopic. If one eye is more myopic, we must find the concave lens which exactly suits each eye separately, beginning with the least myopic eye.

If, with the concave lens, the patient spells the letters of No. 20 at 20 feet, of No. 40 at 40 feet, &c., we have not only ascertained the degree of the myopia, but also the acuteness of vision for distance. Very often in high degrees of myopia the acuteness of vision is imperfect.

A myopia of  $\frac{1}{10}$ th ( $= M \frac{1}{10}$ th) means a myopic eye which requires a concave lens of 10 inches focus, for seeing at distance, as acutely as the emmetropic eye does without artificial means.

The highest degree of myopia on record is one of  $\frac{1}{2}$ , i.e. one requiring a concave lens of a little more than 1 inch negative focal distance.

For practical purposes, when speaking of the treatment of myopia by spectacles, a myopia of  $\frac{1}{20}$ th is termed one of slight degree; a myopia of  $\frac{1}{10}$ th one of moderate degree; and a myopia of  $\frac{1}{5}$ th one of high degree. In the treatment of intermediate degrees of myopia (of those exceeding  $\frac{1}{5}$ th, e.g.  $\frac{2}{5}$ , or  $\frac{3}{5}$ , and those slighter than  $\frac{1}{20}$ th, e.g.  $\frac{1}{30}$ , or  $\frac{1}{40}$ ) we must be guided by the rules laid down for the treatment of slight, moderate, and high degrees of myopia.

*Cause and progress.*—The cause of myopia is found in the too great distance of the retina and of the adjoining tunics from the dioptric system (from the cornea, lens, &c.). The abnormal position of the tunics is the result of distension and of increased curvature, especially round the optic disc, and in the region of the yellow spot. The diminution of the natural thickness and curvature of the tunics is congenital.

The eyes, like the rest of the body, increase in size up to a certain period of life. In the myopic, this is accompanied by a more or less rapid increase of myopia, which is chiefly promoted by the nature of the work which the eyes have to perform.

During reading, and other "near-work," the object has to be held close. The great convergence

of the eyes is accompanied by pressure of the muscles upon the eyeball, and generally by stooping, with increased accumulation of blood in the eyes.

The tunics, especially round the optic disc, and in the region of the yellow spot, being naturally weak in the myop, their curvature becomes increased, and their structure altered. This alteration occurs in every myopic eye, and makes itself most felt between the age of fifteen and twenty-five. Its chief symptom, as regards vision, is an increase of the myopia. In many patients this increase is accompanied by what are termed symptoms of irritation. These may rise to inflammation. They are generally coupled with a more rapid increase of the myopia, though in rare instances myopia may rapidly reach a high degree without symptoms of irritation.

An increase of myopia, with changes in the tunics, is observed in every myopic eye. In some the progress is rapid, in others almost imperceptible. Slight degrees of myopia may become changed into extreme ones, while high degrees may increase but slowly; though the rule is, that the myopia increases more rapidly if it has already reached a high degree before the age of twenty.

Myopics generally are aware that by the aid of spectacles vision can be improved for distant objects, but often for appearance sake prefer being without such. Others occasionally use an eyeglass for looking at distant objects. Many myopic persons pass through life without ever wearing spectacles, and without experiencing inconvenience from their myopia, and retain excellent sight for reading and near-work. Experience, however, has shown that myopics who wear spectacles throughout life, are much less exposed to the morbid changes which at some period make the myopic eye very troublesome, and, in many instances, useless.

Of these morbid changes the most frequent are: symptoms of irritation, *muscæ volitantes*, and sudden or rapid impairment of vision.

*Vision of Myopics.*—The rays coming from objects which are placed beyond the farthest point of distinct vision of the myopic eye are no more brought to a focus in the retina. The objects appear ill-defined, but are seen more distinctly by "screwing up" the eyelids, so as to narrow the palpebral aperture and the pupil. Some myopics very much improve their vision for distance by narrowing the palpebral aperture so as to look, as it were, through a slit. The same occurs if the size of the pupil becomes diminished, as in advanced age. The acuteness of vision is normal if the myop can, with the aid of a concave lens, read the test types at the normal distance; e.g. No. 1 at 1 foot, No. 2 at 2 feet, &c.

The myop sees small objects better, because he can bring them closer to the eyes, and therefore sees them under a greater visual angle. With this is connected his being able to work, read, &c., with less light than other eyes. The acuteness of vision in the highest degrees of myopia is generally imperfect, so that in a myopia of  $\frac{1}{2}$ , No. 1, instead of being read at 5 inches, can only be read at 3 inches, or not at all.

Often we find one eye more myopic than the other, or in rare cases only one myopic, the other emmetropic, or even hypermetropic. One eye is often used for reading, the other for distance.

*Diminution of the acuteness of vision.*—Some myopics state that vision at no time of life was comfortable, that symptoms of irritation, difficulty of recognising objects, &c., always existed more or less. In these we must, besides the myopia, expect to find some congenital anomaly, as cataract, displacement of the crystalline lens, or a troublesome degree of astigmatism of the cornea.

Impairment of vision, accompanied by symptoms of irritation, generally appear during rapid growth of the body.

The acuteness of vision, as age advances, decreases more rapidly in the myopic than it does in the normal eye. E.g., in a myopia of  $\frac{1}{4}$  it may, at the age of sixty, only amount to  $\frac{1}{3}$ , while in a normal eye of the same age it is nearly as great.

The distension of the retina, together with that of the other tunics (especially in the region of the yellow spot), if it goes beyond a certain point, is the cause not only of rapidly increasing myopia, but also of amblyopia. The elements of the retina displaced or destroyed through distension of the tunics, &c., cease to act, and patients complain of "scotomata." (See *Scotoma*.) The scotomata are most troublesome if situated at or near the yellow spot. The patient complains of "glimmering or quivering of the letters." These, during reading, with slight movements of the eyes, come to stand alternately opposite sensitive and more or less damaged elements of the retina. The complaint of not seeing some words of a sentence, or some letters of a word, is generally explained by morbid changes in corresponding parts of the retina. Small letters or objects can be seen, while larger objects are less readily recognised, through parts of them coming to lie opposite impaired portions of retina. Other causes of impairment, or of loss of vision, are: Atrophy, Displacement of the retina, Effusion of blood, and Glaucoma. (See these articles.)

Impairment of the function of the part of the retina which joins the outer margin of the optic disc is, on examination, often observed in myopia, though it rarely attracts the patient's attention unless it encroaches upon the region of the yellow spot. In the latter case patients complain of a dark spot (by some described as having coloured margins) which obscures the part of an object which is situated outwards from the point of the object directly looked at.

The size of the impaired portion of retina sometimes corresponds exactly to the size of the crescent, but generally only partly so. It depends upon destruction of the retina adjoining the atrophic choroid. The optic nerve fibres passing over the impaired portion of retina are intact, since retinal impressions formed beyond the blind part are perceived. Cataract is a frequent complication of myopia; not the uniform grey and opaque kind, but the one which appears as minute white dots, or as polar cataract, or commences with narrow striae appearing at the margin of the lens, and leaving the rest transparent sometimes for years.

Partial or total spontaneous dislocation of one, or generally of both lenses, has repeatedly been observed.

*Muscæ volitantes.*—The abnormal condition of the tunics surrounding the vitreous chamber, and the changes to which the "vitreous" itself is subject during distension of the tunics, are the causes why most kinds of *muscæ* may be met with in



myopic eyes. The muscæ often appear suddenly, and without any signs of irritation. They are too small to be visible with the ophthalmoscope, and are connected with morbid changes of the "vitreous."

Not unfrequently we meet with partial displacement of the hyaloid membrane, fluid intervening between it and the retina. On careful examination with the ophthalmoscope, we may succeed in seeing the displaced part. It appears as a transparent fold of membrane which in a limited area floats to and fro in front of the retina. It is distinctly perceived by the patient as a dark, slightly movable spot, and has repeatedly been found on dissection.

The vitreous substance, though free from muscæ, frequently loses its consistence, becomes more or less fluid, either throughout, or only adjoining the most atrophic portions of the tunics. It often gives rise to "tremulous lens and iris."

Photopsia greatly distresses many myopic persons for years, and without giving rise to any impairment of vision. It may be intermittent or persistent, and is most troublesome in the dark. The patients generally complain of red flashes of light, or of red spots appearing before the eyes. Several patients repeatedly have stated, that when the flashes appear suddenly, objects situated externally to the eyes could be recognised during the duration of a flash.

Hyperæmia of the optic disc accompanying the distension, &c. of the adjoining tunics, and unusually rapid atrophy and distension of the hexagonal cells affecting the rods and bulbs, are probably the sole cause.

If the photopsia appears suddenly and simultaneously with amblyopia, it must not be treated lightly. Partial displacement of the retina, or inflammation of some parts of the tunics, may be the cause, and must be looked for.

*Treatment.*—The functions of the myopic eye as regards acuteness of sight are often impaired by undue distension of its tunics; the predisposition to which exists in every myop. The increase of distension cannot wholly be counteracted, whatever treatment be adopted.

Our advice must tend as much as possible to diminish the progress of the distension, i.e. the increase of the myopia. We therefore recommend the patient—

Not to stoop when reading, &c. Especially strongly myopic persons, as a rule, stoop when reading, &c., and hold objects nearer than is necessary for distinct vision. They must, to do this, converge the eyes strongly, if both are used.

Stooping gives rise to over-fulness and congestion of the eyes, to increase of tension, and through too great convergence to pressure upon the already too thin coats of the eyeball. Patients should hold the head upright when reading, and place the book or paper, when writing, on a sloping desk. Particular attention should be paid to this in children.

Objects must be held as far from the eyes as is compatible with distinct vision, and, if that distance is less than 10 inches, spectacles may be recommended in young myopics.

If the patient complains of weakness, fatigue, pain, irritability, &c. of the eyes.—These symptoms are termed symptoms of irritation. They may appear during near work, e.g. reading only. Often they are present whether looking at near or at distant objects. They are connected with

hyperæmia of the external and internal parts of the eye, as observed in the course of progressing myopia (distension of the eyes). Close application to study, or to other near work, during rapid growth of all parts of the body, seems to be the most common cause of these troublesome symptoms. They very rarely rise to actual inflammation.

The patient complains of intolerance of light, which may be very great, and continue for months; of watering of the eyes, and of aching or of actual pain over the eyebrows, and "at the back of the eyeballs." The pain may be caused by the hyperæmia and distension of the tunics, or by spasm of the ciliary muscle. In the latter case, we often find the portion of the tunics which lies over and near the ciliary muscle tender to the touch, when the pain increases rapidly during near work.

The eyes continue sensitive to light and touch after all near work has been discontinued. Rarely do we hear the common complaint of hypermetropics, of the letters running into one another, or disappearing after reading for some time (=Asthenopia).

It is generally the aching, the weakness, the "dazzling," and the intolerance of light which compel the myop to discontinue near-work, and in high degrees even to abstain from moving about in bright light. Frequently the complaint is made, that after reading for some time, one eye "moves outwards," that the words seem to move over each other, and that efforts to overcome the outward movement are painful. This symptom is attributed to insufficiency of the internal recti muscles.

On examination with the ophthalmoscope we find sometimes the entire optic disc hyperæmic, sometimes only the portion which joins the least distended part of the tunics, while the one next the crescent appears anæmic. In many cases it appears as if the retina (the retinal aperture) encroached upon the optic disc, i.e. as if it was drawn over the margin of the disc by the distended portion on the opposite side.

The optic disc, choroid, and retina at that spot are particularly hyperæmic.

The veins of the retina are often very tortuous and full over the distending portions of the tunics. Sometimes the retina is not quite as transparent as in other parts. The choroid adjoining the transparent atrophic portions appears unduly "red," and its veins gorged with blood.

The margin of the eyelids appears somewhat reddened, and in many, generally thin, "delicate" myopics, we find slight tinea. The subconjunctival vessels, emerging from the sclerotic near the margin of the cornea, are numerous, and the pupil, in higher degrees of hyperæmia, is sluggish.

In high degrees of irritation, a rapid increase of myopia, amounting in some cases to amblyopia, is observed.

The patient must abstain from the kind of work which brings on the symptoms of irritation, and should never work longer than can be done with comfort. The sooner and more strictly this rule is observed, together with proper treatment, the shorter will be the period during which reading, &c., need be prohibited, and the less rapid will be the progress of the myopia.

Spectacles with blue-tinted, large round glasses, the tint being selected which feels most pleasant to the patient, should be worn. They must be laid aside if light is no more troublesome. The

aching and pain are often permanently relieved by the frequent use of atropia.

Leeches (from six to twelve) are applied to the skin of each temple at bed-time, while both eyes are carefully kept closed for forty-eight hours after the leeching, if the pain is severe and not soon relieved, though the patient have worn tinted glasses, used atropia, and abstained from near work; or if a rapid relapse of pain, &c., occurs, and especially if the irritation is great. In actual inflammation (choroido-retinitis) the artificial leech is preferable, with which a large quantity of blood can be obtained in a very short time. In some cases, as much as forty ounces of blood have been abstracted within two hours.

The patient must be kept in a dark room for two or three weeks. The transition to light must be gradual.

Other means which may be recommended to prevent or remove symptoms of irritation are: rest, keeping the head, when lying down, well raised, and the feet warm; much sleep before mid night; the eye-douche (made by Mr. Durroch, of St. Thomas's street, Southwark).

Many myopics prefer tepid water, others select tepid water in the morning and cold water at bed-time. The douche may be used for from ten to fifteen minutes at a time, and as often as convenient. The best time is after breakfast (using tepid) and at bed-time (using cold water).

No spectacles with concave lenses should be allowed for reading as long as the symptoms of irritation persist. If they are slight, spectacles with slightly-tinted concave lenses may be worn for walking or for distant vision only.

The irritation having subsided, we recommend continuation of the general hygienic measures, and prescribe the necessary spectacles for reading, &c.

Their use must be discontinued at once if they give rise to irritation.

Besides attending to the symptoms of irritation, we must ascertain whether insufficiency of the internal recti muscles exists. The latter is a fertile source of impairment of vision.

If the patient complains of scotomata, corresponding to which we discover atrophic changes in the choroid and retina, no improvement of vision can be obtained, though loss of vision need not be feared.

Spectacles with concave lenses enable the myop to see distinctly at a greater distance.

Concave lenses increase the divergence of the rays of light. Rays coming from objects which are situated beyond the furthest point of distinct vision of the myop, can by the aid of concave lenses be brought to a focus in the retina.

Concave lenses also increase the region of accommodation. A myop, who without concave lenses sees distinctly from 3 inches to 10 inches, has a region of accommodation of 7 inches, and a myopia of  $\frac{1}{10}$ . With concave lenses of 10 inches focus, his region of accommodation becomes very much larger, since with them he can recognise objects as well at 4 inches from the eyes as at a great distance.

The chief difficulty which, especially more highly myopic persons (above  $\frac{1}{10}$ ) find in using spectacles with concave lenses (which make their "sight" equal to that of the "healthy eye") is that the spectacles cause the nearest point of distinct vision for both eyes to stand too far from the

eyes. The consequence is that, for reading or near-work, the patient has not the necessary relative range of accommodation, i.e. the one which is required to maintain prolonged distinct vision at a certain convergence of the eyes. It is only by practice that the myop succeeds in altering the relative range of accommodation, so that, with slight convergence, he can bring into play the power of accommodation which is necessary for easy vision with that degree of convergence.

When selecting spectacles with concave lenses, the following points should be attended to:—

1. We first determine the degree of the myopia; in other words, we find the weakest concave lens which, held close in front of the cornea, gives the most distinct vision for distance, e.g. with which letters of No. 20 can be recognised at 20'.

In high degrees of myopia (if stronger concave lenses than  $-\frac{1}{10}$  are required for distance), we should be particularly careful to ascertain the exactly suitable lens. We place the concave lens which is thought best close before the patient's eye, and alternately hold in front of it a weak convex and concave lens (say  $\frac{1}{80}$  and  $-\frac{1}{80}$ ). If, e.g. of several convex or concave lenses  $-\frac{1}{80}$  held before  $-\frac{1}{10}$  (this being the concave lens which at first was thought best), improves vision most; then  $-\frac{1}{10}$  was too weak, and we give ( $-\frac{1}{10} + \frac{1}{80}$ ) about  $-\frac{1}{9}$ . If vision is most acute by  $\frac{1}{80}$  being held before  $-\frac{1}{10}$ , then  $-\frac{1}{10}$  was too strong, and we give ( $-\frac{1}{10} - \frac{1}{80}$ ) about  $-\frac{1}{11}$ .

In higher degrees of myopia, especially, we must pay attention to the distance of the concave lenses from the eyes. A concave lens makes objects appear the smaller (i.e. displaces the nodal point the more towards the retina) the further it is held from the eye.

A concave lens held at 1 inch from the eye acts as a stronger concave lens than if it is held at  $\frac{1}{2}$  inch from the eye; and at  $\frac{1}{2}$  inch from the eye it acts as a stronger concave lens than if it were placed immediately upon the crystalline lens within the eye.

E.g., in myopia of  $\frac{1}{10}$ , a concave lens of 10 inches focus, held at  $\frac{1}{2}$  inch from the eye, acts as a concave lens of  $9\frac{1}{2}$  inches focus. If, therefore, we order spectacles with concave lenses, the negative focal distance of which is greater than 10 inches, we must consider the distance of the lens from the eye. If, to see distinctly at a great distance, the patient requires spectacles with  $-\frac{1}{10}$  placed  $\frac{1}{2}$  inch in front of the eyes (or  $\frac{1}{4}$  inch in front of the nodal point), we order spectacles with concave lenses of  $10\frac{1}{2}$  inch focus.

If to see distinctly at 30 inches he requires lenses of 5 inch negative focal distance, we order lenses of  $5\frac{1}{2}$  inch negative focal distance, &c., &c.

2. If both eyes are equally myopic, or nearly so, we give lenses of equal strength.

3. If one eye is more myopic, the difference between the two being slight (one requiring, e.g.,  $-\frac{1}{30}$ , the other  $\frac{1}{40}$ ), we find the lens which is best suited for the least myopic eye, and give the same for the other eye. If the difference of myopia is great, e.g. if one eye requires  $-\frac{1}{5}$ , the other  $-\frac{1}{10}$ , we may partly correct the difference of refraction by giving  $-\frac{1}{5}$  to the one, and  $-\frac{1}{6}$  to the other eye. If this combination fails, we give the suitable concave lens to the least myopic eye, and the same lens to the fellow eye.

Sometimes it happens that only one eye is used in reading, not through the retinae being at fault,



but through the converging power of one or of both eyes being too weak ("insufficient").

In such cases, when using spectacles for reading, the book being held at 10 inches or 12 inches, we may find that the patient complains of fatigue after reading for some time, which fatigue ceases on excluding one eye. The spectacles have caused the eye, which previously to wearing spectacles was not used, again to participate in the act of reading, and the insufficiency of the converging muscles makes itself felt. In these cases the insufficiency must be attended to, as well as the myopia.

4. The "spectacles" are too strong, i.e. an undue amount of accommodation is used, if the patient states that looking through them makes distant letters appear smaller.

5. In high degrees of myopia, where spectacles had not been used until middle age, and in myopics suffering from symptoms of irritation, if we think proper to order spectacles with concave lenses, we should give those which allow the patient to see distinctly only at a limited distance. The lenses of these spectacles must be weaker than those which would completely remove the myopia. How much weaker depends upon the distance at which we wish the myop to see distinctly. If it is desirable that a myop, who for distance would require  $-\frac{1}{5}$ , should see distinctly only at 30 inches (that his furthest point of distinct vision should be brought to 30 inches) we give him lenses of  $-\frac{1}{6}$  ( $-\frac{1}{5}) - (-\frac{1}{30}) = -\frac{1}{6}$ .

If the furthest point of distinct vision has to be brought to 10 inches we order  $-\frac{1}{10}$ , since ( $-\frac{1}{5}) - (-\frac{1}{10}) = -\frac{1}{10}$ .

No spectacles need be worn—1. If the myopia is slight, e.g. if with  $-\frac{1}{20}$  the patient can read No. 20 at 15 or 18 feet.

To see distinctly at distance an eye-glass or spectacles, which completely neutralise the myopia, may be used.

Spectacles should be worn—1. If the degree of myopia is higher than  $\frac{1}{20}$ , so that to read No. 20 at 20', stronger concave lenses than  $-\frac{1}{20}$ , say  $-\frac{1}{10}$  or  $-\frac{1}{8}$  are required. In this case, we order for distance spectacles with concave lenses, which at once completely neutralise the myopia, i.e. which make the patient read No. 20 at 20'.

2. The same spectacles may be allowed for near-work if the patient is young, not more than twenty-five,—if there are no signs of irritation,—if the degree of myopia amounts to about  $\frac{1}{4}$  of the range of accommodation—and if the myopia does not exceed  $\frac{1}{10}$  or  $\frac{1}{8}$ : i.e. if with  $-\frac{1}{10}$  or  $-\frac{1}{8}$ , he can read 20 at 20', and recognise letters placed at about 4 inches from the eyes.

If the degree of myopia amounts to more than one-fourth of the range of accommodation, or if the patient cannot read with ease with the spectacles which were given at first, we begin with weaker ones, e.g. with spectacles which enable the patient to read No. 20 only at 10 feet. After some time we give stronger spectacles, e.g. a patient with a myopia of  $\frac{1}{10}$  would commence with spectacles with lenses of  $-\frac{1}{20}$ . After three months he may try lenses of  $-\frac{1}{15}$ , and three months later lenses of  $-\frac{1}{10}$ . If the spectacles with lenses of  $-\frac{1}{10}$  give rise to irritation, those with  $-\frac{1}{15}$  must be continued somewhat longer, &c. If the patient (the myopia amounting to not more than  $\frac{1}{8}$  or  $\frac{1}{10}$ ) is of middle age, has never, or only rarely, worn spectacles, and wishes to have such for reading, we

often find that signs of irritation appear if we give spectacles with lenses of  $-\frac{1}{8}$  or of  $-\frac{1}{10}$  for reading, or even for looking at objects a few feet distant. The cause of this lies in his power of accommodation, which naturally has become less, not having been practised with spectacles. In these and similar cases, we order spectacles which allow the patient to see distinctly at from 4 to 6 feet, and gradually increase their strength.

In the myop of  $\frac{1}{4}$ , e.g., we begin with  $-\frac{1}{6}$ . Several years may pass before we can give spectacles with  $-\frac{1}{4}$  for reading and for distance.

If the patient has an occupation which requires acute vision for a prolonged period at a given distance, we must find the spectacles which bring the furthest point of distinct vision exactly to that distance for which acute vision is required. Suppose our patient's myopia amounts to  $\frac{1}{10}$ , and we wish to bring the furthest point of distinct vision to 20 inches, we give spectacles which are  $\frac{1}{20}$  weaker than those used for distance ( $-\frac{1}{10} - (-\frac{1}{20}) = -\frac{1}{20}$ ) we give spectacles with lenses of  $-\frac{1}{20}$ .

If the myopia amounts to  $\frac{1}{5}$  or more (if, e.g.,  $-\frac{1}{5}$  is required to read No. 20 at 20') we give spectacles which bring the furthest point of distinct vision to about 15 inches. Thus, if the myopia amounts to  $\frac{1}{5}$  we give  $-\frac{1}{8}$ , with which the patient can see distinctly at about 15 inches. To see distinctly at a greater distance, we order an eye-glass or a lorgnette, which when held before the spectacles should neutralise the myopia. In the above case, spectacles with  $-\frac{1}{8}$  being worn, the eye-glass to be used for distance would be one with a lens of about  $-\frac{1}{15}$ .

In high degrees of myopia (of  $\frac{1}{5}$ ,  $\frac{1}{4}$ , or more), if the acuteness of vision is decreasing, we ascertain which is the least myopic eye, and, for distance, order an eye-glass which removes only part of the myopia (e.g. for myopia of  $\frac{1}{5}$  we give an eye-glass with  $-\frac{1}{10}$ ). We then ascertain whether looking through a slit or small aperture with and without the  $-\frac{1}{10}$ , improves vision for distance (holding the concave lens next the eye). We can, if there is considerable improvement, combine the slit and the  $-\frac{1}{10}$  into a stenopaëic eye-glass.

No reading or other near work should be allowed as long as the loss of acuteness of vision and the myopia are progressing rapidly, or as long as there are symptoms of irritation.

It often happens that highly myopic persons only use one eye when reading. These need not wear spectacles, since the danger arising from great convergence of the eyes does not exist.

In such cases symptoms of irritation may appear if spectacles are given which bring both eyes into use while reading. Such myopics should carefully avoid stooping, use an eye-glass for distance and no spectacles for near-work.

Patients complain that "the spectacles make the eyes ache."

This occurs if the spectacles are not properly selected ("too strong"): 1. Most frequently in myops who had signs of irritation previous to using spectacles. 2. In persons who did not wear spectacles until middle age; and 3. in some myopics who are advanced in life, and wore spectacles continually. No spectacles with concave lenses should be worn as long as the eyes are irritable. They increase the irritation, the distension of the tunics, and with it the myopia. The irritation having subsided under proper treatment,

we give at first spectacles with lenses which neutralise about one-half or one-third of the myopia. E.g., in myopia of  $\frac{1}{10}$  we order at first spectacles with lenses of  $-\frac{1}{20}$  instead of  $-\frac{1}{10}$ . These may be used for going about and at short intervals frequently during the day for near work.

No spectacles must be used, and all near-work discontinued for a time, if the habit of stooping or of bringing objects too near the eyes increases or continues, or if the myopia makes rapid progress, or if signs of irritation appear.

Myopic persons advanced in life (above forty-five or fifty) become presbyopic, and for near-work require spectacles with weaker concave lenses; if the myopia is slight, with slightly convex lenses; others can lay aside the spectacles altogether, and perform all near work without them. We must remember that in myopics also the power of accommodation and the acuteness of vision become diminished as age advances. We should therefore be particularly careful in selecting the lenses, to give those which bring the furthest point of distinct vision exactly to the point at which the patient wishes to see.

The acuteness of vision in older myopics often decreases rapidly within a few months. If in these cases we find no anomaly beyond the usual changes of the power of accommodation and those of atrophy and distension in the tunics, we need not be alarmed. We prohibit near-work for a time, and order leeches to be applied to the temple once a week several weeks in succession.

C. Bader.

**VOLVULUS.** (From *volvo*, to roll up.) See **INTUSSUSCEPTION.**

**WART.** A wart appears to be an excrescence from the cutis, or a tumor formed upon it, by which means it becomes covered with a cuticle, which is either strong and hard, or thin and soft, just as the cuticle is that covers the parts from which the excrescence arises. Warts are radiated from their basis to their circumference. The surface of the radii appears to be pointed or granulated, like the surface of healthy granulations, with the exception of being harder and rising higher. The surface on which a wart is formed seems only to be capable of producing one; for the surrounding and connecting surface does not throw out a similar substance. Thus when a wart has once begun to grow, it rises higher and higher, without becoming larger at its basis. Such excrescences seem to have within themselves the power of growing; for, as Hunter remarks, after they have risen above the surface of the skin, on which their basis cannot grow larger, they swell out into a round thick substance, which becomes rougher and rougher. In consequence of this structure, warts are liable to be hurt by bodies rubbing against them; and, from such a cause, they often bleed very profusely, and are rendered sore and painful. (*On Venereal Dis.* p. 250, ed. 2.)

[According to Rokitansky, there are sundry varieties of warts. "The most ordinary consist of cornified epidermis forming a sheath-like receptacle of considerable thickness for the hypertrophied cutaneous papilla; others are marked by the elongated fibrous arrangement of very luxuriating cells, as polyedrical, edged cylinders in parallel array, some of which show imperfect cornification. They have a fibro-villous appearance, are humid, and

readily broken up by pressure into fibres and their elements. Their cells are devoid of nuclei, and, in only a few instances, cornified."—*Rokitansky*, vol. i. p. 202, *Syd. Society's Translation*.]

As warts are adventitious substances, and not any part of the original structure of the body, their powers of life are weak. Hence, when stimulated, they generally become smaller, and at length disappear or drop off. On this principle, warts may frequently be cured by the application of the tinctura ferri muriatis, sulphate of copper, tinctura cantharidum, or a powder composed of the powder of savine leaves and the subacetate of copper in equal proportions. However, the employment of stronger escharotics, like the nitrate of silver, or the concentrated acetic acid; the removal of such excrescences with a knife or pair of scissors; or tying their necks with a ligature; are plans frequently preferred. The last two methods are eligible when the wart has a narrow neck; but, after the removal of the excrescence, it is still proper to touch the root with the caustic, or the acetic acid; for, unless the whole be completely destroyed, the wart will grow again. Mr. A. G. Welsh, of Annapolis, informs us, that he once had several warts upon his hands, and having repeatedly tried nitrate of silver and other caustics in vain, he determined to try electricity. "I therefore commenced (says he) by sending sparks through them, which was repeated for five minutes daily, when, to my great satisfaction, I found that they had entirely disappeared, since which time they have not reappeared, as they did after having been removed with the knife or caustic." (See *Baltimore Med. and Surgical Journ.* Oct. 1833.)

Warts on the pudenda, and about the anus, scarcely ever withstand the effect of the powder of savine and subacetate of copper, though they will sometimes resist a course of mercury, adequate to cure lues venerea; a consideration which led Mr. Hunter to believe them not to be syphilitic. In this opinion, I believe, all the best surgeons of the present day concur.

[The most speedy and effectual cure for warts, and condylomatous excrescences about the genitals, is their removal with the knife or scissors.]

**WHITLOW.** (*Panaris, Onychia, Panaritium, Paronychia.*) A whitlow is an inflammation at the end of one of the fingers, or thumb, exceedingly painful, and strongly disposed to suppurate. The toes are also sometimes the seat of similar inflammation and abscess.

Whitlows commonly begin on the palmar side of the fingers; but they do occasionally commence on the back of them, and even on that of the hand.

Writers usually divide whitlows into four kinds. In the first, or mildest, a vesicle, filled with matter, commonly arises near the root or side of the nail, after superficial inflammation of trivial extent. Sometimes the abscess takes place under the nail, in which case the pain is severe, and not unfrequently shoots upward to the elbow.

The second kind of whitlow is chiefly situated in the cellular tissue, under the cutis, and for the most part occurs at the end of the finger. In this case, the inflammatory symptoms, especially the pain, are far more violent than in other common inflammations of the same extent. Writers usually impute the violence of the pain, and the considerable degree of inflammation attending the com-



plaint, to the hard and unyielding nature of the skin of the finger. To the same cause they also ascribe the difficulty of perceiving any fluctuation after matter is formed; and the slowness with which the pus makes its way outward.

The third kind of whitlow is distinguishable from the others by the following circumstances. With the most excruciating pain there is but little swelling of the finger, but a vast deal of the hand, particularly about the wrist, and up the forearm (*thecal abscess*). The pain extends to the hand, wrist, elbow, and even the shoulder. When suppuration takes place, a fluctuation can never be felt in the finger, though it may often be distinctly perceived in the hand, at the wrist, or even somewhere in the forearm. The case frequently is accompanied with considerable fever. The disease is seated in the tendons and their sheaths, and the power of moving the fingers, and even the whole hand, is lost.

Authors describe the fourth kind of whitlow as arising principally from an inflammation of the periosteum. Suppuration generally follows very soon, the usual consequence of which is a caries, or rather a necrosis, of the subjacent finger-bones.

Mr. Wardrop favoured the public with an account of a particular species of whitlow, which, from its severity, he denominated the *onychia maligna*, now generally considered of venereal origin, and curable by mercury or iodide of potassium. "The commencement of this disease is marked by a degree of swelling, of a deep red colour, in the soft parts at the root of the nail. An oozing of a thin ichor afterwards takes place at the cleft formed between the root of the nail and soft parts, and at last the soft parts begin to ulcerate. The ulcer appears on the circular edge of the soft parts at the root of the nail; it is accompanied with a good deal of swelling, and the skin, particularly that which is adjacent to the ulcer, has a deep purple colour. The appearance of the ulcer is very unhealthy, the edges being thin and acute, and its surface covered with a dull yellow or brown-coloured lymph, and attended with an ichorous and very fetid discharge. The growth of the nail is interrupted, it loses its natural colour, and at some places appears to have but little connection with the soft parts. In this state (says Mr. Wardrop) I have seen the disease continue for several years, so that the toe or finger became a deformed bulbous mass. The pain is sometimes very acute; but the disease is more commonly indolent, and accompanied with little uneasiness. This disease affects both the toes and the fingers. I have only observed it on the great toe, and more frequently on the thumb than any of the fingers. It occurs, too, chiefly in young people; but I have also seen adults affected with it." (See *Med. Chir. Trans.* vol. v. p. 135, 136.)

The causes of whitlows are generally of a local nature. Writers enumerate the following as the most common: a contusion; suddenly warming the finger when it is exceedingly cold; pricks with needles, or other sharp instruments; and the insinuation of irritating matter into scratches on the finger. A surgeon, in operating for a fistula in ano, has been known to cut his finger, and have, in consequence of the accident, a very severe and dangerous kind of whitlow. Richter also mentions a person who had a most obstinate whitlow, in consequence of a slight wound on the finger, in

examining the head of a horse that died of glanders. Sometimes the cause of a whitlow depends on a splinter or thorn, which continues lodged in the part. Very often, no particular cause whatever can be assigned for the complaint.

The first case, which occurs about the root of the nail, ought to be opened as soon as possible. When this plan is not adopted, the matter is apt to penetrate more deeply, and occasion a loss of the nail. When an effectual opening is not made, the matter collects again. In general, a detachment of the cuticle takes place, as far as the abscess extends. When the inflammation has been violent, and the matter has made its way to the root of the nail, the nail itself is in general gradually detached; while the denuded portion of the nail acts on the sore as a foreign body, and hinders it from healing. Hence the surgeon should repeatedly cut away as much of the lower edge of the nail as he can, and insinuate a little soft lint between the margin of the nail and the sore, in order to keep the latter from being irritated by the former. In proportion as the old nail gradually separates, a new one makes its appearance.

When matter lies under the nail, an opening should be made through the part as speedily as possible, for the discharge of the abscess. In order to perform this operation, Richter advises the surgeon to scrape the nail till it is as thin as it can well be, when it may be cut through with a bistoury.

In the second species of whitlow, suppuration may sometimes, though very rarely, be prevented by the timely employment of proper means. When the pain is violent, and acute fever prevails, it may be advisable to bleed the patient. In a few severe cases, the application of three or four leeches to the affected finger has been known to procure prompt relief. Platner advises the finger to be for some time immersed in water, as warm as the patient can bear. Some recommend the external use of camphorated spirit, or the linimentum ammoniæ; while others advise the affected finger to be plunged in a warm solution of soap, or an alkaline lotion. I have known a few whitlows resolved by blackening the skin over the inflamed part with nitrate of silver. (See *Higginbottom, On Nitrate of Silver*, ed. 2.) When whitlow is occasioned by a prick, particular care must be taken that no extraneous substance remain in the puncture.

When the symptoms do not abate by the fourth day, Richter recommends an opening to be made. Even when no fluctuation is discovered, he approves of this practice, and states, that although no matter may be discharged, the patient always derives infinite relief from the operation. The benefit, he says, may either be imputed to the bleeding, or to the division of the hard tense skin, which compresses the subjacent inflamed parts. Sometimes, the collection of matter can be plainly felt, and in this case there can be no hesitation about the place where the opening should be made. However, it may be proper to remark, that the opening should always be made sufficiently large. When the surgeon makes a small puncture, it soon closes again, and a repetition of the operation becomes necessary. When opening the abscess is delayed, the theca of the flexor tendons easily becomes affected, or the matter may spread to a considerable extent under the skin. Sometimes it makes its

way through the cutis, by ulceration, and raises up the cuticle. In this case, as soon as the cuticle has been opened, a director should be introduced into the aperture in the skin, and the latter opening be enlarged with a bistoury.

In the third species of whitlow, Richter enjoins us never to defer making an opening longer than the third day. If we wait till suppuration happens, we shall wait till the tendons are destroyed, and the use of the finger is lost. In the case under consideration, the matter is always of bad quality, and in small quantity. A fluctuation in the finger can seldom be felt. However, in a few instances the matter is perceptible at the extremity of the finger, or about the finger-joints: but more often, in the palm of the hand, or near the wrists. In these circumstances, the tendons are in general already destroyed, and a stiffness of the finger and hand is to be apprehended. When the complaint is the consequence of a puncture, the best plan is at once to enlarge the wound. It is not enough, however, to cut through the skin; the tendinous theca itself must be laid open.

When a collection of matter forms towards the wrist, attended with violent pain in that situation, an opening must also be made there. If an opening should have already been made in the hand, a probe may be introduced into the wound, and another aperture made in an eligible situation by cutting on the end of the instrument. In the same way, an opening is to be made in any part of the forearm, where great pain or the symptoms of suppuration may indicate its propriety.

In the fourth kind of whitlow, early incisions, made down to the bone, are the most certain means of obviating the danger. When such incisions are not made soon enough, suppuration takes place, and the bone perishes. The cut is to be made in the place where the pain is most severe. When the first phalanx is affected, the incision may be made in front of the finger; but when the second or third is the seat of the complaint, the opening should be made on one side. However, in order that the opening may be useful, it is absolutely necessary to make it down to the bone. When the incision is deferred too long, a small quantity of unhealthy matter is usually detected, and the bone is found in the state of necrosis. As an exfoliation can hardly be expected in this situation, it is best to remove at once the diseased piece of bone. When the last phalanx alone is affected, the finger retains its form, with the exception of its end being a little shorter and flatter. When the disease, however, is situated in the third phalanx, Richter thinks it better to amputate the finger than remove the diseased bone, as the finger, if left, would always remain stiff and unserviceable. (See *Anfangsgr. der Wundarzneykunst*, vol. vii.)

Dr. J. B. Whitridge, of Charleston, South Carolina, in cases of whitlow, when the bone has become carious, has frequently preserved the part by the timely removal of the diseased bone. Persons much in the habit of using the pen, and others whose livelihood depends on their retaining the use of the thumb and forefinger, are the subjects to whom this operation is particularly advantageous. Dr. W. has several times removed the bone of the first phalanx, and twice that of the second, and still preserved sufficient flexibility of the part to enable the patient to use it. (See *Reese, in American Ed. of this Dictionary*.) Such practice

is common in England, though, perhaps, oftener deviated from than it ought to be. "Exfoliation of the distal phalanx, which frequently occurs, does not require amputation, as the finger, though somewhat shortened by it, is not materially impaired, either in appearance or utility." (*Syme's Principles*, p. 403, ed. 2.)

With regard to the treatment of the species of whitlow named by Mr. Wardrop *onychia maligna*, all local applications have in many instances proved quite ineffectual, and the part been amputated. The only local treatment which Mr. Wardrop has ever seen relieve this complaint has been the evulsion of the nail, and afterwards the occasional application of escharotics to the ulcerated surface. I have myself seen a similar plan occasionally succeed; and the applications which appeared to answer best, were arsenical lotions, Plunket's caustic, or a very strong solution of nitrate of silver. Nothing, however, will avail till the nail is removed; and its total separation sometimes takes up a good deal of time, unless the patient submit to the great pain of having it cut away.

In four cases of the *onychia maligna*, Mr. Wardrop tried with success the exhibition of mercury. It was given in small doses at first, and afterwards increased, so as to affect the gums in about twelve or fourteen days. When the system was in this state, the sores in general soon assumed a healing appearance, and the bulbous swelling gradually disappeared. (See *Med. Chir. Trans.* vol. v. p. 138.) I have known of similar cases, which were traced to inoculation of the finger with venereal matter.

**WOUNDS.**—[A wound is a solution of continuity in the soft parts, produced suddenly, by direct external violence.

Any agent capable of exercising a greater degree of force than the resistance opposed to it by the tissues, may occasion a wound. As such agents are very numerous and diverse in nature, it follows that wounds will vary much in shape, depth, extent, number, &c. In medico-legal investigations, it is especially necessary to pay careful attention to the minute features of wounds.

The importance of this subject, and the necessity of carefully studying it, can hardly be exaggerated. Heister well expresses this when he says "we are persuaded by two reasons to begin these institutions of surgery with an inquiry into the nature of wounds; for wounds are not only more common than any other external injuries, but the nature of them also is more easily explained in our schools of surgery; and, indeed, when we are thoroughly acquainted with the nature of a wound, we shall with much greater ease and clearness comprehend all the other doctrines of surgery."

The division of wounds which meets with modern acceptance is into five classes—viz., incised, punctured, contused, lacerated, and poisoned. Such a distinction is convenient for description and comparison, but frequently in practice the features characteristic of several of these species are combined.

An *incised wound* is that which results from the action of sharp-edged weapons. It is a clean cut, without tearing or bruising. The lips of such a wound, being little injured, unite readily. In length, depth, shape, &c., incised wounds of



course vary greatly, and they may be complicated by the presence of foreign bodies, hæmorrhage, injury of nerves, muscles, joints, &c. Some incised wounds are sub-cutaneous, while others are open to the surface, but the subsequent remarks refer to the latter alone, a separate article being devoted to the consideration of sub-cutaneous wounds.

The *primary phenomena* attending open incised wounds are, *gaping, bleeding, and pain*; while the *secondary* are those which mark the repair of such wounds.

The *gaping* which follows an incision in the soft parts will vary with the tension and elasticity of the texture in which it is situated, its vital contractility, and the action of the muscular fibres implicated. In dense textures the separation of the lips of the wound may be very slight. By the judicious use of position and apparatus during treatment, the surgeon has much in his power to diminish the strain which otherwise would fall on the edges, and so cause gaping.

The amount of *bleeding*, will of course, chiefly depend on the vascularity of the tissues divided, and in a lesser degree on the plasticity of the blood of the person wounded. The nearer the vessel wounded is to the main trunk from which it comes, the freer will the hæmorrhage be. That peculiar diathesis to which the term "hæmorrhagic" has been applied, may occasion most dangerous bleeding to follow even a slight wound. Warmth and a dependent position encourage, while cold and elevation diminish the bleeding.

The amount of *pain* attending an incised wound will be chiefly determined by the nerves which are divided, and also, in no small measure, by the temperament of the patient. The skin, especially in some regions, as on the face, palmar and plantar surfaces, and about the anus, is peculiarly sensitive; while bone, cartilage, tendon, &c., are but lowly endowed with sensibility. Inflamed textures are especially painful when cut, and this is peculiarly true of some tissues, which in their normal condition are nearly devoid of sensation, as for example, the tendons. Frozen parts, or those stupified by injury, are little sensible to incision.

Clean cut, uncontused incised wounds are those especially fitted for early and rapid union, and the measures to be employed to bring that about will be discussed presently.

*Punctured* wounds are those caused by pointed sharp weapons. They are, as a rule, narrow and deep, and are thus liable to complications by the injury of deep textures. Bayonet, lance, and many sword wounds come under this designation, and it need hardly be said that such lesions are frequently of the utmost severity. Foreign bodies are apt to be concealed in punctured wounds; blood-vessels and nerves may be seriously wounded; and discharges are liable to be confined, and so to cause mischief. Erysipelas, lymphatitis, abscess, and sinus, are not unfrequent consequences. These wounds are often slow to heal, especially if there is much bruising (as there frequently is) accompanying the puncture, and it is by granulation they commonly unite.

*Contused* wounds are the effects of blunt weapons which bruise the lips of the solution of continuity, and either produce sloughing, or so impair the vitality of the textures, that they are incapable of

early healing. Union in these wounds takes place by granulation, or by secondary adhesion, as a rule, though portions of them less contused than the rest may heal by primary adhesion. The edges are commonly ecchymosed and bruised in proportion to the severity of the violence, and their vascularity; and sloughing will occur to a greater or less degree, leaving afterwards granulating surfaces to be dealt with. Contused wounds rarely bleed much, and thus cause less alarm than an incised wound of the same magnitude, but they are *greatly* more dangerous in their after effects, from the destruction of substance which occurs, and the complications apt to rise. Secondary hæmorrhage is liable to follow as the sloughs separate, and inflammation and gangrene are readily established. *Gunshot wounds* are of the class of contused wounds, and receive separate consideration in vol. 1.

*Lacerated* wounds have torn, irregular edges; as for example, those produced by a saw. They are not unfrequent as resulting from machinery, or from the bites of some animals. The phenomena attending lacerated wounds are very similar to those which are seen in contused wounds, and the progress of both are much alike. The tearing of the blood-vessels which takes place occasionally to so remarkable an extent in many severe machinery wounds may prevent any great hæmorrhage attending even the most terrible injuries of this class. When the contusion and laceration are great, the pain is often very slight, from the vitality of the textures being gravely interfered with, but when the contusion is slight the suffering is often violent.

The amount of sloughing which follows a lacerated or a contused wound will of course depend mostly on the violence of the injury, but also on the recuperative power of the part, and in no small degree on the treatment pursued. In most cases the recovery is tedious, and the risk of secondary bleeding, erysipelas, gangrene, abscess, and sinus considerable.

Limbs torn off by machinery or cannon-balls are perhaps the most terrible accidents which fail to the care of the surgeon. The blood-vessels, nerves, and tendons are then found hanging out torn and ragged, and the integuments and muscles irregularly separated, bruised and destroyed. The bones too, are frequently so split that the injury is irretrievable. The various tissues opposing different degrees of resistance, the resulting wound is thus most irregular.

*Poisoned wounds.*—The lesion may present the features of any of those species of wounds already described, but we have, besides and beyond these characters, others which belong to the inoculation of a poison on the part. Usually the wound is a punctured or incised one, and in that respect in no way peculiar, but the presence of a poison adds special and characteristic features to the case. The poison introduced into the wound may be either an animal, vegetable, or mineral one. Some barbarian tribes, as is well known, dip their arrows in poison of a most subtle and deadly kind, which acts with amazing speed and potency. Woorara is used for this purpose, and also the poison of the rattlesnake, as we are told by some American writers.

Certain animals are provided with a venom for their protection, which, if introduced into wounds, may prove hurtful or highly dangerous. There are many species of insects and spiders possessed

of such a power. The bee, wasp, hornet, the mosquito, the tsetse, the scorpion, various centipedes and spiders (especially the tarantula katipo and tenderaman) are more or less injurious. In the case of the bee, wasp, and hornet, the poison is stored in a venom-sac in the abdomen, at the root of a pair of fine pointed weapons, which are enclosed in an outer sheath, and by these darts the wound is made. Occasionally, the sting is left adherent to the surface, being torn off from the body of the insect. The sting of the scorpion consists of a perforated claw at the end of the tail, connected with venom-glands. As a rule no danger to human life attends the sting of any of these animals, but in certain conditions and circumstances they may create much irritation. Some persons are peculiarly sensitive to the effects of these poisons, and when in weak health all may suffer severely. The sting of a common bee in the mouth, or throat, or neck, may cause most dangerous effects; and multiple stings, even on the surface, have occasioned rapid death. The consequences are said to be most violent in the heat of summer, and when the insects are roused to anger. Faintness, sickness, giddiness, dimness of sight, and general oppression, are the effects complained of. In Africa and Asia, where scorpions of large size exist, great danger may follow their sting; in Europe the effects are similar to that of bees, but somewhat more marked. No allusion need be here made to the apocryphal narrations regarding the effects of the bite of the tarantula, the poetic descriptions long received being now exploded.

Many venomous snakes exist whose stroke is most deadly. They possess a sharp incurved hollow tooth in each upper maxilla, which, when not in action, is laid backwards, but can be quickly erected for offence. These teeth communicate with a sac supplied by a poison-gland within the orbit, and the venom is pressed out through the canal in the fang when it is driven into the tissue. This venom is described as a viscous greenish fluid, of neutral reaction, and almost without smell, and containing a peculiar principle ("viperine," or "echidnine").

The rattlesnake, the copperhead, the cobra, the water moccasin, &c., are the best known of the venomous snakes. The symptoms which follow the stroke or bite of a snake are both local and constitutional. The limb swells, and the neighbourhood of the wound becomes red and irritable, while the lymphatics, and veins leading from it, become the seat of inflammation. Vesicles frequently form around the point inoculated, and get filled with bloody serum. The pain varies much in different cases, being occasionally slight, but often most severe. The subcutaneous cellular tissue gets infiltrated, and mortification may appear before death. The constitutional symptoms frequently arise with great rapidity and violence, so that the local are but little regarded. The nervous and the circulatory systems give token of being gravely affected. There is paleness, prostration, dimness of vision, sickness, bilious stools, trembling, and delirium, stupor, or even unconsciousness. The surface gets cold, and bedewed with sweat. The pulse gets feeble and intermitting, the respiration oppressed, and there is much anxiety. The surface may become yellow, and abscesses may form (if the patient lives long enough) in the cellular tissue

of the limb and trunk. The poison which is capable of producing such terrible effects when inoculated, is harmless when swallowed, or when applied to the unbroken skin. If the supply of venom is exhausted by the serpent having recently repeatedly expelled it, the effects are greatly less severe, and may even fail altogether to appear. If the fang enters a considerable blood-vessel, then the destructive influence is intensified. Wounds of the face and trunk are the most dangerous, and the more venom introduced the more powerful and rapid the effect. After death various appearances have been ascribed to the septic action of the poison. None of these are constant, though a dark and fluid state of the blood has been often noted, as well as congestion of the lungs and brain, and a loaded state of the right side of the heart.

The vipers of this country rarely cause harm, unless young children or feeble and old persons are bitten by them; and even then, dangerous symptoms have been rarely met with.

But besides the poisons above alluded to, wounds may be complicated by the presence of other poisons secreted by some animals when diseased. Thus, hydrophobia (which see), arising chiefly in members of the canine and equine tribes, may be inoculated on man, and glanders can be propagated in like manner to man, and by him communicated to his fellows.

*Dissection Wounds.*—Dead bodies beget a septic poison which when inoculated produces special, and often most disastrous consequences, and differs yet again from those poisons already described. There is reason to believe that this virus is most potent at a period before putrefaction has made any way, and it appears to be more powerful when derived from persons dying of certain diseases, more especially those marked by diffuse unhealthy inflammations, as puerperal peritonitis. The condition of the recipient, too, greatly influences the results of inoculation; as, if in health, and of good constitution, he runs a vastly better chance of escaping the more violent effects, than if he is feeble, over-worked, or intemperate. A very minute amount of the poison is capable, in many cases, of occasioning the most powerful results, but many persons resist its effects in a marvellous manner. Fortunately, in most instances of dissection wounds, no evil effects follow, or at worst only trifling local irritation; but when circumstances favour the more pernicious development of the poison, then a train of the most serious local and constitutional symptoms appear. A vesicle, or pustule, forms at the wounded spot, and unhealthy inflammation seizes upon the veins, lymphatics and cellular tissue of the limb, causing it to become red, hot, boggy, and painful. The glands enlarge, and suppuration of a circumscribed or diffused character follows in the limb, and possibly on the trunk, and utter disorganisation may result. The constitutional effects often set in quickly, and with much severity. Chills, followed by fever, at first, and for a short time, inflammatory in type, but quickly assuming the typhoid or irritative form. The period at which the patient begins to suffer varies from twelve hours to several days. There is commonly severe headache, nausea, racking pains, sleeplessness, delirium, much depression, dyspnoea, and other evidences of profound constitutional involvement. The local symptoms may be but little marked, and attract slight attention, so completely are they overshadowed by the condition of the



general system. If death follows, it may be in a few days, or not for weeks, when the patient is finally worn out by the suppuration and hectic. In forming an opinion of the final result, we must take into account not merely the violence of the local and constitutional symptoms, but also the power of resistance possessed by the patient, and the risk that may attend the separation of sloughs after the brunt of the attack has passed away. Purulent infection may occur, and in any case the recovery cannot fail to be very slow, and often unsatisfactory. Even if not the precursor of incurable disease of the lungs or other internal organ, severe local injury often results from the accident.

Lastly, *Malignant pustule* is another result of the inoculation of an animal poison. In this case it is derived from contact with murrained cattle. The hides, hoofs, horns, hair, and even the flesh and blood, of such animals, have the power of conveying it to man; but he in turn does not, so far as is at present known, transmit it further. This poison appears to be very powerful, as it is capable of being carried even by insects. There is reason also to think, that fences or posts with which the diseased oxen have been in contact may serve as media for conveying the contagion to man. The disease first shows itself by local signs in from twelve to sixty hours after contact, and the constitutional symptoms do not appear usually till the local have made some progress. The inoculated spot gets irritable, itchy, and somewhat painful. It becomes red, a small vesicle forms which is filled with turbid serum, and this passes into the pustular stage, with a red hard base. The inflammation extends, and if it be a limb which is affected, it will swell, become red, œdematous and painful—though mere painfulness is not usually a leading sign of this complaint. The lymphatics and veins are affected, and as the pustule breaks, a dark dry gangrenous spot is found on the surface, which soon implicates the skin throughout its entire thickness. Crops of vesicles or bullæ appear around the original spot of inoculation, and the constitution soon becomes gravely affected. Fever of a low form sets in with a rigor and great disturbance, and leads with much rapidity to prostration, delirium and sinking. The evidences of blood-poisoning are well marked, before death, in the deep prostration of the powers of life, and the "post mortem" appearances correspond. When inoculation takes place on the face, the disfigurement is hideous in the extreme.

*Constitutional Effects of Wounds.*—Besides the special consequences produced by poisons inoculated on wounds (and which have been in the preceding paragraphs sufficiently alluded to), extensive incised, lacerated or contused wounds may be followed by shock and by fever. The shock may be violent and the reaction proportionately trying. The usual remedies for such conditions must be employed. Depressing treatment should as far as possible be avoided, as the powers of life will soon require all the sustaining support they can receive. The fever, at first sthenic and threatening, will in the progress of the case be apt to assume the typhoid or hectic type, and will require to be treated accordingly. During convalescence every means of recruiting the general vigour must be sedulously employed. Tonics, generous food, cod-liver oil and country air are the remedies commonly enjoined, and are, if judiciously used, sufficient to meet the needs of the case.

The appearance of any internal disease, the result of the traumatic lesion, must be watched for and combated.

*The Repair of Wounds.*—The mode in which wounds heal is evidently a subject of the highest interest and importance. Only a brief sketch of the process can be here attempted. Mr. Paget, in his "Surgical Pathology," has most fully and most ably described the whole, and he has shown that open wounds heal in one of five ways: viz., immediate union; primary adhesion; granulation; secondary adhesion, or the union of granulating surfaces; and, lastly, by scabbing.

The blood which is poured out in varying quantities between the lips of a recent wound, and which is always an obstacle and hindrance to its repair, till it is removed or organised, is got quit of either by being thrown out mechanically by the swelling which attends the inflammation set up by its presence, or it is absorbed by the vessels of the organising reparative material which comes to be poured out, and which encloses the blood within its meshes. The clot is decolourised, altered, degenerated, and finally absorbed. In rare cases the blood is neither ejected nor absorbed, but becomes organised, and takes part in the reconstruction of the breach.

The material by which wounds are repaired is fibrinous organisable coagulable lymph, and the more perfect it is in its intimate organisation—in its vitality—and the more truly those conditions requisite to its sound development are supplied, the more rapid and complete will the result be. In open wounds, Mr. Paget, following the observations of Schwann, has described the lymph as passing through a structure of nucleated cells to fibrillation, the cells undergoing elongation to form the filaments of the connective tissue which results. Virchow, on the other hand, concludes from his observations, that the bundles of fibres are formed, not by the cells, but by the intercellular substance. The cells he represents as constituting the corpuscles of the connective tissue and as throwing out processes from their ends and sides to unite with one another, and establish a stellated network between the masses of fibrillæ formed as above stated.

In subcutaneous wounds, Mr. Paget states that the lymph is transformed, not from nucleated cells, but from nucleated blastema—a molecular homogeneous matrix of fibrine, which develops clear oval nuclei in its substance. Fibro-cellular tissue is formed from the blastema assuming a filamentous disposition. This process of development is, as Mr. Paget points out, more perfect and complete than that occurring in open wounds, and both may be observed simultaneously in the same wound.

Let us now give a short *résumé* of the different ways in which wounds heal.

1. "*Immediate Union*" of Macartney, i.e. the growing directly together of the divided surfaces, without the intervention of any new agency whatever. This was the "union by the first intention" of Hunter. The disjoined parts adhere "immediately" and directly. In order that this most complete, perfect, and rapid issue should be obtained, it is evident that all foreign bodies must be carefully and completely removed from between the cut surfaces; that the vitality of these surfaces must be wholly uncompromised; that the

most scrupulous adjustment of tissue to like tissue in the lips of the wound should be quickly secured and rigidly retained; and further, that no degree of inflammation should follow by which the state of rest, so necessary to success, be disturbed. Those conditions in the constitution and habits of the patient, and in the circumstances in which he is treated which are most conducive to healthy nutrition, aid most materially the desired end. The result is most perfect. A mere line, which will shortly disappear, constitutes the only trace of the injury.

2. *Primary adhesion.* Hunter's "Union by the Adhesive Inflammation."—Here lymph is poured out between the cut surfaces (and little, if any, into the surrounding tissues), forms a connective tissue, and establishes a bond of union between them—in short, solders them together. The closer the edges of the wound are placed to one another, the narrower will the plate of interposed lymph be; and as it is the cutaneous edge of this plate which, becoming covered with dermal tissue, constitutes the scar, it follows that the mark left will be diminished in like manner. Inflammation, if at all violent, will manifestly mar the result by interfering with the perfect constitution and successful organisation of the lymph, which, in favourable circumstances, quickly becomes vascular, and may in a few days achieve a firm repair. Here the issue is slower of attainment, and not so perfect as in immediate union, in so far as that a scar remains, and the process is more open to accident.

3. Healing by granulation is a still less desirable method of repair than those already described, as it is slower, less certain in its progress, and more liable to interruption, as well as being in general followed by greater deformity. It consists in the pouring out of a thin glazing of white blood corpuscles embedded in fibrine over the raw surfaces, which after an uncertain period of rest—of incubation (varying with different circumstances, more especially with the nature and extent of the wound, and the constitution of the patient)—is followed and replaced by an effusion of lymph, which in time becomes organised. This effusion of lymph is preceded and accompanied by a determination of blood to the part. "Granulations" consist of small acuminate papillary succulent projections of vascular lymph, which may or may not be accompanied by pus, i.e. by granulation cells, which have been rejected from the work of repair going on. In open granulating wounds there is always pus poured out, and the character of the fluid will vary with the healthfulness of the granulations supplying it.

4. *Healing by secondary adhesion* consists in the union of granulating surfaces. The lips of a wound which are covered with healthy granulations of similar or nearly similar age, being held gently in contact, grow together—the cells on either surface adhering, and an interchange of blood-vessels taking place, so that the two lips become amalgamated. There must be no inflammation, otherwise the end will not be obtained.

5. *Healing by scabbing* is the last method of repair. This, the ordinary mode of healing in the case of the lower animals, consists in the formation of a scab by the drying of some secretion over the wound, and its protection thus from the atmospheric air. The formation of a scar takes place beneath, always supposing that the scab is

not continually displaced by renewed secretion from the wound, as when inflammation gives rise to a continued discharge of pus.

In all these modes of repair, except the first, there will be more or less scar or cicatrix left to mark the seat of the wound, and in many cases this scar is extensive, discoloured, deformed and enduring. The cicatricial tissue has in itself the inherent property of long-continued contraction, so that all the tissues on which it acts yield in time to its power (when the cicatrix is extensive), and thus much displacement and distortion may be caused. Joints thus get fixed; parts which are separate are approximated and united; orifices misplaced and obstructed, and in this way the utmost embarrassment and evil follow. Much can be done during the healing of wounds by granulation to counteract or diminish the effects of this contraction; e.g. by attention to position during healing, by the use of splints and special apparatus, such as elastic bands, moveable appliances fitted to oppose the contraction, &c. These measures must be long employed, as the morbid tendency is very enduring. Fomentations, shampooing, exercise, help to oppose the contraction. Scars too, sometimes, especially in delicate persons, long remain weak and tender, liable to erosion from slight causes, and being quickly destroyed if excited to inflammation. Such weak cicatrices may be improved by protection, by the application of astringents, and, above all, by invigorating the patient's general health. Redundant scars traversed by thick bands of superabundant tissue, when necessary to be interfered with, may be improved by being kept moist by a lotion or ointment of iodide of potassium, or being painted with iodine, or blistered, so as to cause absorption of the excess of new material, care being taken at the same time not to excite undue inflammation and the entire destruction of the tissue. Depressed and adherent cicatrices may be much improved in many cases by subcutaneous section of the adhesions, and this will be the more necessary when the scar is placed on a prominent and visible part, as the face.

In time the intimate structure of cicatrices tends to improve, and to become more assimilated to the tissues they replace. The vitality of the new material, long depressed, mends, and it becomes less unlike the normal textures of the part in which it lies, and so less inimical in its action to the neighbouring tissues. While of lowered vitality (i.e. so long as their organisation is incomplete), scars are very easily and quickly destroyed. Inflammation seizing upon them rapidly ends in destructive ulceration, and, while friction or undue pressure very surely causes such a result, exposure to severe cold is very apt to produce a like effect. Weakly, delicate persons, in virtue of their want of organising power, are liable to the formation of shallow weak ulcers on cicatrised surfaces. In these ulcers the edges are usually red, thin, and undermined, while the surface of the sore is covered with weak, pale, toneless granulations. Such ulcers indicate the need of invigorating remedies—country air, wine, cod-liver oil, and iron—while locally stimulants and astringents combined act best.

Cicatrices are sometimes the seat of many uneasy, if not painful sensations, which cause annoyance or distress to the patient. Formication, prickling, shooting or burning sensations; but



these fall far short of the terrible suffering occasionally endured in the ends of stumps. Steaming with narcotic vapours, careful protection from vicissitudes of temperature, shampooing, the use of lotions containing gentle stimulants or narcotics, and the employment of those internal remedies which are found useful in neuralgia (of which such painful impressions are frequently examples), constitute the most useful methods of treatment for the slighter cases. For painful stumps, if no explanation can be found, on a careful examination of the divided ends of the nerves—no adhesion to bone or skin, no undue pressure from any source—the same plan must be pursued; but if the exact seat of the affected nerve can be determined, or its morbid adhesion discovered, then it can be subcutaneously divided for temporary relief, or a portion of it excised to obtain a more permanent good.

As a remedy for the persistent weakness, or unsightliness, or deformity of cicatrices, or the evils they occasion, it is occasionally the best practice to remove them altogether, and either seek by care to direct and control to a better result the new scar, or, what is better, to repair the breach by a plastic operation. Occasionally, the hiatus is best filled up by carefully dissecting up the flaps on either side and sliding them together, while at other times by transplantation a better covering is obtained. Bands may be divided at several points, and the tissues then stretched, or the most contracted portion may be wholly removed, while the less injurious part of the cicatrix is not interfered with. In extreme cases of deformity and embarrassment, the patient is sometimes glad to get rid of the part altogether, if it can be removed by amputation.

Cicatrices are liable to various affections, besides those already alluded to. Horny and warty growths, fibrous and cancerous tumours, bony concretions, &c., occasionally form in them. The weak vitality of cicatricial matter will render it liable to the development of any latent constitutional disease. Epithelial cancer presents itself in scars as a coarse warty condition. It is in old rough scars which have been frequently exposed to irritation that such disease is most apt to appear. Mr. Caesar Hawkins has ably described the warty affection of cicatrices. After the removal of primary cancer, the recurrent growths frequently show themselves in the scar, and from the paucity of the soft parts, we are often in such cases unable effectually to interfere. If cancer were to appear in the cicatrix of a limb, amputation at a point well above the seat of the disease might get rid of it; and in other parts of the body, if the case be fitting, caustic may be decidedly used to destroy the growth.

Cheloid is a most curious, rare, and ill understood affection which may attack old scars. The cicatrix hypertrophies gets thick, and enlarges in all its diameters, so as to overhang the limits of the former scar. It increases slowly and gets prominent. It is occasionally painless, but more frequently it becomes the seat of burning, stinging, lancinating, or distressingly itchy sensations. The surface is usually smooth, and in its early stage permeated by small branching vessels, which may give it a brighter colour than the surrounding skin, or, later in its history, its surface may be distinguished by its pale or white colour. In inti-

mate structure, cheloid is composed of firm, hard, compact tissue, consisting of grey closely-woven fibres, mixed with cells. In their clinical history such cases often vary much. Frequently no explanation whatever can be given of their cause. They are evidently constitutional in their origin, and being so, admit of but little local treatment. They frequently cease spontaneously to enlarge, may remain long stationary, and may contract and disappear. They do not often ulcerate and prove destructive. If removed by the knife, they usually recur, and the new growth is often more troublesome and active than the original one. In the hope of cheloid being spontaneously arrested or removed, it is well to delay all interference with it as long as possible, but if it be growing very actively, we may try by counter-irritation and pressure to moderate or check its advance. Blisters of cantharides, or painting with strong iodine, or using iodine and mercury in combination, has given the best results; but when the growth is quiescent, simple protection by collodion should alone be employed. To remove cheloid by caustic or the knife is very rarely successful, yet patients occasionally press for such a step, in order to escape, even temporarily, from the pain and annoyance it occasions. If excised, the necessary incisions must keep well free of the limits of the disease, and an attempt should be made, by the substitution of healthy textures from the neighbourhood, to close up the gap as quickly as possible. The internal administration of iodine, arsenic, and mercury, separately and in combination, has been recommended.

#### THE GENERAL TREATMENT OF WOUNDS.

*Constitutional Treatment.*—This comprehends all those measures which are calculated to improve and sustain the patient's strength and health, and enable his system to restore the injured tissues to their integrity. Rest of mind and body greatly conduces to recovery, and helps to ward off complications. All excitement of mind, be it agreeable or the reverse, is hurtful to the happy cicatrisation of wounds, hence the advantage of a serene and equable temperament to a wounded man. Agreeable, but not too engrossing mental occupation is always beneficial, and will in most cases prove a useful aid to the other means of treatment.

A moderately warm and fine atmosphere is always of essential consequence in the sick-room. So long as it is of a good temperature, and free of draughts, the more abundant the supply of air to wounded persons is the better. No more powerful preservative against the most serious of the complications which attend wounds can exist than in the free supply of atmospheric air. The close, ill-ventilated houses of the poor, and the loaded miasmatic atmosphere of a large and crowded hospital, are far behind the pure uncontaminated air of a dry sunny country house, as aiding convalescence from injury. The overcrowding and indifferent hygiene of military hospitals during a campaign have been long recognised as the prolific sources of the frightful mortality which has at times signalised warfare. The most scrupulous cleanliness in the sick room, both as regards the person and the surroundings of the patient, is imperative. The body clothes and the bed linens should be frequently changed, both to maintain cleanliness, and also for the grateful refreshment it produces. Baths too, both local and general,

produce much to the desired end. No dressings which have been in use should ever be left lying about, and when numbers of wounded men are treated together, even the materials provided for future dressings should not be left exposed to the emanations of the wards, otherwise they will become contaminated. The use of disinfectants and antiseptics should be encouraged, as they contribute much to the salubrity of the sick quarters. During convalescence, a change of apartment previous to a change of residence is often helpful to recovery, by the encouraging mental effect it has, and the complete change of atmosphere it ensures. That a warm equable temperature favours the healing of wounds has been well illustrated in some countries where such a climate exists, and where the evils of rapid decomposition, inseparable from such climates, have been carefully guarded against. A cold, damp, changeable climate is the worst of all for the recovery of wounded men, and is a prolific source of dangerous complications.

The food required by persons suffering from wounds should be generous, and suited in quantity and quality to the natural inclinations of the patient. It should be mixed and regulated by the powers of appropriation. During convalescence from severe wounds accompanied by great waste and exhaustion, it is essential that the most sustaining and easily assimilable food should be provided, but there is in many cases too great a tendency among practitioners to overload the system during such a period, by forcing a diet on the patient which is much more concentrated and more abundant than his requirements demand, and often very considerably more than his digestive organs can make use of in the circumstances in which for the time he is placed, and thus great evil is done when only good is intended. Stimulants, too, are frequently ordered in lavish quantities, under the veil of "keeping up the system," when the extra call on the vital powers is but small. It is true, that in many cases we are compelled to administer the most nourishing food, and the largest amount of stimulants, to support the strength when unequal to the struggle in which it is engaged; yet these cases should be carefully discriminated. The state of the pulse and tongue, the expression of the patient, and the temperature of his surface, together with a due regard to the patient's tastes, habits, and sensations, and the condition of his secretions, will be our best guides as to the management of the diet. Common sense and experience, together with a full appreciation of the individuality of the patient, his habits and his failings, will be a better guide to us than any theoretical or artificial scheme of aliment. Acidulated and refreshing drinks are always grateful to those suffering from wounds, and these should be freely administered. Fresh fruit too, unless contra-indicated, is much appreciated, and is usually highly useful in allaying thirst and fever, and aiding the alimentary secretions.

As regards the use of drugs, the fewer administered the better. The indications for their use should be clear and manifest before they are ordered. It is requisite to health, and so to good recovery from accident, that the secretions should be maintained in proper and due activity, and to this end it may be necessary in the progress of such surgical injuries as are now under consideration that drugs be employed, but as a rule the fewer

medicaments administered the better. If there has been much blood lost, there will likely be some constipation for a time, but this will disappear, or may be relieved by a lavement, which, when it can be used, is in general much to be preferred, in surgical cases, to the use of purgatives. There are, of course, many cases in which lavements will prove insufficient to meet the requirements of the case, but much can, in all cases, be done by the proper regulation of the diet, to ensure a sufficient and regular alvine evacuation. Salines will be needed if there is fever, but tonics, diuretics, &c., should be held in reserve for employment when there is a clear call for them. Opium or bromide of potassium, and hydrate of chloral, are extremely serviceable in the progress of most wounds for allaying pain and nervous agitation, or obtaining sleep. Opium and arnica are given by some surgeons of high reputation, as prophylactics against surgical fever and purulent absorption, but the evidence in their favour as agents for that purpose is defective. It is almost needless to add, that the use of emetics and general blood-letting, as an initial treatment of wounds, has disappeared from modern surgical practice.

*The Local Treatment of Wounds.*—It is not a little remarkable that the simple dressings and early adhesions aimed at in the modern treatment of wounds should have been practised in the earliest epochs of surgical history, though long lost sight of afterwards. Hippocrates, Celsus, Galen, and Ætius all advocated early union, and Galen, more especially, describes healing by "first intention." Such wise practice was, however, unfortunately afterwards widely departed from, and the very opposite plan pursued. Every means was adopted calculated to delay and oppose union, so that the wound might be "purged" from certain supposed evil elements, which, if not expelled, would sooner or later bring about harm. Every effort made by Nature to repair the breach was thwarted, and that often by means whose ingenuity was undoubted. The surgeon appeared to exercise his skill and dexterity, not in devising and carrying out measures calculated to aid Nature's beneficent labours, but, on the contrary, to interfere and neutralise them as much as lay in his power. Long without adequate means of commanding hæmorrhage, the ancients could not in many cases effect the early closure of wounds, and not understanding aright the phenomena of early adhesion, they feared to accomplish it, in dread of the harm which might follow. Till the ligature was appreciated and used, the different methods employed to arrest bleeding from wounded arteries were so ingeniously destructive of all possible hopes of early union, that till these were abandoned, it was clearly impossible to obtain aught but the most tardy and unsatisfactory repair. So long as the actual cautery was in daily use to restrain the ever-recurring hæmorrhage—while the soft parts were divided with dread by means of red-hot knives or instruments impregnated with powerful acids—so long as "buttons" of vitriol were tied over bleeding vessels, or the most powerful astringents and mechanical appliances used as styptics, or coagulants stuffed into bleeding wounds—it was hopeless to expect early union. Wide-spread destruction, prolonged suppurations, delayed repair, and grievous deformities were the necessary consequences. Even after Pare had



been "inspired with the good thought" of the ligature, the improvement in the local treatment of wounds was not great, as, from ignorant fear, every conceivable method was employed to retard union. Setons, sydons, tents, metal tubes, and other horrid contrivances were used to keep the wound open; and if by any chance it had closed, ingenious instruments were at hand to tear it rudely open again. "Vulnerary" balsams, "incarnatives," "glutinantia," "cicatrissants," made of diverse irritating and secret compositions, were poured into the depths of the wound, or forced into it on setons, so as to cause the whole surface to pass through the orthodox process of "digestion, mundification, incarnation, and cicatrisation," which constituted the "*more canonico*," from which no "regular practitioner" dared depart without subjecting himself to the charge of heresy from his brethren, and exposing himself, it might be, to an amputation of criminality on the part of his clients. The more free the suppuration proved, the more perfect and complete the "purging" was supposed to be, yet they were not content to give such coveted secretion a ready issue, but caused it to be pent up by the insertion of tents between the lips of the wound. In this way trivial wounds were terribly aggravated and frequently rendered incurable. Fistulous orifices, wasted limbs, and shattered health bore testimony, but too frequently, to the ignorance and cruelty of the practitioner.

Before the profession awoke to a sense of errors committed, the "irregular practitioner" had hit the blot, and had partially remedied it. The "secret" and "sympathetic" dressings which attained so great a reputation were attempts to secure the good of early repair, and yet escape the censure of not following the orthodox canons. They desired to obtain the requisite "purging" from deleterious agencies, by which alone they would be held free of blame, and yet not keep the wound open. The secret dressing of most repute was that of the "Suckers" (the *Psylli* and *Mersi*), who with their mouths removed all foreign bodies and blood from between the lips of the wound, and by the warmth of the application promoted the effusion of lymph, while they immediately closed the orifice hermetically by a plug of chewed paper held in place by a firm bandage till union was achieved. It was by the accompanying incantations that the cleansing from injurious agencies was ascribed, but the firm closure contained the real secret. Those who practised this art were careful only to apply it in fitting cases, yet its success, even in the most serious wounds (as those penetrating the chest and abdomen), was such as to astonish the great *La Motte*, and others of equal eminence. So, too, the "sympathetic" powders of *Digby* might well be applied indifferently to the wound, the weapon, or a cloth dipped in the blood, so long as all foreign bodies were carefully removed from the wound itself, and its lips quickly and accurately adjusted, and kept together. The "purging" was of course accomplished by the magic action of the powders, but the success depended on what the attention was withdrawn from, viz. the local treatment by early adjustment. In any case where methods of treatment were adopted at direct variance with those usually followed, it was customary to ascribe them to some venerable Eastern sage, or some learned Jew, who had

acquired the knowledge among the wild tribes of the desert. Without such an introduction, it were almost vain to expect a fair trial.

The lesson taught by the secret dressings was but slowly learned. As *John Bell* says, "the world had to be cheated into this easy method." In time, however, in different ways and degrees, *Paré*, *Vesalius*, *Guillemeau*, *Belloste*, *Petit*, *Garangeot*, and *Ledran* adopted the improved principles. Whenever the wounded arteries could be securely closed after amputation, surgeons came to pay attention to the shape and composition of their flaps, and to the perfecting of their union, and thus the doctrine of adhesion began to be more carefully studied, and the old practices abandoned.

The acuteness and intelligence of *Ambrose Paré* did not prevent him employing such hideous "vulneraries" as the famous "*Oleum catellorum*," which, he tell us, he learned, after two years' toil, from a famous surgeon of Turin, who "honoured it with the glorious title of Balsam," and who rewarded him at last, on promise of secrecy, "with this most precious gift." It consisted of earth worms digested in white wine, oil of lilies, turpentine, "*aqua vitæ*," and live puppy dogs boiled in oil.

The poisonous nature of gunshot wounds (supposed to be derived either from the powder or the electricity, or the heat evolved) was the reason given for the "pouring in" of caustic solutions and boiling oil to destroy this "venom." It was only from the accident that *Paré* ran out of his store of destructive materials, that he began to use the somewhat less severe (!) applications of turpentine, and his famous "*Egyptiacum*," composed of milder caustics.

In modern times we leave Nature to do more, and we do less, in the repair of wounds. How well does *John Bell* put it, when he says: "It is an old, but it is a becoming and modest thought, that in our profession we are but as ministers of Nature; and, indeed, the surgeon, still more than the physician, achieves nothing by his own immediate power, but does all his services by observing and managing the properties of the living body; when the living principle is so strong and active in every part, that by that energy alone it regenerates any lost substance or reunites in a more immediate way the more simple wounds." "We shall find our duties happily reduced within the narrowest bounds, viz. of saving the patient from immediate bleeding, and of laying the wounded parts so cleanly, so neatly, and so evenly in contact with each other, that they may adhere. The rest we leave to Nature."

The enormous advantages of early union are now well established, and many methods which profess to facilitate it have of late years attracted the attention of the profession. That all hemorrhage should have ceased, so that not even blood be left between the lips of the wound, is fully recognised as a necessary condition to rapid adhesion, while by exposure to the air, or the application of cold water, oozing from small vessels is in general sufficiently checked. The larger arteries can be closed by ligature, torsion, or acupuncture. It is not now the custom to follow the practice of *Liston*, of leaving the wound open till it is glazed by plastic exudation, yet occasionally such a step has much to recommend it. As a

rule, the sooner the dissevered surfaces are laid together the better. "Nothing can agree better with one surface of a wound," says Bell, "than the opposite one, which has just been separated from it." Further, the same writer adds: "This simple duty of closing a wound is both natural and safe." So, too, Assalini in his Manual says: "Every wound of the soft parts formed by a cutting weapon, from the opening of a vein to withdrawing a few ounces of blood, up to the incision made in the uterus for removing the fœtus, should be united by first intention." Of late, much unmerited obloquy has been cast on the ligature as an hemostatic agent. It has been said to act as a seton, and to poison the tissues by getting impregnated with the decomposing secretions of the wound. To overcome these evils, and allow of early and complete closure, Sir James Simpson perfected acupressure, and Mr. Syme has reintroduced that torsion which Maunoir, Amussat, and Velpeau did so much at one time to encourage. More lately, Mr. Lister has proposed to recur to the ligatures of animal tissue, so largely used at one time by Jamieson of Baltimore, Physic of New York, Sir A. Cooper, Wardrop, and Manec, and which in their hands so signally failed; but when impregnated with carbolic acid, Mr. Lister hopes that they may become absorbed, and cease to irritate or excite suppuration. Metallic ligatures, too, have had their trial since first used by Levert, but the success has been but small and not encouraging. All these are attempts (and there have been others) to enable the wound to be early closed, so as to avoid the complications which otherwise may arise.

The blood-vessels being secured, the careful apposition of the lips of the wound next claims the surgeon's attention. To exclude the atmospheric air in the most perfect manner is an object of importance to rapid and unchecked union. It is well known how successful and complete is the repair of subcutaneous wounds, and to assimilate as much as possible all wounds capable of it to the same conditions would naturally be very desirable. That continued exposure to the atmosphere induces suppuration is well ascertained and long known, but it is not so clear by what exact agency it so acts. Whether we believe, with most physiologists, that it is the oxygen and moisture of the atmosphere which is the detrimental principle, or, relying on Pasteur's experiments, find it in the organic germs which are deposited by the air, we are equally convinced of the propriety of excluding that air, if possible. If it cannot be wholly excluded, the next best thing to do is to neutralise its pernicious effects by employing various agencies which may be supposed to possess the required qualities. Let us glance at the more recently suggested methods of securing these advantages.

1. *Methods of treatment which aim at excluding the air altogether.*—Guerin would perform as many operations as possible subcutaneously, in whole or in part; and when this is impracticable, he proposes to use air-tight galvanised caoutchouc coverings, from beneath which the air is removed by a pump communicating with a jar into which a tube connected with the vulcanised cover also leads. The coverings are afterwards held in close contact with the wound by atmospheric pressure. This he terms "pneumatic occlusion." He places a thin permeable tissue between the

wound and the india-rubber, so as to facilitate exhalation.

To the same end, Chassaignac recommends his "pansement par occlusion." This consists in closely covering ("en cuirasse") the wound, but without exerting any pressure, with strips of adhesive plaster, the one layer crossing the other "so as to form a sort of mosaic." Each layer slightly exceeds in size the dimensions of the wound, and the most superficial layer of all is the longest. In this way, three layers are usually employed. The whole is covered with linen (perforated or not) spread with ointment, which Richard recommends should be mixed with resinous matter, to act as a disinfectant. By this arrangement, the wound is hermetically sealed from the air; but to make doubly sure, charpie is placed over all, then some carded cotton, and, finally, a bandage whose turns are sewed together to make all close and firm. If no pressing cause arise, the apparatus is not removed for a week or more, but it is rare, from the irritation set up, that more than two weeks can be exceeded.

Laugier, again, accomplishes the same end—the complete closure of the wound from all atmospheric contact—by covering it with gold-beater's leaf and a solution of gum-arabic. This has been found useful in the treatment of burns.

Further; various methods of sealing wounds have been at various times followed among ourselves. A piece of lint steeped in blood, or in glycerine, or compound tincture of benzoin, or the use of some gum which will adhere and exclude the air, have each had their advocates. The styptic colloid of Dr. Richardson closes superficial wounds most effectually. Solutions of gutta-percha, india-rubber, &c., have all been employed with certain advantages in many cases.

Further, the treatment introduced by Langenbeck, in 1839, of keeping the wounded part constantly under water, may be put under this head. It is well known that the distinguished surgeon referred to at one time employed this mode of dressing even for amputation wounds. The difficulty of obtaining a fitting apparatus, and the discomfort attending it, have prevented this plan being much followed. A current of water of any desired temperature can be made to flow through the vessel containing the wounded part, so that all discharges are at once removed, while disinfectants, stimulants, &c., can, if required, be mixed with the water. For crushed hands, this method of immersion is very useful.

2. *Plans of disinfecting or preventing putrefaction, or modifying the absorbent activity of the surface.*—When the air cannot be excluded, the next best thing obviously would be to neutralise, if possible, any deleterious agency which it may hold in suspension. If it be oxygen, or moisture, or organic germs, the problem is to find an agent which will remove, nullify, or destroy such noxious influences, and yet leave the tissues unharmed. To counteract the evil effects of contact with the living textures of decomposing or putrefactive secretions is the great desire and aim of many methods of local management.

Alcohol has been used from the earliest times in some form to wash out and dress wounds. Hippocrates protests against the use of water to open surfaces, but advises the use of wine, under the idea that it dries the wound, "a dry condition being nearer a state of health, and humidity nearer



that of disease." He used wine alone, or having mixed with it astringents or resinous matters. Thus gall nuts, saffron, myrrh, the twigs of the oak, the dried peel of the pomegranate, &c., were used, mixed with the wine. Celsus, Galen, Paul d'Egineta, all used wine dressings, sometimes mixed with oil; and the writer on one occasion in Asia Minor saw the same agents used by the Turks during the Russian war.

By washing out the wound with wine, the ancients proposed to arrest bleeding, by constringing the small vessels and cleaning the raw surfaces. Arnauld de Villeneuve, Guy de Chauliac, Paracelsus, Petit, Larrey, and many others in more recent times, continued and lauded the same practice. Dionis used camphorated spirit of wine. Desault abandoned it and introduced cerat and vegetable or mineral washes. In 1859 MM. Batailhé and Guillet proposed to the Academy of Sciences to revert to this old dressing, and Nélaton has practically shown its great advantages. It is from camphorated spirit of wine that the best results have been got. It is found to act as a coagulant and astringent, and thus to favour early adhesion; to moderate undue granulation in open wounds, and very manifestly to act as a disinfectant, and prevent complications such as erysipelas, gangrene, and purulent infection. Alcohol destroys the pus cell by dissolving its envelope when brought into contact with it external to the body, and on the surface of wounds its beneficial effects may thus be partly explained. M. Chédevergne, having clinically experimented with every known antiseptic, including carbolic acid, came to the conclusion that "camphorated spirit of wine is without contradiction the best disinfectant which can be found for the treatment of wounds and ulcers." The manner in which alcohol is supposed to act in preventing purulent infection is by closing the open vessels, opposing the softening and ulceration of bloodvessels in old suppurating wounds, and in obviating the putrefaction of the pus. There can be no doubt but that alcoholic dressings deserve more attention from British surgeons than they have yet received. The tinctures of aloes, arnica, benzoin ("Friar's balsam"), and catechu have also been used, but the best results have been got from the camphorated spirit of wine.

Maissoneuve proceeds in this way. He bathes the raw surfaces of the wound with alcohol, or with diluted tincture of arnica, and having supported the lips with adhesive plaster so placed as not to interfere with the free escape of discharges, envelopes the whole in a bandage steeped in tincture of arnica, and over all applies Guerin's india-rubber apparatus, which he has somewhat modified by adding a glass vessel, capable of containing three or four litres, fitted with a vulcanised india-rubber stopper, and traversed by two metallic tubes. An exhausting pump of small size, and in shape like an ordinary syringe, provided with a vulcanised tube, is connected to one of the tubes in the receiver and enables the air in it to be exhausted, and as the india-rubber bag which covers the wound (stump) communicates with the receiver by the other tube, all secretions fall into it so soon as the air is withdrawn from the receiver, while no air gains admission to the wound. As the receiver is transparent, all that falls within it is at once seen. This simplification of the apparatus has added much to its adaptability for ordinary

practice. The pump must be worked every few hours, so as to prevent the secretions destroying the closeness of the fit between the india-rubber bag and the surface, and so leaving these exudations to decompose in a confined atmosphere.

Foucher, again, uses alcohol combined with glycerine and chlorate of potash (400 parts of the first, 625 of the second, and 40 of the last, which gives a transparent liquid that does not stain); while Demarquay eulogises glycerine alone as a dressing of much advantage to wounds.

Since the experiments of MM. Corne and Demeaux with Paris plaster and powdered coal-tar, various preparations of tar have been advocated as disinfectants, and many of them are highly useful. Lebeauf's taponine preparation is one of the best. No antiseptic has attracted more deserved attention than phenic alcohol since Lemaire and others used it abroad, but especially after the careful experiments and strikingly successful practice of Professor Lister. That carbolic acid dissolved in water or mixed with oil in various proportions, forms a most admirable antiseptic dressing for wounds the writer can most amply testify. Even in the most serious wounds in which bone and deep tissues are widely implicated, the careful management of them by the method so minutely described by Mr. Lister (*Lancet*, 1869 and 1870), has been found to succeed. The depths of the wound must be well washed out by a watery solution of the acid (1 to 40), and the lips afterwards carefully guarded by a covering impregnated with the antiseptic, while provision is made for the free escape of all discharges beneath the veil or rag which covers the orifice. Mr. Lister's method of employing this agent is of course wholly founded on the "germ theory" of suppuration; and while the primary washing out aims at the destruction of all germs which may have been carried into the recesses of the wound, the subsequent guarding of the orifice has in view the destruction of all such organisms in the air that comes into contact with the part, and so the prevention of any putrefactive influences. That very much can be done by the careful development of this system of practice, and that much more may be expected of it than has even yet been accomplished, no one who has read Mr. Lister's able papers can doubt.

Many other agents have been employed with success in the disinfection of wounds. Aromatic wine; infusion of elder flowers (Cusco); solutions of the perchloride and sulphate of iron (Professor Bourgade); iodine alone, or in various combinations; chloride of zinc (Mr. De Morgan), 30 or 40 grains to the ounce; solutions of permanganate of potash (Reveil and Condy); chloride of lime and soda diluted; turpentine, petroleum, bromine, sulphate of alum, charcoal, lotions of arnica, sulphurous acid, and the sulphites and hyposulphites (Drs. Polli and Dewar); Richardson's colloid styptic, &c. Of the great advantages to be derived from the solutions of the perchloride of iron, iodine, permanganate of potash, chloride of zinc, and sulphurous acid in the management of open, suppurating, and, above all, foul wounds, the writer has had ample proof, both in public and private practice. Charcoal is dirty, and acts by hastening oxidation; it has no advantages over other more manageable and cleaner applications, such as the perchloride of iron or the permanganate of potash. Venice turpentine was long a favourite application

to wounds, and its good effects, as contrasted with other more modern applications, have been recently extolled by Dr. Kerner, who has found no remedy for granulating surfaces so good as one composed of 2 lbs. 8 ounces of turpentine digested for a week in a bath at a temperature of 75° cent. with 6½ drachms of bicarbonate of soda, and 18 pints (imperial) of water, and then filtered. This forms an emulsion, and is applied on lint. Several layers of cloth saturated with this, and covered with oiled silk, are put over the wound, and left on (being, however, moistened with some of the mixture every six hours) for twelve hours. If the contusion has been great, he recommends that cold irrigation be employed for a few days before the application of the turpentine is made.

Lime water alone, or with mercury, long had a popular reputation as a local dressing to foul sores. The famous "Aqua phagedenica," described by Heister, consisted of lime water and corrosive sublimate. It is mainly to the researches of Reveil that we owe a knowledge of the antiseptic power of iodine and bromine.

Lastly, the actual and potential cauteries and nitrate of silver (Higginbotham) have been applied to wounds, in order to diminish their absorption and disinfect their surface. Such applications, however, are now-a-days rarely made, and only in very exceptional circumstances.

3. The thorough drainage of open wounds has engaged the attention of all practical surgeons. The elastic perforated tubes of Chassaignac have been found very useful for this purpose. They are the modern improvement on the "pipes," "tubes," "tents," "sidons," &c., of the ancients. It was in 1859 that Chassaignac first published his account of these appliances. As injections can be made through them a double end is often served by their introduction. They are somewhat apt to render the orifice through which they pass fistulous, and are so far limited in the period when they can be retained with advantage.

When the surgeon fashions the wound he takes care to render it dependent, and so placed, as regards the tissues involved, that it will allow of the continuous free escape of all secretions, and whatever dressings he employs he makes provision that this important end is fulfilled.

4. In order to keep the wound clean, moist, and covered, "water-dressing" and "irrigation" are frequently used. Water was used from very early times as an application to wounds, as it was believed to be especially appropriate, and "holy water" at one time was believed to be especially efficacious. It were well for surgery if popular belief had continued to rely on water-dressing, to the exclusion of the filthy poultices "the very name of which," as Liston says, "is associated with putrefaction and nastiness," which so long (and even yet) did discredit to our art and so much injury to the luckless sufferer.

"Water-dressing" implies lint saturated with water and covered with some impermeable substance. It seems of little consequence whether the water used be cold or hot when applied, as it is soon assimilated to the temperature of the body. We may variously medicate the water to suit the requirements of the case. Again, continuous irrigation, i.e., keeping the surface of the wound constantly moist by a trickling stream of water, simple or medicated by the addition of various agents, of

a temperature suited to the requirements of the case, is rightly esteemed one of the most useful and efficient methods of treating open wounds. For lacerated wounds of the limbs, as well as for many stumps, no method of management can be more successful. Inflammation is most surely subdued, pain relieved, secretions removed, and a healthful state of the tissues secured. That a too-prolonged use of cold water appears occasionally to retard cicatrisation may be granted; but raising the temperature, or adding a metallic stimulant or an astringent to the water employed, obviates this drawback in a very great measure; or, when all fear of inflammation has passed away, the irrigation may give place to some more tonic application. Since Breschet first re-introduced and A. Berard (1835) advocated this method of treatment, it has steadily been gaining the confidence of the profession, especially in the management of those severe contusions and lacerations of the hands which are so often admitted into the hospitals of our great industrial centres. While several ingenious apparatus have been constructed to facilitate irrigation, nothing can act more satisfactorily than a simple high wooden basin-stand, the top perforated to hold the basin, and of a height sufficient to raise the basin a couple of feet above the limb. A projecting arm with a few upright rests upon it carries a skein of worsted thread (one end of which is immersed in the basin) over the side of the bed, so as to allow the water, which easily flows along it, to fall on the part submitted to its action. A piece of wet lint placed over the wound distributes the fluid equally, and a sheet of oiled cloth properly arranged keeps the bed dry, and conducts the water to a vessel placed on the floor. Many ingenious and not a few expensive apparatus have been constructed to effect the irrigation of wounded parts, but none are more effectual or easier managed than this. A high stool with the basin on the top, and a piece of flat wood to carry the threads, will effect the end, but in a less substantial manner than is done by the simple appliance described. The writer has extensively used irrigation for some years and with most satisfactory results. The only drawback to it when properly employed is the necessity for keeping the patient in bed or in a fixed posture, when, possibly, his injury may not absolutely demand such constraint.

5. Heated atmospheric air, oxygen gas, and carbonic-acid gas have also been employed in the treatment of open wounds, according to their several proposers, with admirable effect. Heated air, and also a current of cool air is used for the purpose of drying up the secretions of the wound, and so causing a scab to form, underneath which the breach may cicatrise. Oxygen and carbonic acid gas have been employed for the medicating influence they are supposed to exert on the open surface.

The effect of temperature in hastening or retarding cicatrisation has been already alluded to. In 1840, M. Guyot published his work on "Incubation," in which he detailed his experience (which was then mature) on the use of air at a fixed high temperature in the treatment of wounds. He invented apparatus of a somewhat complicated nature to ensure the required conditions in the case of wounds of different parts of the body, and there cannot be a question but that both in his hands and those of Breschet, Marjolin, Robert, and others, the success was remarkable.



Following out the idea of causing a scab to form, Bouisson of Montpellier, in 1858, applied the common house-bellows to produce a current of air, and so desiccate the wounded surface. In one sense this plan of treatment might have been with greater propriety described when speaking of methods of excluding the air from the wounded surface. In order that a crust should be formed, it is necessary that the current of air be applied frequently till all secretion is dried up and cemented into a firm scab. This plan can only be useful in small superficial wounds, and in exceptional circumstances. It is termed "sub-crustian" cicatrization.

Carbonic acid gas relieves pain and hastens cicatrization, restoring exuberant granulations to a healthful tone, and promoting recovery. It has been to burns and ulcers that this application has been found most useful. Demarquay, in his "Pneumatologie," published in 1866, has fully entered into the history and practice of this application. In the same work the beneficial effects of oxygen gas on open wounds is recorded, and will astonish those who so much dread the effects of this element of atmospheric air on such surfaces. It has been found most useful in the treatment of foul and gangrenous sores.

Thus, then, we see how diverse and unsettled have been the methods of locally treating wounds, and though many able surgeons in different countries have in these ways tried to improve the practice of our time, yet on the continent the favourite plan is still to cover up the surface with charpie and lard, and to confine the whole by bands of linen and cumbersome rollers, while in Great Britain surgeons are most content to employ the "water-dressing," of which Liston so emphatically said that it was "the most perfect of all external applications."

With this sketch of the ancient and modern plans of dressing wounds we may go on to consider more carefully various important details connected therewith.

The *position* in which the wounded part is placed and retained is of the utmost consequence to successful treatment. The wounded textures should be relaxed as much as possible, and the part made comfortable. Complete rest is essential to a happy recovery, and we should avoid causing pain, as to many (children especially) it is highly injurious, and to all it is in some degree hurtful. To avoid unnecessary pain, and to do all we can to assuage it when it is unavoidable, is not only the dictate of humanity but of good surgery. That some surgeons greatly excel others in that most excellent quality of "lightness of hand" is a matter of every-day observation, and that much of this is born with its possessor cannot be doubted; yet all can attain to it by attention and care, and that it is well worth acquiring the wounded alone can perfectly judge.

The local treatment demanded by wounds will of course vary with the mode of union aimed at. If immediate union or primary adhesion is expected, then we employ the measures necessary to close the wound in the most effectual and secure manner; while if granulations have to be dressed, or healing by secondary intention, or by scabbing sought, different applications will be required.

In any case the *dressing* of a wound should be carefully and systematically gone about. Before

removing the old appliances the new should be completely arranged, so that each piece may be readily got when wanted, and the proceeding completed with celerity and order; but security should never be sacrificed to speed. All necessary things should be near at hand, disposed in the order in which they are to be employed. The patient should be comfortably placed, and if assistants are required they should be instructed in what duty is required of them. The old dressings should be thoroughly softened by warm water or oil before removal so as to avoid all tearing or displacement of the wound. Great gentleness is desirable in all these proceedings. As Mr. Paget well says, "wounds must be handled, if at all, like embryos; for such indeed their healing structures are, and a rude touch spoils many a good day of Nature's work." A stream of water poured over the part or injected by a syringe, is the best method of cleansing the surface or any sinuses, and all "scrubbing" or rough rubbing of the part is scrupulously to be avoided. A piece of oiled cloth should be spread over the bed while all this is being accomplished, otherwise stains and disagreeable smells will cause unnecessary annoyance afterwards. If the surface to be dressed is a large one, as for example a burn, we should never expose it all at once to the air, but replace one portion of the dressings before removing another. The period for removing the dressings will vary with circumstances, and that chiefly with the amount of discharge, the necessity for surveillance, the heat of the weather, and the nature of the application. Frequent dressings irritate and stimulate, and so augment the discharge, while we cannot usually command the same cleanliness with long intervals between the renewals. The morning is, on the whole, the best time to re-apply dressings, as then the patient is fresh after the night's rest, and has the whole day to recover any irritation caused before the time for sleep comes. If two dressings are required in the twenty-four hours they should take place at as long an interval as possible. Sometimes we may require to administer chloroform if the dressing is very painful, and an opiate given afterwards may procure rest and relieve pain.

In all cases in which it can be safely accomplished, we endeavour to obtain the early union of wounds. By so doing we avoid many of those sad complications to which such injuries are liable. Yet, in order to be secure and not lead to any harm, the union must not be in seeming only, that is, merely along the edges, but throughout the whole depth of the breach, otherwise decomposing matters may be retained, and the worst evils produced. To accomplish this we remove all blood and foreign bodies from between the surfaces, and having secured all vessels, &c. adjust the tissues most accurately to one another, so that textures of a similar nature may lie in contact. We are enabled to bring them into contact by placing the part in such a position as will allow of the easy approximation of the lips of the wound, and the least amount of traction being applied to them afterwards. This is the only true rule for our guidance as regards the posture of the part involved. But as it is impossible for a patient, without other aid, fixedly to retain the part in one position and entirely at rest (as, for example, during sleep and involuntary movements), we require to employ certain appliances to

fulfil the desired end, and thus bandages, sutures, and even splints or other rigid apparatus come into use in the management of wounds. Besides the reason just given for the use of these applications we have the additional one, that mere position and rest, however assured, cannot, in most cases, retain the sides of wounds in close enough apposition.

*Bandages* are often highly useful, especially in giving support and retaining dressings. These are of many kinds, adapted to the special requirements of the case, and they are frequently combined with compresses, which, acting on the sides of the wound, help to keep them in contact. The "uniting bandages" of systematic writers, fitted for either horizontal or vertical wounds, are occasionally good. These are too well known to require description here.

The ancients employed bandages in the treatment of wounds to which they gave such distinctive titles as "incarnatrix" or "agglutinatrix," "retentrix," "expultrix," &c.

*Adhesive Plaster.*—The soap, resin, lead, and isinglass plasters are used for retaining the lips of wounds in contact. From resin we obtain adhesiveness, but induce irritation and dirt. The late Mr. Liston, as is well known, introduced an isinglass plaster which was transparent, unirritating, and easy of application, but its want of adhesiveness, and its being easily detached by moisture, renders it of little service. The following is the formula for the very admirable plaster of the United States Pharmacopœia, for which the writer is indebted to Professor Gross, of Philadelphia. "Resin, in fine powder, 6 troy ounces; plaster of lead, 36 troy ounces; the former being added to the latter, melted over a gentle fire. The mixture is spread upon muslin, rolled up and kept in tin." "The litharge," he adds, is made of oxide of lead in fine powder, 30 troy ounces, olive oil, 56 troy ounces, and a sufficient quantity of water. The lead is sifted into the oil and half-a-pint of boiling water is added, the whole being boiled until a plaster is formed, a little boiling water being added from time to time during the process." This plaster is said to be much more adhesive than the British. It is well to shave and dry the part before the adhesive plaster is to be applied. It is hardly necessary to add that such fantastic modes of applying adhesive plaster as some have employed, have now been abandoned. e.g., putting a stripe of plaster along and parallel to either edge of the wound, and then sewing or lacing them together; or attaching ribbons to the ends of the adhesive stripes, and knotting these over the wound, or uniting the plaster by metal clasps. The idea, too, that erysipelas can be caused by adhesive plaster must be discarded, though slight erythema may. If judiciously applied adhesive plaster is capable of securing most accurate apposition in superficial wounds, and is altogether very useful.

But in many cases these measures are insufficient to secure accurate adjustment, or at least to maintain it, so we have recourse to

*Sutures.*—In former times it was customary to call adhesive plaster "the dry or bastard suture," as contri-distinguished from "the bloody or true suture," in which the lips of the wound were pierced. It is to the latter we now attend. The object of sutures, properly so-called, is, by means of agents traversing the lips of the wound, to fix

them together in the most complete relationship. The ancient surgeons used the suture frequently to staunch bleeding by the mutual pressure of the sides of the wound, and they were very minute in their description of such appliances. Such sutures were called "restrictiva" or "sanguinis suppressoria."

All the sutures used now-a-days may be thus designated: (1) the interrupted; (2) the twisted; (3) the quilled. The "continuous" suture is not now employed (except it may be after the Caesarian section) from its liability to come to pieces, and the impossibility of removing one stitch and leaving the rest. The "herring-bone" too, and the "zigzag" are useless. The fibula, or clasp of iron, gold, or brass, used by the Arabians and Romans, has also disappeared. Special methods of fastening sutures are used in particular wounds; as the running knot for staphylocorophy; the "suture à anse" of Ledran; that which M. Maisonneuve has described under the title of "en broche;" Pancoast's "plastic suture," Bozeman's "button suture," and Sims's "clamp suture," &c.; but these cannot find a place here for want of space.

The *needles* used for sutures are of different kinds, according to the material to be introduced and the kind of suture to be used. Straight and curved; eyed at the hilt or near the point; having a double eye; pointed with fixed or movable steel; spear or triangular shaped piercing ends, and grooved or not from the eye to the hilt to cover the thread. Some are hollow, and allow the metallic thread to traverse them; and some possess various ingenious, but often troublesome, contrivances for projecting the thread when it is wanted from the point. Sometimes the needle and the wire are annealed together, sometimes the needle is set in a handle and may have an eye to open and allow the escape of the thread. It would be endless, and somewhat useless, to describe all these, and even more difficult to ascribe each to its rightful inventor; but it may safely be said that for metallic sutures no better needle can be used than Professor Lister's very simple one, with a deep notch in its heel to allow of the sinking into it of the wire when it is twisted in order to fasten it.

Pins, too, are used for sutures. Those used by entomologists answer admirably. Some have glass and others porcelain heads, or wax is run on when they are to be used. The author has been in the way of using a very simple and efficient contrivance in substitution of the common pins used in the twisted suture. Strong steel wire, pointed at one end like a needle, is kept in lengths of 6 or 8 inches, and when going to be used the temper is removed from the whole, except the sharp end, so that after having been passed through the tissues and drawn home, till a piece long enough to remain clear of both lips of the wound is left for the twisting of the thread round them, the wire is cut with pliers, and the next suture introduced in the same way. Thus time is saved and any length of pin required is at once got, while a great saving in needles is effected, and the whole is very easy of accomplishment.

If pins are employed a "pince à verrou" for grasping them will be found most useful. This instrument is sometimes made so as to allow of the pin being fixed and held at different angles.

Silk, cotton, hemp, silver, iron, platinum, aluminium, and other metals are used for suture threads,



Fabricius recommended iron, and Percy used lead ligatures. That metallic threads have a great advantage for sutures over all absorbing materials there cannot be a question. Silk, cotton, hemp, &c., get impregnated with the secretions of the wound, and so retain what is most hurtful in contact with the raw surfaces, but metals do no such mischief, and they also keep a firmer hold of the tissues, though more liable to cut their way out and more troublesome to remove. Silver and the passive iron of Schönbein form the best materials. These wires are made of different strengths, and should be thoroughly annealed, pliant, and strong. Of late the true value of metallic sutures is better understood, and they are not now used so exclusively as after their re-introduction into practice by Dr. Sims. The use of lead shields secured by the metallic threads over the orifice of some wounds, the employment of shot, beads, clamps, &c., to fasten the ligatures, have of late fallen much into disuse. If lead shields are used it is better to have nipple-like projections attached to the holes (as introduced by Mr. Hilliard, of Glasgow), which can be clenched on the wire, rather than employ shot.

In introducing sutures the first should be placed in the centre of the wound, and the rest at equal distances from it towards either end. If necessary they need not be finally secured till all are in place. The distance asunder and the depth to which they penetrate must depend on the wound, and the object they are intended to fulfil. Some sutures are only fitted for superficial wounds, and others are used in deep ones. As a rule they should be sufficiently close to one another to prevent gaping, and sufficiently deep to obviate the lodgment of secretion below them. Frequently it is desirable to leave the dependent end of the wound open for the free discharge of secretion, but that will depend on the probable progress of the case. Adhesive plaster may be alternated with the points of suture, so as to secure the most perfect apposition and to give greater firmness to the whole. We leave sutures undisturbed so long as they are of use and productive of no harm, but as they all act more or less as foreign bodies, and therefore as irritants, they should be dispensed with as soon as possible. If tension or strangulation occur they must at once be removed. In withdrawing sutures we should carefully support the side of the wound towards which we draw them, and employ adhesive plaster, and possibly a bandage for a short time, to give due support to the delicate adhesions.

Of the sutures in common use, the interrupted and the twisted are adapted for superficial, and the quilled for deep wounds.

1. The "interrupted suture" consists of a series of separate and unconnected stitches, which traverse the lips of the wound and are tied separately, sometimes over a piece of lint or plaster, to prevent undue pressure. This suture can be introduced with one needle or two (in the latter case each stitch being passed from within outwards), and each stitch forms a loop or circle embracing the lips of the wound. The needles used are sometimes larger in diameter at the point than at the heel, so as to render the passing of the doubled thread the more easy. By uniting the wound in the first instance by a continuous suture (taking care to keep the points of entrance and exit opposite one another), and then cutting the superficial loops, we

have separate points of suture introduced, which converts it into the interrupted suture. The various loops should be knotted with sufficient firmness to hold the lips of the wound gently in apposition, but not so strongly as to injure them by their mutual contact.

2. The "twisted suture" is formed with pins or needles made to transfix the lips of the wound from side to side, and then a thread twisted in the figure of 8 round them several times, and finally knotted. The thread may be elastic or not, firm or soft, according to the requirements of the case; and we may use separate threads for each needle, or carry the same thread on from one to the other. The points are cut from the needles (previously untamped), and a piece of lint or plaster is put under their ends if they are likely to injure the soft parts. Rigal de Gaillac employed a piece of elastic tissue (vulcanised india-rubber) to connect the two sides of the wound, the needles being made to traverse it before entering on one side, and after escaping on the other lip of the wound. There are no very apparent advantages in this, while there is the obvious drawback of being more difficult to apply than the thread, and that the wound is covered up from sight. An ingenious modification of this, which obviates the objections to Rigal's suture, we owe to M. Gariel. He uses sections of india-rubber tubes of various sizes, which are put over the ends of the needles to keep them together, thus simulating loops of thread.

3. The "quilled or compound suture," is so termed because quills formerly were alone employed in its construction, but any rigid body of suitable dimensions may replace the quills. A piece of bougie, or pencil, or wood, or whalebone, or even adhesive plaster rolled up, will do perfectly. This suture is used to bring together the deeper portions of large wounds, and it is frequently combined with one of the other sutures already described. The deeper the wound the further we enter the sutures from its edge. The threads are best passed by means of a long needle set in a handle, and with an eye in its point. The thread is passed double and caught as it emerges, after having traversed both lips of the wound, while the needle is withdrawn. As many threads as are considered necessary are passed, and then a quill or other body is engaged in the loops which project on one side of the wound, while the free ends which hang out at the other are first drawn upon to tighten the said loops, and finally knotted over a quill placed between the series of threads. Each stitch may have a short bit of quill for itself, or one continuous piece may be engaged in all the stitches.

The "beaded suture" was fastened on either side by beads. The "serres-fines" of Vidal (de Cassis) are most admirable contrivances which frequently enable us to dispense with sutures. They consist of minute forceps whose points are toothed, and kept in contact by the spring given in its construction to the wire of which they are composed. They are only to be trusted in superficial wounds, and those "serres-fines" which have the points at right angles to the stems, are the best, from being least liable to displacement.

Varieties of suture for special purposes have been suggested or employed by Bozeman, Sims, Nelaton, Minturn, Pancoast, Debout, &c., but space will not allow of their description.

If the attempt at early union fail, or if, from the

nature of the wound, it is useless or undesirable to attempt it (as in wounds whose lips are much contused or lacerated), then such dressings are employed as its requirements at the time demand. "Healing by granulation" is, as was shown, a much more protracted and a more perilous proceeding than "immediate union" or "primary adhesion," and its progress must be watched and carefully guided by the surgeon, so as to avoid those complications to which it is open. Of late the treatment of such wounds has attracted much attention, and the antiseptic method of treatment, or the use of various disinfectants, have been replacing the old "water-dressing" of later years. If a wound is not covered up from sight, and is daily dressed, we vary the applications according to its demands. A granulating open wound is to be managed in accordance with the principles laid down for ulcers. (See ULCERS.)

In order that granulating surfaces may unite, it is necessary that the granulations on either surface should correspond, or nearly so, in development; that they should be healthy, and fitted to accomplish the end sought; that they should be brought gently into contact and kept so during the period of union; and lastly, that all inflammation should be ward off. If these conditions are fulfilled the adhesion of such surfaces is often rapid and complete.

To obtain healing by scabbing, the air must be excluded by some of the plans already reviewed, whereby an artificial crust is formed. To allow the blood or other discharges to dry and cover the breach of surface is a dirty method of obtaining the result, and is often wholly insufficient. Mr. Lister's plan of managing the wound is an efficient means of covering, and at the same time disinfecting it. The colloid styptic is a very admirable method of securing a crust; while by collodion, various gums, solutions of gutta-percha, &c., the same result is attained. The method, too, of expediting the formation of a scab by the projection of a current of air on the open surface has already been spoken of. That healing by scabbing should take place, inflammation in the part must be subdued, otherwise the amount of secretion thrown out would cause a constant displacement of the crust.

Let us now turn to the treatment of the different kinds of wound, and indicate the method which the surgeon is to pursue in each case.

*Incised Wounds* heal quickest and most satisfactorily, and with the least risk of complications. The measures fitted for bringing about immediate or early union before described are here demanded. Before these are employed the bleeding must of course have ceased, and whatever steps are required to secure that must be put in force.

*Contused and Lacerated Wounds* must be carefully cleared of foreign bodies, any bleeding vessel secured, and an attempt made to unite such portions as are capable of being so treated, by early adhesion. If the bruising is great, early union will fail, but no harm can arise from attempting it so long as all secretions are carefully given vent to, and inflammation subdued. If primary union fail, then the treatment resolves itself into that for open wounds, and that has been reviewed at length. These wounds do not require enlargement or "scarification," as was at one time supposed, unless, during treatment, some evident and well-

understood end demand it. If an extension of the wound is required, it is almost needless to say it should be made, if possible, in a dependent direction, and parallel to blood-vessels and nerves, and so as to occasion the least amount of destruction of tissue. Any sloughs which form must be separated by the use of poultices or warm-water dressing, aided by the judicious interference of the surgeon when the opportunity presents itself. It is in the treatment of these wounds that we gain the greatest amount of good from the use of disinfectants, irrigation, &c., and that efficient drainage is most essential. When the slough is separated and a granulating wound is to be managed, we employ those appliances which the features of the sore at the time suggest (see ULCERS). It must be stimulated, soothed, or simply protected from harm, according to its requirements. During cicatrisation every means should be employed to supply the place of lost tissue and to prevent deformity, to keep orifices free and articulations unfixed, by position, bandages, splints, plaster, &c. The "desire to meddle" should be strenuously subdued, and the intelligent aid of an "attendant on nature" alone aimed at. Sutures are not usually appropriate to these wounds, but both in their early and late stage they are often of great service in obtaining, it may be, partial primary adhesion, or in keeping granulating surfaces in contact.

In very severe lacerated wounds in which portions of the body are torn off, as by machinery or by round shot, we may be called on to perform an operation in order to render more regular the parts which remain, and to make them more capable of healing firmly. Blood-vessels and nerves may have to be shortened, and the former secured, muscles may require to be cut clean, and splintered bone removed. The ingenuity of the surgeon is often severely taxed to perform all this with the best results and the least risk to life. Frequently he performs most irregular operations, so far as "methods" are concerned, but he contents himself chiefly in getting a reliable covering and yet approaching the trunk as little as possible. As the risk of sloughing in the flaps is, in such amputations, of course, considerable, it is necessary to make liberal allowance in forming the coverings.

In contused and lacerated wounds the fear of secondary hæmorrhage as the sloughs separate, or from ulceration, is always considerable, and will demand vigilance. All constriction and pressure should be avoided, and the utmost gentleness used in dressing till the vitality of the tissues is ensured.

As regards cases of contused and lacerated wounds which require amputation, it may be remarked (in addition to what has been said above), that when the chief blood-vessels and nerve of the part are destroyed—when the soft parts are reduced to a pulp—when the bones are crushed to pieces, as by the squeeze of machinery wheels—when a large joint is opened and its articulating surfaces extensively fractured, and when gangrene sets in and spreads rapidly—amputation (or in some cases possibly excision) is required. The question of operation will, of course, in all cases be affected by such obvious points as age, constitution, visceral healthfulness, habits, means of



treatment, &c. Old age, feebleness, disease in one of the organs important to life, vicious habits, inefficient means of after-treatment, would each and all in varying degrees oppose the success of operations. Wounds of the upper extremity are of course far less serious than those of the lower, and much more can be done to save an arm than a leg. Yet with all such well-recognised rules for our guidance, cases constantly present themselves in hospital practice in which it is exceedingly difficult to determine, on perfectly satisfactory grounds, whether an operation is called for or not—to weigh accurately the arguments for and against interference—and it is often no less difficult to say *when* it is best to operate. Doubtless, if the need of an operation is perfectly clear, and the patient's state admits of it, the sooner it is performed the better; but in less evident cases we should carefully watch day by day after suppuration has become established, for such a favourable moment as will enable us to interfere with least risk to the patient.

*Poisoned Wounds.*—In many of these wounds it is requisite to administer internal remedies to counteract the violent constitutional depression which the poison occasions. The heart's action must be supported, and time gained for the elimination of the poison. No depressing agent should be given in such wounds. In various countries special remedies have been, or still are, believed to exert a specific effect in some of the worst forms of poisoned wounds. Thus, in snake-bites, arsenic, the aristolochia, the snake-root leaves, the plumieria obovata, the grease of the lizard tree, the herva cobreira, iodine, olive oil, guaco, &c., have had a reputation. The strongest diffusible stimulants are alone believed in by experienced men in our day. It is in this way that ammonia has proved so useful when freely administered. In Bombay a police ordinance supplies this agent at each station, together with directions for its use. The dose thus employed is 35 minims in a wine-glassful of water, but greatly larger doses have been more frequently used and repeated. This is just another form of the "whisky cure" of North America. That it can be more effectually given by injection into the veins, as practised by Dr. Beaumont, of Australia, seems exceedingly doubtful, but it can, if necessary be thrown into the rectum.

As it is the poison present which gives to these wounds all their gravity, it is evident that to withdraw or neutralise that poison must comprise the most important element in the local management of such wounds. Beyond this we must combat any complication which may arise.

The local indications, then, are:

1. To prevent or retard the entrance of the poison into the system, to keep it imprisoned in the wound till removed.

2. To withdraw it from the wound, or

3. To destroy, neutralise, or decompose it.

- 1st. To exclude it from the general circulation, pressure is applied between the point wounded and the heart. This must, of course, be done most promptly, and with energy sufficient to arrest the circulation in the part. In the portions of the body where the diameter is small, the grasp of the hand may be sufficient for the purpose desired, but in other cases a ligature or a tourniquet even may be required. The great speed with which a poison is carried towards the heart makes it necessary to be

very prompt in the application of these measures. Pressure, however, can at best be only looked on as a temporary step, and as affording time for the removal or neutralising of the poison.

- 2nd. Measures which aim at withdrawing the poison. Suction in some form is the most efficient of these measures. If the wound is a contracted and deep one, it should be enlarged so that its depths may be reached, and while a stream of water (or spirit and water, as advised by some) is poured with some force into it, the part may be squeezed so as to express the blood, and so carry the poison out of the wound. If the poison be one to which a chemical antidote is known, then the fluid used to wash the wound may have that agent mixed with it; but there are few poisons which complicate wounds of a nature to allow of such treatment, and the antidote is not likely to be at hand.

Suction with the mouth is possibly the most effectual of all methods of withdrawing a poison from a wound. If there is no lesion on the lips this can be accomplished with the most perfect safety, and to secure, if possible, greater surety, the mouth can be afterwards rinsed with spirits and water. The experiments of Barry made the use of cupping glasses a mode of treating poisoned wounds from which much good was expected, but besides the fact that these are seldom available when the occasion for their use arises, they are difficult to apply to an irregular or small surface so as to be of any service. Pravaz invented a very ingenious instrument, which scarified the wound, sucked out the poison, and enabled the surgeon to inject any fluid he desired into its depths. This for practical purposes can hardly be regarded as else than an ingenious toy. Excision can seldom be necessary; but if freer access to the wound and more thorough emptying of its blood-vessels, as well as more complete removal of all possibly contaminated tissue, were deemed desirable than can be got by simple enlargement of the wound, then such a step may be undertaken. By excision, perhaps, greater confidence is given to a patient who is in dread of the result, as after the bite of a mad dog.

- 3rd. To neutralise the poison various chemical agents may be employed. Caustics are supposed to effect this partly, and partly to destroy the tissue in which the poison may still lurk. The actual and potential cautery—the strong mineral acids—acid nitrate of mercury, and galvanism, have all had their advocates. Nothing acts more effectually than strong nitric acid. Pravaz studied galvanism in this connection, and supposed it capable of removing the poison when lying deeply in the tissues or among blood-vessels, more safely and surely than any other agent. Nitrate of silver cannot be relied upon except for the slighter cases. The actual cautery is much more formidable to apply than an acid, and is not more efficacious.

In desperate cases amputation has been had recourse to, but there are few instances in which a deliberate review of the circumstances can justify this at an early stage, though later the disorganisation following a severe poisoned wound may call for it.

Lastly, if, as a result of a poisoned wound, cellular inflammation or lymphatitis arise, they must be treated as usual, and abscesses opened so soon as formed. The convalescence is frequently very

protracted, and will require the strenuous employment of such invigorating measures as are put into force in like circumstances.

To relieve the pain of wasp, bee, or hornet stings, lotions of ammonia, eau de Cologne, bicarbonate of soda, narcotics, olive oil, poultices of powdered Ipecacuanha, Goulard's lotion, salt and water, &c., may be used. If the sting remain in the wound it should be withdrawn by means of a fine pair of forceps, or pressing the barrel of a watch-key over it.

The union of wounds may be delayed by the nature of the textures which are involved in it, by the presence of foreign bodies, by the want of rest, by unskilful applications, and by the want of vigour in the patient. If the patient's blood is in an unfit state to supply the materials of repair by reason of constitutional disease, or if the requisite nerve force is not provided, then repair may be abnormally slow or altogether fail.

As regards the complications which may attend wounds, they are both numerous and important. They may be *primary* or *secondary*, *local* or *general*. Inflammation, erysipelas, foreign bodies, hæmorrhage, infiltration of irritating fluids, sloughing or gangrene, tetanus, paralysis, purulent absorption, opened articulations or injury of viscera, &c., &c. All of these are considered under various heads in this work. Traumatic gangrene demands a short notice. It is one of the most serious of all the complications of lacerated and contused wounds. It may appear very quickly after the receipt of a wound, or not develop itself for a considerable time. In the worst or most rapid form of such gangrene the limb is so irretrievably destroyed, its vitality is so compromised, that it mortifies at once, and that apparently without resistance. In such cases the soft parts may be quite jellified and its blood-vessels so destroyed that disorganisation quickly follows. This is not, however, the usual progress of events. An interval commonly interposes between the receipt of the injury and the outset of those constitutional and local signs which are associated with traumatic gangrene. During the interval reaction sets in, but the weakened textures being unable to withstand its effects, die. Even though the soft parts are not so hopelessly injured as is above supposed, yet if the blood-vessels are ruptured so that the arterial supply to the part is cut off, and if the venous blood stagnates, then the same unfortunate result may be anticipated. The rapidity with which the limb may be destroyed by gangrene appearing after a severe railway, round shot or machinery accident, especially in persons of intemperate habits or unhealthy constitution, or who are badly circumstanced for recovery, is sometimes appalling. The surgeon is the more alarmed in many cases from his inability accurately to define the limits of the disease, as it may pass far up in the planes of cellular tissue, superficial and deep, from its apparent bounds, and so if amputation has to be performed, it must be at a point much nearer the trunk than the external manifestations of the affection would lead the inexperienced to believe. It is unnecessary to describe here the signs of this dire form of gangrene, as it will be fully dwelt upon elsewhere.

As regards the treatment required for this destructive form of gangrene, it is always very difficult and anxious. Whether to remove the limb early,

and high above the limit of the disease in parts to which the morbid action has not yet extended, even in the deep planes of cellular tissue, or to wait the subsidence of the more severe symptoms, and obtain, if possible, some indication of the point where it inclines to cease, is often a subject of the gravest anxiety to the surgeon. Either step is full of peril, and fraught with disappointment. We get no line of demarcation as a rule to guide us, and if amputation is to be successful, we must have recourse to it before the vital powers are much exhausted, and so far away from the apparent limits of the destruction as to appear cruel and unnecessary to the inexperienced. By fully supporting the strength, administering opium freely, and employing soothing local remedies, the march of the disease may be arrested, and then we remove the diseased parts in tissues that are well removed from the focus of morbid action. If this is not done sooner or later the gangrene spreads to the trunk, and the patient dies, if he has not succumbed sooner to the waste and bloodpoisoning. The danger of a recurrence of the gangrene in the stump is of course to be apprehended, especially after amputation of the lower limb. In truth, the results of operation for spreading gangrene are sufficiently discouraging, yet without amputation the patient dies. The soundest side of the limb should be chosen from which to fashion the flaps, and great gentleness should be employed in their dressing. Opium should be freely given to the patient during convalescence, and his strength sedulously augmented by nourishing food and stimulants suited to his taste and wants.

*Foreign bodies* of very various kinds may be found in wounds. It is not requisite that these be here enumerated. The more liable to absorb the secretions of the wound and to decompose such bodies are, the more injurious they will prove. Metallic bodies may long remain harmless, and may even become encysted, but even these are most usually hurtful, and should, if possible, be removed, so long as the steps necessary thereto are not more injurious than can arise from allowing the intruder to remain undisturbed. The presence of a foreign body is often the cause of a wound remaining fistulous, or closing and re-opening at varying intervals. If it press on a nerve most distressing effects may follow. The patient is occasionally conscious of the presence and apparent movements of foreign bodies imprisoned in his tissues, and not unfrequently they can be felt and their outline distinguished after the parts are healed. Parts thus fretted are constantly liable to inflammation and abscess, and sharp bodies may migrate freely from the point where they originally entered. This is especially true of needles, which have often appeared long years after introduction at parts far removed from where they entered. In their transit they may occasion great harm by wounding important organs, but the instances in which they have done so form but a small proportion of the cases in which their expulsion has been safely accomplished.

*Hæmorrhage* in all its forms occurring as a complication of wounds is fully discussed in vol. i. of this book.

It remains for the completion of this article to review very briefly those wounds of regions which require special description over and above what has been attempted in the foregoing pages.



Injuries of the thorax are discussed in this vol.

*Wounds of the Abdomen* may be of an incised, punctured, contused, or lacerated character, and are attended with much danger and many serious complications. Punctured wounds are peculiarly anxious, as it is frequently difficult to recognise their extent; they are specially subject to complications, and are generally very difficult to manage. Such wounds are met with in civil and military practice as inflicted by a large variety of instruments.

Wounds of the abdomen may implicate the parietes alone, or penetrating these injure the contents of the cavity. The fear of peritonitis is of course the chief risk in all wounds of the abdomen, yet the risk attending even extensive incised wounds (as in ovariectomy) is not so grievous as was at one time apprehended. When any of the viscera contained in the belly are wounded the danger is enormously augmented, both on account of the bleeding, which is almost certain to follow such lesions, and the violent inflammation which is set up if any of the secretions from these organs are effused into the sac of the peritoneum. Urine, bile, and fæces act most powerfully as irritants, and the inflammation they occasion is both rapid in its progress and intense in its violence.

*Non-penetrating wounds* present no characters which are so special as to demand particular description, nor does their treatment call for any remarks, as they are to be managed on the general principles fully described in this paper. It is true that in former times these wounds were supposed to be very dangerous, and that chiefly on account of the extensive tendinous structures in the parietes. No special fear is now excited by such wounds. Having removed foreign bodies and commanded bleeding—enlarging the wound if necessary to do so—inflammation, if it arise, is to be combated, pus is to be evacuated; adhesion between the lips of the wound promoted by plaster or sutures, and above all by position and bandages; and if sinuses form they must be obliterated by pressure or split open. Great care must be taken not to imprison pus in the depths of a wound whose lips are got to adhere. In opening abscesses or laying open sinuses we should strive to weaken the parietes as little as possible, so as to leave no point whereat subsequent protrusion can take place. Sometimes the pus lies within the sheath of the rectus, and may take very long to work its way to the surface, then it must be evacuated by an early and dependent opening. If pus burrow among the muscles of the abdomen, serious constitutional disturbance may arise and most troublesome and dangerous sinuses form. The only true remedy is early incision. In the treatment of wounds implicating the walls, quietness and rest of body, simple food, a good position, and possibly opium, are our chief resources.

*Wounds penetrating the abdomen* may simply traverse the walls, or may wound some of the viscera, and, of course, the features and result of the case will accordingly vary enormously. It is by no means easy in many instances to say whether the viscera have escaped or not, especially as it is opposed to the rules of practice to make any prolonged or minute search in such a case. If any viscus is seen protruding and wounded, or if

the contents or secretion of any special organ is observed to escape, or if the symptoms appear clearly referable to interference with the function of any viscus, or even if violent hæmorrhage take place from the interior of the abdomen, outwards by the wound, upwards by the mouth, or downwards through the bowel, then we can be sure there is some serious visceral lesion; but it is right to add that the absence of such evidence as has been hinted at does not justify us in all cases in concluding that no such injury has occurred. Further, the apparent direction of the wound, the nature of the weapon and the seeming depth of its penetration, while they are all important and often most significant points for consideration, do not enable us to conclude positively whether any organ, or what organ, has been wounded. Such data give us only elements from which a presumption more or less plausible may be founded. Such at least has been the author's experience both in military and civil practice.

In examining wounds penetrating the abdomen the finger should be alone used. Metallic probes are of no service, and may do much damage, and in conducting such examinations the patient should be placed as nearly as possible in the same posture he occupied when he was wounded, while perfect gentleness should be exercised. If no inflammation arise, and no evidence of visceral implication occur, the wound should be looked on and treated as a simple one of the parietes, any subsequent complication which may present itself being treated as required.

If any of the viscera protrude, or be wounded, then the case becomes much more grave. It will of course depend on the position, and also to some extent on the size of the wound, what viscus may be involved. It is the small intestine, the omentum, the transverse colon and the stomach, which are most liable to escape, as their attachments are looser than those of other abdominal organs. Hæmorrhage, extravasation, and peritonitis are of course greatly to be apprehended when any of the solid or hollow viscera are wounded. Any bleeding vessel must be secured, the rent in a hollow organ sewed, and the protruded portions restored to their containing cavity in the reverse order to their escape. Care must be taken to insure their return into the abdomen, and that they are not forced between any of the layers of the parietes.

It occasionally happens that a considerable mass is forced out through so narrow an outlet that the neck of the protrusion becomes grasped tightly and may even be strangulated. To facilitate their return such a position is to be sought as will most relax the tension of the edges of the aperture, and then gentle means are used to reduce the protrusion by first drawing it a little outwards to disengage it, and then cautiously pressing it back within the cavity. If distended with flatus, we can by gentle manipulation generally relieve it by pressing it little by little into the interior of the belly, or if such measures totally fail, and the flatus be the cause of the irreducibility, then the plan followed by Paré and Peter Lowe, of puncturing the bowel with a grooved needle, may be had recourse to. Occasionally it is requisite to enlarge the wound to allow of reduction, but this should be very sparingly done, and in such a direction as, while it will coincide with the run of the muscular fibres

and avoid the epigastric artery, may least injure the walls, and above all the peritoneum.

In bowel protruded and wounded a patient and minute search may be required to find the lesion, as the mucous membrane may so fill the breach as to conceal it. If fluid or flatus escape by the wound, then of course we may be enabled more easily to discover it, but the plugging of the aperture by the mucous membrane is in small wounds often very perfect.

Cooper says a wounded intestine presents some particular appearances, to which the generality of writers have paid no attention:—"If a gut be punctured, the elasticity of the peritoneum, and the contraction of the muscular fibres, open the wound, and the villous, or mucous coat, forms a sort of hernial protrusion, and obliterates the aperture. If an incised wound be made, the edges are drawn asunder, and everted, so that the mucous coat is elevated in the form of a fleshy lip. If the section be transverse, the lip is broad and bulbous, and acquires tumefaction and redness from the contraction of the circular fibres behind it, which produces, relatively to the everted portion, the appearance of a cervix. If the incision be according to the length of the cylinder, the lip is narrow, and the contraction of the adjacent longitudinal fibres, resisting that of the circular fibres, gives the orifice an oval form. This eversion and contraction are produced by that series of motions which constitutes the peristaltic action of the intestines." (*Travers on Injuries of the Intestines*, p. 85.) According to this gentleman, some of these appearances were described by Haller, in *Element. Physiol.* lib. xxiv. sect. 2.; and *Opera Minora*, t. i. sect. 15.

Having witnessed the facility with which considerable injuries of the intestinal tube were repaired, Mr. Travers was desirous of ascertaining more fully the powers of nature in the process of spontaneous reparation, and of determining under how great a degree of injury it would commence, as well as the mode of its accomplishment. For these purposes, he divided the small intestine of several dogs as far as the mysentery. All these animals died, in consequence of the intestinal matter being extravasated, if they had been lately fed; or, if they had been fasting, in consequence of inflammation, attended with a separation of the ends of the divided bowel, eversion of the mucous coat, and obliteration of the cavity, partly by this eversion, and partly by a plug of coagulated chyle.

In one particular instance, in which Mr. Travers made a division of the bowel half through its diameter, a sort of pouch was formed round the injured intestine. "A pouch, resembling somewhat the diverticulum in these animals, was formed opposite to the external wound on the side of the parietes, by the lining peritoneum, on the other side, by the mesentery of the injured intestine, that intestine itself, and an adjacent fold, which had contracted with it a close adhesion. The pouch thus formed and insulated, included the opposed sections of the gut, and had received its contents, &c. The tube at the orifices was narrowed by the half eversion, but offered no impediment to the passage of fluids." (P. 96.) Whether, under these circumstances, the functions of the alimentary canal could have been continued, Mr. Travers professes himself incapable of decid-

ing. Among the inferences, which this gentleman has drawn from the experiments detailed in his publication, the tendency of the two portions of a divided bowel to recede from each other, instead of coalescing to repair the injury, merits notice, inasmuch as it tends to prove that the only means of spontaneous reparation consist in the formation of an adventitious canal, by the encircling bowels and their appendages. The everted mucous coat, which is the part opposed to the surrounding peritoneum, is also indisposed to the adhesive inflammation.

When, however, the wound of the intestine is smaller, the obstacles to reparation are not absolutely insurmountable. Here, retraction is prevented, and the processes of eversion and contraction modified by the limited extent of the injury. If, therefore, the adhesive inflammation unite the contiguous surfaces, effusion will be prevented, and the animal escape immediate destruction. But union can only take place through the medium of the surrounding parts.

According to Mr. Travers, it is the retraction immediately following the wound that is a chief obstacle to the reparation of the injury; for, if the division be performed in such a way as to prevent retraction, the canal will be restored in so short a time as but slightly to interrupt the digestive function. In confirmation of this statement, a ligature was tightly applied round the duodenum of a dog, which became ill, but entirely recovered, and was killed. "A ligature fastened around the intestine, divides the interior coats of the gut, in this effect resembling the operation of a ligature upon an artery. The peritoneal tunic alone maintains its integrity. The inflammation which the ligature induces on either side of it, is terminated by the deposition of a coat of lymph, which is exterior to the ligature, and quickly becomes organised. When the ligature, thus enclosed, is liberated by the ulcerative process, it falls, of necessity, into the canal, and passes off with its contents." (Pp. 103, 104.)

It appears, also, from Mr. Travers's experiments and observations, that longitudinal wounds of the bowels are more easily repaired than such as are transverse. In a dog, a longitudinal wound, of the extent of an inch and a half, was repaired by the adhesive inflammation. Here the process of eversion is very limited; the aperture bears a smaller proportion to the cylinder of the bowel; and the entire longitudinal fibres resist the action of the circular which are divided, and can only slightly lessen the area of the canal. (P. 108.)

From very small openings, when filled up as was above described, there is little fear of extravasation when the protruding bowel is returned, as the equable pressure of the abdominal contents the one upon the other, and the adhesions which quickly form between the wounded point and the parts with which it comes into contact, effectually oppose such effusion. In any case, blood-vessels, if open, must be secured, all foreign bodies carefully removed, and, if it be thought desirable, a fine ligature put round the aperture, and its ends cut close before the part is restored, which it is with great gentleness. It need hardly be added that if the protruded portion be quite gangrenous this practice cannot be followed, but any condition short of insured lost vitality would be no valid objection to the parts' reduction. The wound in



the parietes is then carefully closed, and the necessary precautions taken against complications. Sutures, which include and keep in contact the layers of the peritoneum, are employed in closing wounds of the belly.

In larger wounds, where measures are requisite to oppose extravasation, we sew up, by the continuous suture, the aperture by means of a round needle and fine silk thread, in such a manner as to keep the peritoneal surfaces in contact, allowing the thread afterwards to ulcerate its way into the interior of the bowel, and be so discharged. This must be done very accurately, and afterwards the bowel is returned and the external wound carefully closed. We do not now attempt to fasten the wounded part in such a case to the external wound by retaining the ends of the suture thread, nor need we take any special pains to ensure that the wounds in the bowel and parietes correspond. The wounded part should be gently returned within the abdominal cavity and there abandoned.

If the bowel is almost or entirely divided, and especially if it is also contused, experience teaches that it is better to stitch the apertures to the external wound, and thus establish an artificial anus, rather than attempt to repair so extensive a breach by sewing. The various expedients of invaginating the divided ends, or inverting the mucous lining, &c., have failed in the human subject. A limited wound heals by being glued by lymph, and becoming adherent to the parts in contact with it.

After all such lesions the utmost care must be enjoined. Rest, quietness, a position which best relieves a strain on the part, opium administered very freely, the bowels kept empty and unirritated by a scanty and simple diet (milk and ice chiefly), and after a few days the use of mild laxative enemata if the necessity exists, constitutes an outline of the subsequent treatment required. If peritonitis arise it must be at once commanded.

If extravasated matter has gained admission into the abdominal cavity it must be got rid of. Cooper, in the former edition of this work, thus speaks of such extravasations:—]

1. *Blood*.—Wounds of the spleen, and of large veins and arteries in the abdomen, usually soon prove fatal from internal hæmorrhage; the blood generally makes its way downwards, and accumulates at the inferior part of the abdomen, unless the presence of adhesions happen to oppose the descent of the fluid to the most depending situation. The belly swells, and sometimes a fluctuation is perceptible, as was exemplified in one of my patients, in University College Hospital, who died with a vast effusion of blood in the belly from a laceration of the liver. The patient grows pale, loses in strength, is affected with syncope, and his pulse becomes weak and scarcely distinguishable. In short, the symptoms usually attendant on profuse hæmorrhage are observable.

In cases where the wounded vessel is under a certain size, the bleeding goes on slowly, and some time elapses before the extravasation is considerable: here the symptoms, which perhaps had disappeared under the employment of bleeding and anodyne medicines, now recur. A soft fluctuating tumour may be felt at the lower part of the abdomen; sometimes on the right side; sometimes on the left; but, occasionally, on both sides. The pressure, made by the effused blood on the urinary

bladder, excites distressing inclinations to make water; while the pressure, which the sigmoid flexure of the colon suffers, is the cause of obstinate constipation. In the meantime, as the quantity of extravasated blood increases, the peritoneum inflames; the pulse grows weaker; debility ensues; the countenance becomes moistened with cold perspirations; and, according to some writers, unless the surgeon practise an incision for the discharge of the fluid, the patient falls a victim to the accident.

In the year 1733, Vacher adopted this treatment with success. Petit afterwards tried the same plan, though it did not answer (as is alleged), in consequence of the inflammation having advanced too far before the operation was performed. Long before the time of Vacher and Petit a successful instance of similar practice was recorded by Cabrole, in a work which this author published under the title of *Ἀλφάβητον ἀνατομικόν, id est, Anatomies Elenchus accuratissimus, omnes humani Corporis Partes eâ quâ solent secari Methodo, delineans. Accessere Osteologia, Observationesque Medicis ac Chirurgicis perutiles*. Geneva, 1604. The method pursued by Vacher was therefore not so new as Petit imagined.

Surgeons should recollect, however, that if no opening be made, a small extravasation of blood may not produce any considerable irritation. On the contrary, when the cavity, including the blood, is opened, the air then has access, and that part of the fluid which cannot be discharged putrefies, and becomes so irritating as to be a true cause of inflammation. The bad symptoms are also sometimes chiefly owing to the injury done to parts within the abdomen, and still more commonly to inflammation within that cavity, arising as much from the wound as from the presence of effused blood. On the whole, I am disposed to join a late writer in the belief, that the practice of discharging extravasated blood from the abdomen can rarely be advisable. (See *Hennen's Mil. Surgery*, p. 412, ed. 2.) I have never seen an instance in which the plan was adopted, or promised to be anything but pernicious if it had been followed.

2. *Chyle and Fæces*.—These are not so easily extravasated in the abdomen as blood, because they do not require so much assistance on the outside of the stomach and intestines to make them continue their natural route through the alimentary canal, as blood requires to keep it in the vessels. However, when the wound is large, and the bowel distended at the moment of the injury, or when, as Mr. Travers has explained, air is extravasated, or blood effused in the abdomen, which fluids are incapable of making effectual resistance to the escape of the intestinal matter, the latter may be effused. (See *An Inquiry into the Process of Nature in repairing Injuries of the Intestines*, &c. p. 26.) Nothing is a better proof of the difficulty with which chyle and fæces are extravasated, than the operation of an emetic, when the stomach is wounded and full of aliment. In this instance, if the resistance to the extravasation of the contents of the stomach were not considerable, they would be effused in the abdomen, instead of being vomited up. A peculiarity in wounds of the stomach and intestines is, that the opening, which allows their contents to escape, may also allow them to return into the wounded viscus.

Extravasation of intestinal matter in the

abdomen is attended with severe febrile symptoms; considerable pain and swelling of the belly; convulsive startings; and hiccough and vomiting, with which the patients are generally attacked the day after the receipt of the wound. (*Sabatier, Méd. Opératoire, t. i. p. 34.*)

In these cases only general means can be employed—venesection, leeches, fomentations, low diet, perfect rest, anodynes, &c. All solid food must be strictly prohibited. If pressure can be borne without inconvenience, as is sometimes the case in the early stage, the close state of the viscera may be increased by the application of a bandage round the body.

If the symptoms are not speedily assuaged, the inflammation spreads over the whole cavity of the abdomen, gangrenous mischief takes place, and the patients die before the end of the second or third day.

3. *Bile*.—Bile, on account of its great fluidity, is more apt to be widely extravasated in the abdomen than either blood or the contents of the stomach and intestines. However, on account of the small size of the gall-bladder, and its deep-guarded situation, between the concave surface of the liver and upper part of the transverse arch of the colon, wounds of it are uncommon.

Sabatier informs us, that he has only been able to find one example on record. This case was communicated to the Royal Society of London, by Dr. Stewart (No. 414. p. 341. *Abridg. vol. ii. pp. 571, 572*). A wound penetrated the cavity of the abdomen, and entered the fundus of the gall-bladder, without doing any material injury to the adjacent parts. The abdomen was immediately distended, as if the patient had been afflicted with the ascites, or tympanitis; nor did the swelling either increase or diminish till the patient's death, which happened in a week.

Though there was a great deal of tension, there was no rumbling noise in the abdomen. No stools, and very little urine were discharged, notwithstanding purgatives and clysters, and a good deal of liquid nourishment were given. Anodynes failed to procure one instant of sound sleep, and the patient was incessantly in a most restless state. There was no appearance of fever, and the pulse was always natural till the last day of the patient's life, when it became intermittent. After death, the intestines were found much distended, the gall-bladder quite empty, and a large quantity of bile extravasated.

Sabatier had an opportunity of noticing the symptoms of an extravasation of bile, in consequence of a wound of the gall-bladder. The patient's abdomen swelled very quickly; his respiration became difficult, and he soon afterwards complained of tension, and pain in the right hypochondrium. His pulse was small, frequent, and contracted; his extremities were cold, and his countenance very pale. The bleedings, which were practised the first day, gave him a little relief; but the tension of the abdomen, and the difficulty of breathing, still continued. A third bleeding threw the patient into the lowest state of weakness, and he vomited up a greenish matter. On the third day, the lower part of the belly was observed to be more prominent, and there was no doubt of an extravasation. Sabatier introduced a trocar, and gave vent to a green blackish fluid, which had no smell, and was pure bile, that had

escaped from the wound of the gall-bladder. After the operation, the patient grew weaker and weaker, and died in a few hours. On opening the body, a large quantity of yellow bile was found between the peritoneum and intestines; but it had not insinuated itself among the convolutions of the viscera. A thick gluten connected the bowels together, and they were prodigiously distended. The gall-bladder was shrivelled, and almost empty. Towards its fundus, there was a wound, about a line and a half long, corresponding to a similar wound in the peritoneum. The wound which had occurred at the middle and lower part of the right hypochondrium, between the third and fourth false ribs, had glided from behind forward, and from above downward, between the cartilages of the ribs, until it reached the fundus of the gall-bladder.

Sabatier takes notice that the symptoms of the two cases which have just now been related were very similar. Both the patients were affected with an exceedingly tense swelling of the belly, unattended with pain, or borborygmus, and they were both obstinately constipated. Their pulse was extremely weak in the latter days of their indisposition, and they were afflicted with hiccough, nausea, and vomiting.

Sabatier seems to think one thing certain, viz., that wounds of the gall-bladder, attended with effusion of bile, are absolutely mortal, and that no operation can be of any avail. (*Médecine Opératoire, t. i. p. 34–37.*)

A contrary inference, however, may be drawn from a case detailed by Pariosse, in which a bullet had lodged in the gall-bladder two years. (*Opusculs de Chir. p. 255.*) The recovery, published by Mr. Fryer, of Stamford, tends also to prove that every effusion of bile is not unavoidably fatal. A boy, about thirteen years old, received a violent blow from one of the shafts of a cart, on the region of the liver. The injury was succeeded by pain, frequent vomiting of bilious matter, great sinking, coldness of the extremities, and a weak, small, fluttering pulse. The belly was fomented, and purging clysters thrown up. On the third day symptoms of inflammation began, attended with considerable pain about the liver, great tension and soreness of the abdomen, and frequent vomiting. The pulse was quick, small, and weak; the skin hot and dry; the tongue much furred; the urine high-coloured; and there was some difficulty of breathing, and great thirst. Eight ounces of blood were taken away, the fomentations continued, and a few grains of calomel given every four hours, until the bowels were properly opened. Afterwards, the effervescing mixture, with ten drops of laudanum, was exhibited every four hours.

On the following day the patient had motions, and was much better; but, as his sickness continued, he was ordered a grain of opium every four hours. About a week afterwards, he complained of a great increase of pain, which was somewhat relieved by a blister. He was now completely jaundiced, and his stools were white, but the tension, pain, and sickness were abated.

Two days afterwards, a fluctuation was perceived in the abdomen, which, in another week, became considerably distended with fluid. The patient now did not complain of much pain, but appeared to be sinking fast; a puncture was made



in the swelling, and thirteen pints of what appeared to be pure bile were evacuated. The bowels then soon became regular and the appetite good. In twelve days the operation was repeated, and fifteen pints of the same bilious fluid were drawn off. Nine days afterwards another puncture was made, and thirteen pints more let out; and six were discharged in another fortnight. From this period, the boy went on well, and perfectly recovered under the use of light tonic medicines. (See *Med. Chir. Trans.* vol. v. p. 330.)

A previous accidental adhesion of the gall-bladder to the peritoneum might also prevent the extravasation of bile and its dangerous effects. (*Callisen, Syst. Chir. Hodiernæ*, t. i. p. 718.)

According to Dr. Hennen, a deep wound of the liver is as fatal as if the heart itself was engaged. The slighter injuries are recoverable. He states, that the usual symptoms of a wound of the liver are yellowness of the skin and urine; derangement of the alimentary canal, and great and distressing itching of the skin. The discharge from the wound is generally yellow and glutinous; though sometimes either serous, or like unmixed bile. (*On Military Surgery*, ed. 2, p. 429.) For some other interesting observations on wounds of the liver I have great pleasure in referring to the latter work. (See also *Wedekind, de Vulnere Hepatis curato*. Janæ, 1735; and *Thomson's Report of Obs. made in the Military Hospitals in Belgium*, 8vo. 1816.)

4. *Urine*.—Urine may be extensively diffused in the abdomen, when the bladder is wounded at any part connected with the peritoneum; but mostly it gravitates towards the cul-de-sac of the latter membrane. In this kind of case, the urine is to be drawn off with a catheter, which is to be kept in the urethra; but the accident is mostly fatal. (See *BLADDER*.) Many instances are recorded of other parts of the bladder being injured even by gun-shot wounds, and of the patients getting well. I have seen various examples of this in the course of my professional experience.

Wounds of the bladder are attended with a discharge of bloody urine, and a difficulty of making water. They are always dangerous cases, both on account of the risk of the effusion of so irritating a fluid in the abdomen, and of the chance of extravasation in the cellular tissue. Under proper treatment, however, if the urine does not get into the peritoneal cavity, they often admit of cure. (See *GUN-SHOT WOUNDS*.) If possible, the effused fluid should be discharged by a depending posture, or suitable incisions, and the recurrence of extravasation prevented by the introduction of a catheter, which is to be left in the urethra. The patient must also be allowed little drink. As for the tension and pain of the belly, the common attendants of a wounded bladder, they may be greatly relieved by the use of the warm bath (*Callisen*, t. i. p. 719), or, rather, fomentations, which would not require the patient to be moved; bleeding, low diet, and other antiphlogistic means not being omitted.

*Wounds of the Stomach*.—As Dr. Hennen has observed, these cases are extremely dangerous, though not always mortal. "Baron Percy calculates, that, of twenty cases, four or five only have escaped; this, however, is a most favourable average." Two cures of wounds of the stomach are reported by Dr. Thomson. (*Obs. made in the Mi-*

*litary Hospitals in Belgium, &c.*) With respect to the chances of recovery, Dr. Hennen justly remarks, that the histories of the Bohemian, Prussian (*D. Beckler de Cultrivora Prussiaco*, 12mo. Lugd. 1638.), and English "Cultrivores," from some of whom the knives have been cut out, and, in others, discharged spontaneously through the coats of the stomach, and the parietes of the abdomen, are very encouraging. In France, a silver fork was extracted from a young man's stomach, by M. Renaud, of Romans, in the department of the Drôme, who performed gastronomy for the purpose, with complete success. (See *Quarterly Journ. of Foreign Med.* No. xviii. p. 301.) Hevin has collected many instances of recovery, both from incised and gun-shot wounds of the stomach. (*Mém. de l'Acad. de Chir.* t. i.) But, according to Dr. Hennen, Ploucquet, in the articles "Ventriculus" and "Pantophagi," has brought together the largest number of cases. Dr. Hennen also refers to *Louthorpe's Abridgement of the Phil. Trans.* vol. vi. p. 192, for instances, in which the stomach of a horse was wounded, and sewn up; and the same practice extended to the human subject, with success. It appears also from the *Annales de Littérature, &c.*, t. ii., by Kluydens, from *Sehlichting's Traumatologia* and the *Bulletin de la Faculté, &c.*, t. v. p. 386, that wounds of the human stomach have been stitched with success in various cases of recent date. (See *Hennen's Military Surgery*, ed. 2, p. 438.) As the latter author observes, wounds of the stomach not unfrequently become fistulous, and remain open. In a case, recorded by Richerand, the fistula continued open nine years; and in another instance related by Ettmüller, ten years. (*De Vulnere Ventriculi Programma*, Lip. 1730.) And Wencker has detailed a case, in which the opening continued twenty-seven years. (See *Halleri Dissert. Chir.* vol. v. art. 19.) For farther information connected with this subject the reader may also consult *Jungen de Lethalitate Vulnerum Ventriculi*, Helmst. 1751; and *Ludov. Horn de Ventriculi Ruptura*, 8vo. Berol. 1817. Also *Med. Chir. Journ.* vol. v. p. 72.

[If the wound in the viscus cannot be secured, the external wound must not be closed, but free exit given by position, &c., to effusion.]

If the omentum, healthy and uninjured, protrude by an abdominal wound, it should of course be at once returned and the wound in the parietes closed, but if it is wounded the vessels should be first twisted. If the omentum is bruised, or its vitality in any way compromised, a double ligature being passed through it so as to tie it in two halves, what is required should be cut off, and the stump returned within the external wound.

If any of the solid viscera protrude, they are to be treated on the same principles as have been above inculcated. The bladder, kidneys, and ureter may of course be wounded, and yet the peritoneum not be opened.]

G. H. B. Macleod.

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For information on poisoned wounds, consult *F. Redi*, Osservazioni intorno alle Vipere. Firenze, 1664. *M. Charas*, Nouvelles Expériences sur la Vipère, 4to. Paris, 1669. Also, A Reply to Redi's Letter concerning Vipers, 12mo. Lond. 1673. *Stanford Wolferstan*, Inquiry into the Causes of Diseases in general, &c. Also, of the Venom of Vipers. 12mo. Lond. 1692. *A. Moreau de Jonnés*, Monographie du Trigonocéphale des Antilles, ou Grand Vipère Fer de Lance de la Martinique. Par. 8vo. 1816. *A. Vater* et *F. Genster*, De Antidoto Novo adversus Viperaurum Morsum, præsentissimo in Analia haud ita pridem detecto; Wittemb. 1736. (*Haller*, Disp. ad Morb. 6. 593.) *J. E. Berlin* et *J. F. C. Morand*, Thesis in hæc verba, ergo Specificum Viperae Morsum Antidotum Alkali Volatile, in *Haller's* Disp. ad Morb. 6. 611. Paris, 1749. *Catesby's* Hist. of Carolina. *Mead*, On Poisons. *Fontana*, On the Venom of the Viper. *Acrel*, De Morsura Serpentum, 4to. Upsal. 1762. *Russel*, On Indian Serpents. *Ireland*, in Med. Chir. Trans. vol. ii. *Sir E. Home*, in Phil. Trans. 1810. *Sir David Barry*, Exp. Researches on the Influence of Atmospheric Pressure on the Blood in the Veins, &c.; and on the Prevention and Cure of the Symptoms caused by the Bites of Ravid or Venomous Animals; 8vo. Lond. 1826.

WRY NECK. See SPINE.

ZINC. The preparations of this metal are of considerable use in surgery. [Of those admitted into the British Pharmacopœia, namely, the acetate, the carbonate, the chloride, the oxide, the sulphate, and the valerianate, two are of comparatively modern date,—the chloride and the valerianate. The former is a very important surgical agent, whilst the latter is supposed to have a special influence in neuralgic affections. The acetate of zinc is used as a collyrium and also as an injection in the later stage of gonorrhœa. It is less irritating than the sulphate, and may be used in larger doses. The carbonate may be used in the same manner and for the same purposes as the oxide, and although the ceratum calaminum (an impure carbonate of zinc) is removed from the new pharmacopœia, it is a most useful application to irritable ulcers and excoriation, often succeeding better than the ointment of the oxide.]

With respect to the sulphate of zinc, it may be said to be generally the best emetic, in cases where it is desirable to empty the stomach without the least delay, as in cases of poison, for which purpose the common dose is ℥j. [5 ss. is never too much for an adult, and this has sometimes to be



repeated.] "As an external application, the salt dissolved in rose-water, in the proportion of gr. iss. to ℥j. of rose-water, forms an excellent collyrium in the latter stage of ophthalmia, after the inflammatory action has subsided; it is a good injection in a similar stage of gonorrhœa [the strength generally employed being from grs. iii. to grs. v. to ℥j.]; and a lotion in some kinds of superficial inflammations. Of double strength, this solution is the best application that can be used in scrofulous tumors, after they have suppurated, and the abscess has been discharged." (*A. T. Thomson, London Dispensatory*, ed. 2, p. 559.) A gargle of sulphate of zinc is often advisable for ulcerations of the mouth, tongue, or throat. R Zinci Sulphatis ℥j. Aq. Rosæ ℥ vii. Oxymellis ℥ j. M. ft. Gargarisma frequenter utendum.

[The oxide of zinc is a very fine soft white powder, which, mixed with an equal weight of starch powder, has a very soothing and absorbent effect when dusted upon excoriated surfaces, such as the nates of children, superficial burns, eczema, erysipelas, and in the syphilitic eruptions of infants. There are many flabby indolent ulcers, which will not heal whilst lotions or ointments are employed, that yield readily to the treatment by this dry powder. In this form also, or used as a lotion with a little glycerine and rose-water, it is very successful in allaying the irritation of skin, from which some ladies suffer when much exposed to the sun.]

The *unguentum zinci*, composed of an ounce of the oxide of zinc and six ounces of prepared lard, is an useful astringent, mildly-stimulant application; and is frequently employed in various cutaneous diseases, sore nipples, and chronic inflammation of the conjunctiva of the eyelids.

Mr. Erasmus Wilson has suggested benzoate of zinc ointment, and it is much employed, the benzoic acid being very agreeable. The *unguentum zinci* of the present Pharmacopœia is thus prepared.

The *chloride* is by far the most important of all the salts of zinc. It is used largely as a disinfectant. It forms an admirable stimulating and cleansing lotion, and it is the most generally useful and efficient caustic we possess. Under the name of "Sir Wm. Burnett's Fluid," a strong solution of this salt is largely used as a disinfecting agent in ships and hospitals, and very generally in the public service, as well as in private houses. Cases of poisoning have resulted from the accidental drinking of this fluid, for which the alkaline carbonates and albumen would be the proper antidotes. As a stimulating lotion in the proportions of from gr. ii. to gr. vj. to ℥j. of distilled water, it is most valuable in all foul, sluggish, or sloughing ulcers, whether of a strumous, venereal, or cancerous nature. A case of extensive serpiginous venereal ulceration of the thigh, which had resisted all treatment for several years, came under the care of the present writer at the Royal Free Hospital. By the use of a lotion gradually increased in strength up to gr. iv. to ℥j., the ulceration was stopped, and ultimately healed. Epithelioma and lupoid ulcers may often be checked in their progress by this lotion, the surface being cleansed, and the granulations assuming a healthy aspect; after which, by the use of a less stimulating application, such as the chlorate of potash lotion, a perfect healing of the wound may sometimes be obtained. Even in the deep sloughing ulceration, which occa-

sionally ensues in scirrhus of the breast, the use of this lotion may be most advantageously employed for the purpose of detaching the slough, and renovating and revivifying the secreting surface; not only thereby deodorising the foul secretions, but oftentimes inducing entire cicatrization of the wound. After the subsidence of the inflammatory stage of gonorrhœa, there is no injection so efficient in curing the muco-purulent discharge as a lotion containing from gr. i. to gr. ii. of chloride of zinc to the ounce of distilled water. Lately, Mr. Moore, of the Middlesex Hospital, and Mr. De Morgan, have been employing a very strong solution of this salt—forty grains to the ounce—to all wounds after operation. It was used at first as an adjuvant to the knife in cancer, in the hope of reaching any germs of the disease which may have remained in the tissues adjacent to the tumor.

In all the cases so treated it appeared that there was very little suppuration, that the healing was unusually rapid, and that generally there was no unpleasant odour from the wound. This treatment was then extended to all operations, and it seemed to prevent the occurrence of erysipelas and pyæmia, which had previously been rather frequent in the Middlesex Hospital.

The advantage of this treatment in preventing the recurrence of cancer after operations has to be tested by the lapse of time. In a case of keloid disease, situate over the os sternum, removed by the present writer at the Cancer Hospital, this strong solution was used after the operation; but, nevertheless, the disease returned within two months of the cicatrization of the wound. Mr. De Morgan's paper on this subject will be found in the *British and Foreign Med. Chir. Review*, Jan. 1866.

The chloride of zinc is rarely used in its solid form, because, owing to its rapid deliquescence, it is apt to extend its caustic influence beyond the parts intended to be affected by it. It is made in pipe-shaped moulds, and also in flat cakes the size of a shilling, and as fine-pointed arrows. The latter are especially intended to be used after the manner of M. Maisonneuve, who was wont to make several deep incisions around the tumor to be acted on, and insert in each one of these caustic arrows, thus destroying the tumor by cutting off the sources of its nutriment. His arrows, however, were not pure chloride of zinc, but consisted of one part caustic and two parts arrowroot. Although this proceeding has been employed in England, it never obtained much countenance, and has nearly fallen into desuetude.

These arrows are very handy for touching sloughing parts, and especially for acting gradually upon epithelioma of the lips, when the patient is indisposed to submit to excision, or to the more decided application of the caustic paste. The flat tablet is intended to be placed upon the surface to be destroyed, and as it liquefies plaster of Paris must be sprinkled upon it to prevent the extension of the caustic influence beyond the part affected. A paste made of equal parts of the chloride and prepared chalk is generally the most convenient and efficient method of applying this caustic, and the thickness of the paste should be equal to the depth of tissue to be removed. A few years since an American—Dr. Fell—came to this country with a supposed new method of curing cancer. He was

much patronised by the public for a time, and his application remained a secret. Many persons submitted to a very protracted and painful proceeding, but it was not many months before it was shown by the return of the disease that the promised cure was a vain deceit. The paste employed was said to be made of a plant employed by the native women in the American prairies, named Puccoon, and known to botanists as the *Sanguinaria Canadensis*. It very soon appeared, however, that this was a mere colouring matter, and that the real power of the paste was due to chloride of zinc. Dr. Fell had, if not an original, at least an unusual mode of applying this caustic. Having destroyed the skin over the tumor with nitric acid, a layer of the paste was applied. The dead tissue thus obtained was scored by the scalpel, and fresh paste introduced in the interspaces. This proceeding had to be repeated several times, and it was generally six weeks before the tumor was thus destroyed. The pain of these applications has been described as frightful, and seeing that no immunity from a recurrence of the disease was obtained, it is not surprising that no surgeon would now sanction, much less recommend, so barbarous a method of removing tumors.]

Both in scirrhus and medullary cancer, albumen is the principal component of the new adventitious substance. In a paper, inserted by Dr. Ure in the *Med. Gaz.* of Dec. 1835, it was shown that chloride of zinc (a means employed by Dr. Canquoin, of Paris, in the treatment of cancer) has a very powerful affinity for albumen; and Dr. Ure ascribes a part of its efficacy in eradicating the ultimate ramifications of cancerous tumors to its powerful action on albumen. "In this way (he thinks) numerous minute points, undiscoverable by the surgeon, and inaccessible to his knife, are searched out and destroyed." The cases, to which the chloride of zinc seems to him best adapted, are subcutaneous and cutaneous cancers, and cases of *noli me tangere* (*lupus*). To its great use in destroying the tubercles, which form in the latter disease, I can bear testimony, having tried it with great success in several instances. Dr. Ure prefers a paste composed of one part of chloride of zinc, and of two parts of recently-calcined sulphate of lime. Dr. Canquoin mixes the chloride of zinc with flour. (See *Lond. Med. Gaz.* vol. xviii. p. 287.)

The Dr. Ure here alluded to was Mr. Alexander

Ure, afterwards surgeon to St. Mary's Hospital, and son of the celebrated chemist, Dr. Andrew Ure. Mr. Ure died in 1866.

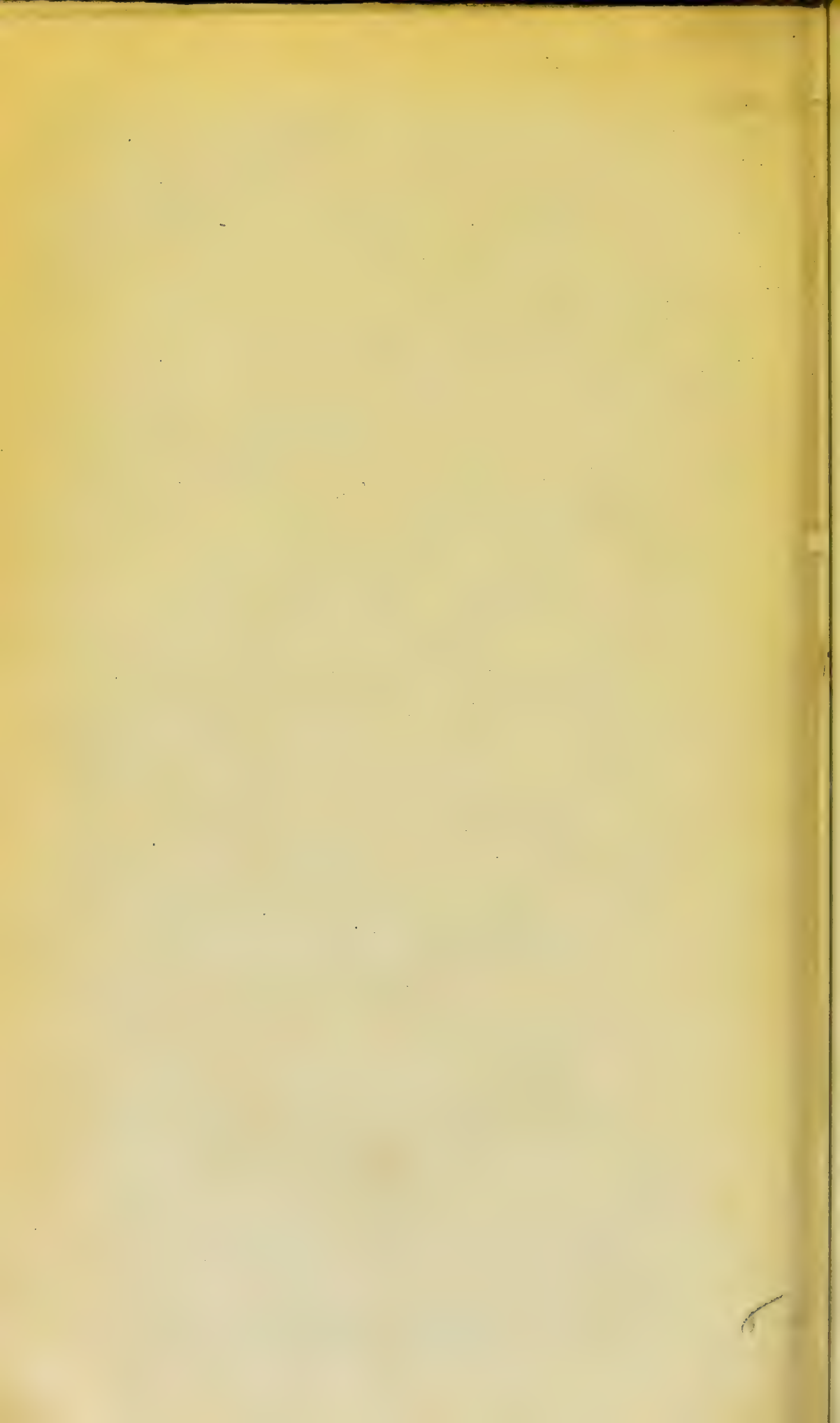
At the Cancer Hospital the writer has used for some time lint saturated with chloride of zinc, and dried so far as it will dry, the salt being very deliquescent. This he has found to be a very convenient form; and perfectly efficacious. It is kept in a wooden box, and lasts any time. It may be used in the smallest pieces to the inner canthus of the eye and eyelids especially with much safety, and indeed to any part of the face or other delicate external structure affected by either epithelioma or lupus, or the extending growths of cancer, or even wart. The smallest piece put on and covered by lint, upon which the old ceratum resinæ is spread, may be readily kept in its place, and the full effects will be obtained in twenty-four hours.

Although doubting much the existence of any elective power in this or any other caustic, and believing that the destructive influence is exerted in an equal degree upon all the tissues, the reviser of this article, from his experience of several, prefers the chloride of zinc and the permanganate of potash to any of the other caustics, because they are the most manageable, are very effective, and exempt from those possible dangers which may and do arise in the case of mercurial and arsenical caustics. Deaths have arisen from the absorption of these latter substances, and a long array of them, as due to arsenic, may be found recorded by Dr. Alfred Taylor in the *Guy's Hospital Reports* for 1864; whilst cases of extreme salivation, resulting in death, from the external application of the acid nitrate of mercury, are related in the journals. Epithelioma, affecting as it does the lips and cheeks, the hand, the penis, the anus, and other external parts, may be successfully attacked by either the chloride of zinc or the permanganate of potash; and in a great many instances this disease thus treated, the constitution being at the same time supported by appropriate tonics and food, may be checked for many years, if not altogether overcome. Lupus also is amenable to the same treatment. The latest combination of zinc is that of the carbolate introduced by Dr. Sanson, and used by Mr. Wood, at King's College Hospital with advantage in gonorrhœa, but it may be doubted whether the carbolates have any special advantages over the chlorides.]

Weeden Cooke.

THE END.





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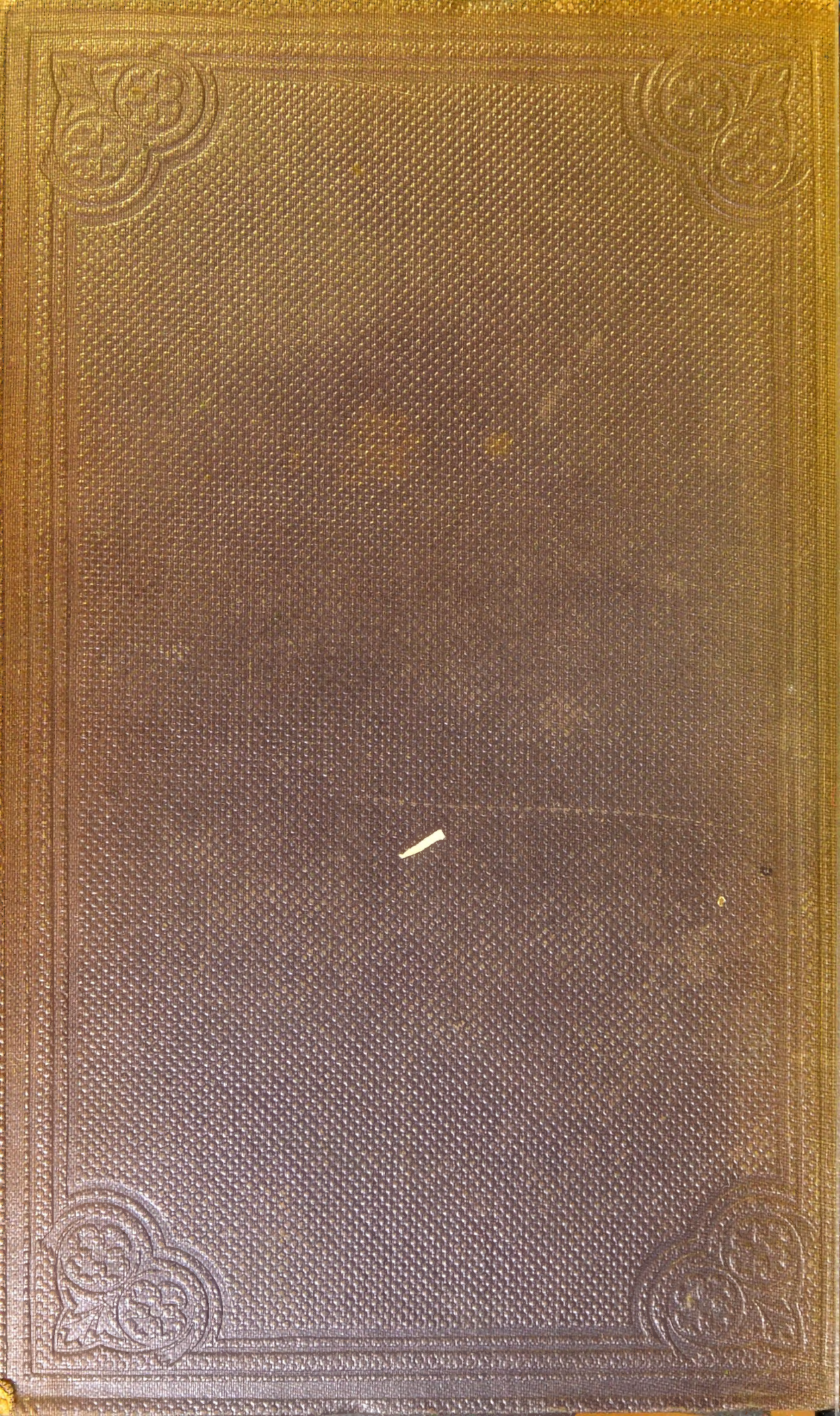
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